Working-draft Operational Plan:

Palmyra Atoll Rat Eradication Project – Alternative C (Preferred Alternative)

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1 INTRODUCTION

1.1 Purpose

The purpose of this conservation project is to aid in the protection and restoration of the unique native species and habitats of Palmyra Atoll (Palmyra) by removing non-native rats from the atoll that harm native trees, seabirds, land crabs, other populations of native species, and ecosystem processes.

Given the widespread successful colonization of rats on islands and their impact on native species, rats are identified as key species for eradication. The most pronounced impact of introduced rats on island ecosystems is the extinction of endemic species of mammals, birds and invertebrates (Andrews 1909, Daniel and Williams 1984, Atkinson 1985, Howald et al. 2007) (Meads et al. 1984; Hindwood 1940; Tomich 1986). Even if species are not completely extirpated, rats can have negative direct and indirect effects on native species and ecosystem function. For example, comparisons of rat-infested and rodent-free islands, and pre- and post-rat eradication experiments, have shown that rats depress the population size and recruitment of birds (Thibault 1995, Jouventin et al. 2003) (Campbell 1991), reptiles (Whitaker 1973) (Bullock 1986; Cree et al. 1995; Towns 1991), plants (Campbell et al. 1984; Pyle et al. 1999; Wegmann 2009) and terrestrial invertebrates (Ramsey 1978; Bremner et al. 1984).

In addition to preying on seabird chicks, eggs, and sometimes adults, introduced rats feed opportunistically on plants, and alter the floral communities of island ecosystems (Campbell and Atkinson 2002, Wegmann 2009), in some cases degrading the quality of nesting habitat for birds that depend on the vegetation (Young et al. 2010). On Tiritiri Matangi Island, New Zealand, ripe fruits, seeds, and understory vegetation underwent significant increases after rats were eradicated from the island, indicating their previous impacts on the vegetation (Graham and Veitch 2002). At Palmyra, the native tree *Neisosperma oppositifolium* established on islands that were temporarily cleared of rats – this is the first record of *N. oppositifolium* recruitment since rats were introduced to Palmyra 60 years prior.

Rats are known to cause disturbance to sensitive breeding seabirds, resulting in failed breeding attempts and higher susceptibility to predation by other species (Tomkins 1985, Jouventin et al. 2003). Rats also affect the abundance and age structure of intertidal invertebrates (Navarrete and Castilla 1993). Rats alter key ecosystem properties; for example, total soil carbon, nitrogen, phosphorous, mineral nitrogen, marine-derived nitrogen and pH are lower on invaded islands relative to rat-free controls (Fukami et al. 2006). Such changes are a result of indirect negative effects of rats mediated by the reduction in seabird populations – rat predation often drives seabird colonies to near-extirpation (Moller 1983, Atkinson 1985, McChesney and Tershy 1998), resulting in the loss of seabird-derived nutrients on islands (Fukami et al. 2006).

By removing rats from Palmyra, we aim to safeguard the atoll's indigenous flora and fauna, and create a refuge for species within the central Pacific region that are at risk of extinction. This project will achieve a monumental conservation milestone for the Refuge, and will establish a benchmark for subsequent eradication campaigns on other tropical islands.

1.2 Agencies

In 2001, after a long history of military and private ownership, most of Palmyra and the surrounding coral reef were designated as a National Wildlife Refuge by the Secretary of the Interior. The U.S. Fish and Wildlife Service (FWS) and The Nature Conservancy (TNC) co-manage Palmyra's emergent land area, and in 2009 Palmyra was included within the Pacific Remote Islands Marine National Monument.

In 2008, a three-party partnership (FWS, TNC, and Island Conservation (IC)) was formed to seek funding for, develop, and implement a rat eradication program at Palmyra.

1.3 Funding

Funding for PARRP comes from three sources: public ($2.2M from Department of Interior grants), private ($500k from a private donation handled by Island Conservation), and agency/organization (in-kind contributions of staff time and logistical support by USFWS and TNC). The total budget for the project is $2.7M, and all funds have been secured.

2 GOALS, OBJECTIVES, OUTCOMES

2.1 Goals

The goal of this project is to aid in the protection and restoration of Palmyra's unique native species and habitats by removing non-native rats that harm populations of native trees, nesting seabirds, and land crabs.

2.2 Objectives

The objectives of this project are:

- The complete and permanent removal of black rats from Palmyra with minimal negative impact to native biota.
- Testing and documentation of rodent eradication tools and monitoring methods tailored for tropical environments.

2.3 Outcomes

The anticipated outcomes from this conservation action are:

- Increased recruitment of native tree species
- Increased fledging success for several seabird species, and possible recruitment of several species that were likely extirpated from the atoll in the 20th century.
- Creation of a refuge for two critically endangered land bird species: *Acrocephalus aequinoctialis* (Christmas Island Warbler) and *Prosobonia cancellata* (Tuamotu Sandpiper).
- Development of conservation tools that will benefit future rodent eradication campaigns on tropical islands.

3 PROJECT SITE

3.1 Biogeography

Palmyra is among the most isolated island systems in the world. It lies in the central Pacific approximately 350 nautical miles north of the equator: longitude 162 04' 59.05" W, latitude 005 52' 55.54" N (Figure 1). Palmyra is part of the chain of islands called the Northern Line Islands, along with Kingman Reef to its northwest and the Kiribati Line Islands to its south.

Similar in climate to archetypal continental and high island tropical rainforests, yet drastically dissimilar in biogeography, the tropical forest systems in the Northern Line Islands lack species richness and diversity of flora and fauna (Rock 1916, Mueller-Dombois and Fosberg 1998). Palmyra has a remnant, regional flora that is typified by low species richness and low rates of endemism (Wester 1985, Mueller-Dombois and Fosberg 1998), yet this atoll provides important habitat for resident and migratory fauna, including seabirds, shorebirds, reptiles, and land crabs.

Through the last two-hundred years, Palmyra experienced major habitat manipulation and numerous plant and animal invasions, including the introduction of black rats (*Rattus rattus*). Palmyra's biotic community is no longer subject to direct anthropogenic disturbance, and this latter factor renders Palmyra's biotic community unique among Central Pacific tropical moist forest systems.

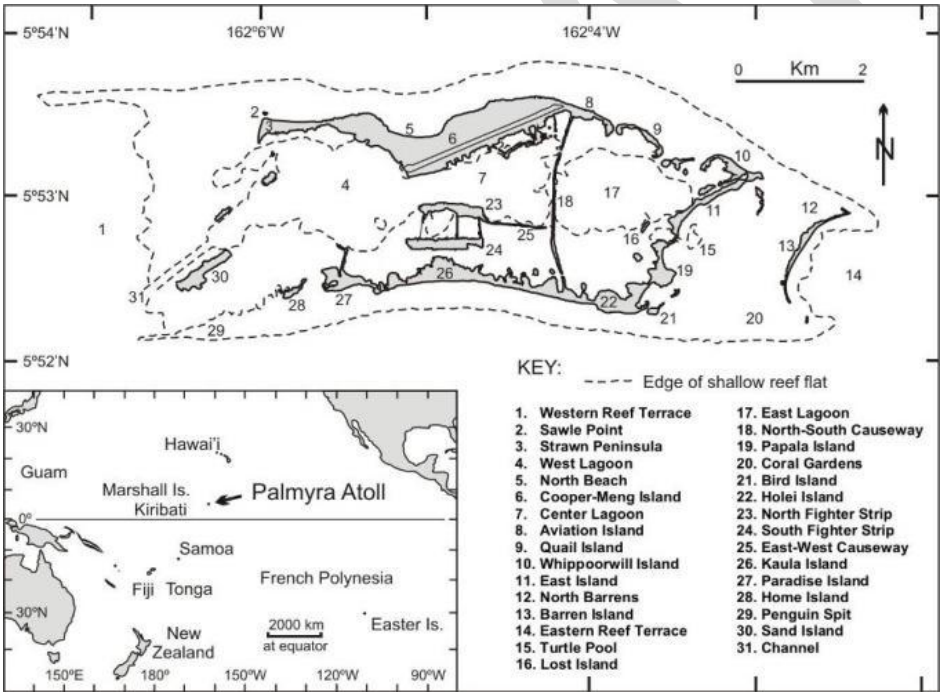


Figure 1. Geographic map of Palmyra Atoll (Collen et al. 2009).

Palmyra's native flora and fauna have been marginalized due to WWII-era landform restructuring and introductions of non-native species, notably coconut palms, ants, scale insects, and black rats. Nevertheless, Palmyra is an important center of biodiversity and species abundance in the Central

Pacific region. Now protected within the US Fish and Wildlife Service's National Wildlife Refuge system, Palmyra sharply contrasts with other moist Central Pacific island groups where the degradation of terrestrial and marine ecosystems keeps pace with increased anthropogenic resource exploitation. However, the continued presence of omnivorous black rats on the atoll will not allow recruitment or population establishment of those species which are limited by the direct or indirect impact of the alien rat population.

3.2 Palmyra's eradication environment

Tropical oceanic islands represent some of Earth's most biologically unique ecosystems, yet the very remoteness that fuels high levels of endemicity and species radiations on islands also renders such systems vulnerable to invasive species. Invasive mammal eradications are a proven, effective method of restoring damaged ecosystems and preserving biodiversity on Islands (Towns and Broome 2003, Howald et al. 2007). The presence of indigenous land crabs on most tropical islands poses a novel challenge to eradication projects, and especially eradications targeting rodents (Wegmann 2008). Land crab consumption of rodenticide bait complicates rodent eradication programs by requiring inflated bait application rates, which increases the risk of non-target species exposure to rodenticide. Because current rodent eradication practices are based on successful temperate or subantarctic campaigns, the conservation community does not have time-tested methods for mitigating land crab interference; Palmyra's eradication environment presents a novel suite of challenges.

Palmyra's emergent land area consists of 25 distinct islands ranging in size from < 0.1 ha to over 100 ha. The islands are separated by shallow channels or lagoon flats, some of which are emergent at low tide. Three deep lagoons run east-west between the two major island groups, and a thin (10-20m) wide causeway runs north-south between the Center Lagoon and Eastern Lagoon (Figure 1).

Palmyra is a breeding refuge for 10 seabird species; however, rat related egg and chick predation has likely led to the extirpation of six additional species (Table 1). Without the consumptive pressure of an established human population, Palmyra's land crab community is among the richest and most robust in the Central Pacific region. Palmyra is home to six species of terrestrial crabs (excluding the intertidal families Grapsidae and Ocypodidae), 4 of which are super abundant (Table 2). Palmyra's crab community includes the coconut crab (*Birgus latro*), the world's largest terrestrial invertebrate.

Table 1. Breeding seabirds of Palmyra Atoll; * = Declining population trend

Family	Common Name	Scientific Name	Breeding Pairs	IUCN
Procellariidae	Audubon's Shearwater	*Puffinus lherminieri*	Believed extirpated	LC
	Wedge-tailed Shearwater	*Puffinus pacifica*	Extirpated	LC
	Phoenix Petrel	*Pterodroma alba*	Believed extirpated	EN*
Hydrobatidae	Polynesian Storm Petrel	*Nesofregetta fuliginosa*	Believed extirpated	VU*
Sternidae	Black Noddy	*Anous minutus*	2,500	LC
	Blue Noddy	*Procelsterna cerulean*	Believed extirpated	LC
	Brown Noddy	*Anous stolidus*	1000	LC
	Sooty Tern	*Sterna fuscata*	10,000	LC
	Gray-backed Tern	*Sterna lunata*	Believed extirpated	LC

Family	Common Name	Scientific Name	Breeding Pairs	IUCN
	White Tern	*Gygis alba*	150	LC
Fregatidae	Great Frigatebird	*Fregata minor*	500	LC
	Lesser Frigatebird	*Fregata aerial*	Non-breeder	LC
Phaethontidae	White-tailed Tropicbird	*Phaethon lepturus*	15	LC
	Red-tailed Tropicbird	*Phaethon rubricauda*	20	LC
Sulidae	Red-footed Booby	*Sula sula*	5,000	LC
	Brown Booby	*Sula leucogaster*	150	LC
	Masked Booby	*Sula dactylatra*	20	LC

Table 2. Land crab and rat abundance survey results, Palmyra Atoll (Flint 1992, Howald et al. 2004). Units represent #/hectare estimates and range in measured body mass. [a] (Burggren and McMahon 1988), [b](Wegmann and Middleton 2008).

Species		Mean (#/ha) ± SD	Adult mass (g)
Land Crabs	*Birgus latro*	7 ± 38	5000[a]
	Cardisoma carnifex	33 ± 8	300[a]
	Cardisoma rotundum	28 ± 5	200[a]
	Coenobita brevimanus	46 ± 8	100[a]
	Coenobita perlatus	182 ± 80	100[a]
Rodent	*Rattus rattus*	90 ± 60	164[b]

Palmyra's plant community includes five distinct associations: *Lepturus repens* grassland, *Hibiscus tiliaceus* forest, *Terminalia catappa* forest, *Pandanus fischerianus* forest, and *Phymatosorus grossus* meadow. Presently, *C. nucifera* forest and *S. taccada – T. argentea* forest respectively cover 40% and 30% of Palmyra's land area. Patchy stands of *Pisonia grandis, Pandanus fischerianus, H. tiliaceus, T. catappa,* and meadows of *L. repens* and *Phymatosorus grossus* constitute the remaining 30%; nine additional tree species occur in low numbers at Palmyra. Mature *C. nucifera* trees comprise 45% of Palmyra's forest canopy. Much of Palmyra's vegetated area is difficult to traverse by foot, and paths cut through the dense vegetation require frequent maintenance

Palmyra's WWII legacy includes remnant concrete structures (bunkers, gun emplacements, pill boxes) and unexploded ordinance (UXO). The enclosed concrete structures, along with structures associated with the PARC research station, provide refuge for rats and will be treated as rat habitat during the eradication.

Lying within the Intertropical Convergence Zone, Palmyra is frequented by low pressure systems that result in over 400 cm of rain each year. A summary of several climate factors measured at Palmyra (2002 – 2009) for June and July, the months targeted for this operation, is presented in Table 3.

Table 3. A summary of climate factors measured at Palmyra between the years 2002 and 2009.

Month	Daily		Monthly				
	Max precip (mm)	Mean precip (mm)	Mean # of days with < 10 mm of precip	Mean max temp in the shade (°C)	Mean wind direction (°)	Min wind speed (kts)	Mean of max wind (kts)

June	190	13	20	31	80	4	10
July	108	15	17	31	83	3	10

3.3 Facilities

In 2004, TNC partnered with 10 academic institutions and government agencies in the establishment of the Palmyra Atoll Research Consortium (PARC). In 2005, a research station was constructed on Cooper Island (TNC 2005). The station includes 16 small residential cottages, a galley, shower house, bathrooms, a research laboratory, a wharf for offloading supplies from large ships and barges, tractors (with forks) and flat-bed trucks, a backhoe, three 15' lagoon boats, a 25' offshore boat, and a large workshop area. The station is capable of housing and supporting 25 staff and researchers at one time. Fresh water is supplied through a refurbished 100,000-gallon rainwater catchment tank. Electric power is generated and transmitted by two 50 kW diesel generators, and a satellite dish was installed in 2006 to supply the station with internet connectivity and web-based telephones. Pre-existing infrastructure in use on Cooper Island includes a seaplane ramp, a crushed-coral runway, and several WWII era concrete foundations and bunkers used for storage of supplies.

4 TARGET SPECIES

4.1 Biology

Rats are omnivorous generalists, adapting their feeding habits constantly to exploit the most nutrient-rich and easiest to obtain food items in their environment. However, rats are also considered "neophobic," or wary of novel objects in their environment including potential food items. Rats will often avoid novel food items completely at first, then sample small tastes, and only wholly consume new food items after multiple exposure events (Jackson 1982). Black rats (*Rattus rattus*) at Palmyra have been documented consuming food items including: native tree seeds and seedlings, native land crabs and other terrestrial invertebrates, seabird eggs, and marine invertebrates.

On small islets surrounding Pohnpei Island (6° 58' N, 158° 13' E), Caroline Islands, black rat breeding does not show a strong seasonal pattern (Strecker 1962). Palmyra is biogeographically similar to these islets and we assume that black rats at Palmyra show comparable aseasonality in their breeding behavior.

5 SITE PREPARATION

5.1 Facilities and infrastructure

While the PARC facility will provide many advantages to the eradication operation (use of equipment, vehicles, storage, meeting, and office space), the structures are potential rat habitat and the presence of human food and food-based refuse create regular feeding opportunities for rats; these factors warrant mitigation.

Food within the camp provides potential sustenance for rats. To avoid providing opportunity for rats to eat anything other than bait during the implementation, all food stores in camp and kitchen areas will be secured. Personnel will work with the Palmyra Field Station Manager to ensure the security of all food storage areas. The compost pit, used for years, has been buried and all food and food-related waste is incinerated daily.

Fresh potable water is supplied through a refurbished 100,000-gallon fresh water catchment tank (Figure 4). Personnel will cover the roof of the water catchment with large tarps to ensure that bait applied during the aerial broadcast does not contaminate the potable water supply, and the screening around the top three feet of the tanks walls will be reinforced to make sure that potential bait consumers (rats, cockroaches, etc) will not contaminate the potable water system. Other non-potable water supply catchment tanks are within the hand broadcast area and will not need to be covered; however, screens will be placed over the intake ports for all non-potable water tanks to prevent rats and invertebrates that have been exposed to the rodenticide from entering the tanks. After the baiting operation has been completed, samples from the potable water system will be tested for brodifacoum residue. If brodifacoum residue is detected, an alternate potable water system will be established and used until the primary system has been cleaned and subsequent tests fail to detect brodifacoum residue.

The dry lab facility will be converted into the base of operations during the implementation. Electronics will be stored inside the air-conditioned lab facility. Other supplies will be stored outside the lab on concrete and protected from the elements by a roof. The large shop area will be used to house the helicopters, and buckets, and for short-term storage of bait pods.

6 ERADICATION TECHNIQUE

The rat eradication action at Palmyra will include several bait application techniques that have been tailored to suit Palmyra's eradication environment. US Environmental Protection Agency (EPA) regulations restrict the intentional spread of bait into the marine environment. Given Palmyra's tortuous coastline and the small size of some of the islands (Figure 1), several broadcast baiting strategies will be employed to minimize the accidental spread of bait into the water bodies, which is termed "bait drift," and maintain a uniform bait application at the designated sowage rates across the entire treatment area.

In order to ensure eradication success a second bait application will occur 10 to 14 days after the first to minimize the likelihood of missing competitively inferior adult rats or juvenile rats that survive the initial broadcast because they did not have an opportunity to feed on bait. For each bait application, there will likely be two to three consecutive days of bait broadcast. The extra four days allotted for the time between broadcasts will be contingency time in case of a delay with the first application.

Bait will be applied according to the limitations set by the EPA's pesticide regulations. The bait application rate for the Palmyra rat eradication is based on the results of several bait availability studies conducted at Palmyra (Buckelew et al. 2005b, Wegmann et al. 2008). "Bait availability" is the time period within which rats have direct access to bait pellets broadcast on the ground. The

2005 trial eradication found that with bait application rates as high as 90 kg/ha, bait is available to rats for a maximum of seven days, and is only uniformly available for four days. Bait consumption by land crabs (c. 300 crabs/ha) is the primary factor determining bait availability. In order to ensure that rats have access to bait for four days, this operation requires bait application rates that exceed the maximum bait application rate specified by the bait product's original FIFRA registration. The project partnership collaborated with the US Department of Agriculture (the current registrant for the Brodifacoum-25W Conservation bait product) to develop a supplementary registration specifically designed for, and exclusive to use in, Palmyra's eradication environment. The following prescription is in accordance with this supplemental label.

The bait application will have a planned, slow start with predetermined stops between every few (1-5) bucket loads of bait. The stops will allow the operations team to assess the accuracy of the bait application and make adjustments to the bucket configurations or the bait application strategy if necessary.

6.1 Bait and bait sowage rates

During the operation, the baiting plan calls for 39,147kg of 25W to treat Palmyra's 250ha of emergent land twice at a sowage rate of 80kg/ha for the first application, and 75 kg/ha for the second application. An additional 10% of this amount will be brought as contingency bait (Table 4). The contingency bait will replace spoiled, spilled, or otherwise unusable bait, and will be used to fill in significant (≥ 10m) gaps between swaths of bait applied by air, but will not be applied to the treatment area in an amount that, when summed with amounts of bait previously applied to the same area during the same application, is in excess of the maximum bait application rate specified by the Section 3 bait label. A supplemental label specific to this project was released on 15 April, 2011, and all aspects of this bait application are in compliance with the supplemental label. The target sowage rate for the second application will be lowered to 75kg/ha to account for an expected reduction in the number of bait consumers (rats) following the first bait application.

6.1.1 Bait transport and storage

Any damage (fragmentation, mold) to the bait that happens during the transportation process could inhibit the bait application. Therefore, specific precautions will be taken with regard to handling, packing, transport, and storage to ensure that bait is in the optimal condition when it reaches Palmyra.

Following manufacture, bait will be packed and shipped from Bell Labs in Madison Wisconsin to the support vessel in Seattle, Washington. One bulk bag (Flexible Intermediate Bulk Container custom manufactured by BulkLift®) containing 318 kg of bait will be placed inside a large plastic bag, and then inside a Buckhorn® Fixed Wall container ("pod"): [external dimensions (with lid in place) 47.9" x 43.8" x 31") (internal dimensions 45.6" x 42.0" x 23.9"). While inside the pod, each bulk bags will be filled with 318 kg of bait. When full, a desiccant pack will be placed between the bulk bag and the large plastic bag, the plastic bag will be sealed, and the pod's lid will be secured in place. The pods will be loaded into shipping containers for transport from Madison to Seattle. One 20' container (16 pods) and one 40' container (36 pods) will be loaded directly onto the deck of the support vessel, and 80 pods (shipped in 53' containers) will be placed in below-deck holds.

Table 3. Bait usage table for the Palmyra Atoll rat eradication operation. The treatment area (Palmyra's total emergent land area) is 250 ha. The target bait sowage rates are presented in the Calculation notes column.

Bait application type	Bait brought to Palmyra (kg)	Contingency	Bait for application (kg)	Calculation notes
Aerial Application	40,920	10%	37,200	AERIAL APPLICATION: 1st application at 80 kg/ha, 2nd application at 75 kg/ha (240 ha - accounts for areas baited by hand) + 10% contingency
Hand Application	1,947	10%	1770	HAND APPLICATION: 1st application at 80 kg/ha, 2nd application at 75 kg/ha (10 ha) + bait for bait stations: 150 stations x 120g/application x 10 applications + bait for abandoned structures: 100 structures at 200g/structure x 2 applications + 10% contingency
Canopy Bait	195	10%	177	CANOPY: 2 applications at 25 g/crown (3,546 crowns) + 10% contingency
TOTAL BAIT - TREATMENT OF EMERGENT LAND	**42,867**	**10%**	**38,970**	
TOTAL BAIT - TREATMENT OF OVERHANING PALM CANOPY	**195**	**10%**	**177**	
TOTALS	**43,062**	**10%**	**39,147**	

In addition to bait packaged in the bulk bags and pods, bait will be shipped in 11.3 kg (20 l) buckets. Bait from the 20 l buckets will be used to hand-bait areas of the atoll that cannot be baited via helicopter, and to fill and refill bait stations. The buckets will be strapped to pallets for secure transport and placed inside the 53'shipping containers.

Prior to shipment, temperature and humidity data loggers will be placed in seven pods: 2 pods from the beginning of the bait manufacturing process, 3 pods from the middle, and 2 pods from the end. The containers will remain unopened until the vessel makes a port call in Honolulu in route to Palmyra. At this point, each container will be opened and the bait inside one pod in each container will be inspected and the data from the data logger will be downloaded and assessed. Bait in at least one pod in each of the ship's below-deck holds will also be inspected at this time and the data loggers (one in a pod in each hold) will be retrieved and the data will be assessed. All data loggers will be placed back in the pods from which they came, and will be checked again when the ship arrives at Palmyra. If the bait appears moist or moldy, immediate action will be taken to dehumidify the containers and the holds.

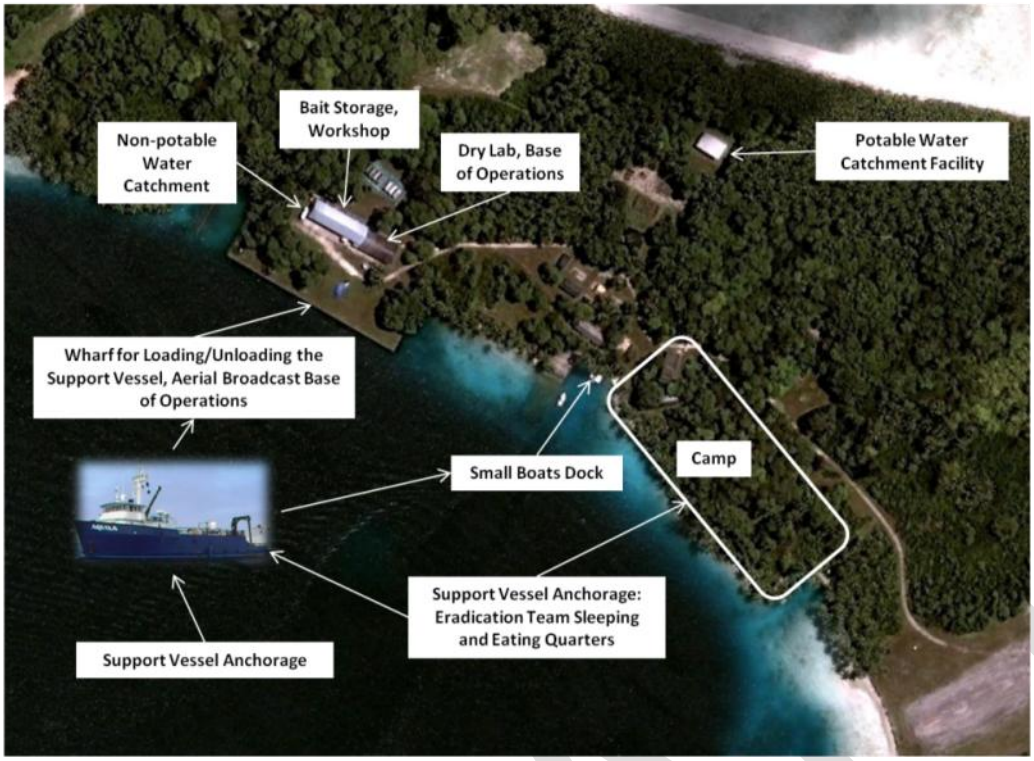


Figure 4. Location of primary operational components for the Palmyra rat eradication project.

6.2 Aerial broadcast

Bait broadcast by helicopter will consist of multiple low-altitude overflights of Palmyra's emergent land area. The baiting system will follow a script (Section 6.5) that is specifically designed to minimize bait spread into the marine environment while maintaining uniformity and compliance with the targeted sowage rates. The aerial broadcast will follow a section-by-section plan that includes 12 blocks (Figure 5). Each block is separated from adjacent land areas by water or thin sections of land. The entirety of each block will be treated before the pilot(s) assigned to that block begin baiting a subsequent block. For example, all of block 2 (Cooper Island) will be treated before baiting begins on block 3 (North Fighter Strip). By sequencing the treatment of the blocks, back baiting – due to weather or mechanical delays – will be minimized.

6.2.1 Aerial broadcast bucket calibration

All three baiting buckets were calibrated for the sowage rates and swath widths that have been prescribed for this operation (Table 4).

Table 4. Bait application factors prescribed for the aerial broadcast component of the Palmyra rat eradication.

Bucket configuration	Sowage rates	Swath width	Flight speed
Narrow Swath Bucket	75 - 80 kg/ha, 37.5-40[1] kg/ha	5 m	30 kts
Directional Swath Bucket	75 - 80 kg/ha, 37.5 - 40[1] kg/ha	20 m	35 kts
Full Swath Bucket	37.5 - 40 kg/ha	40 m	50 kts

[1] 40 kg/ha sowage rates will be calibrated for the Narrow Swath Bucket and the Directional Swath Bucket prior to the initiation of the bait application.

6.2.2 Helicopter operations plan

Refer to Appendix A for a presentation of the helicopter operations plan.

6.2.3 Preventing bait spread into the marine environment

Every reasonable effort would be made to minimize the risk of bait broadcast into the marine ecosystem. A directional deflector will be attached to the hopper for all treatment of areas where the use of a full swath bucket would result in the application of bait into the marine environment. The deflector will broadcast bait to the onshore side of the helicopter, to minimize the risk of bait entering the ocean on the opposite, or seaward, side. Additionally, the hopper will be used with the broadcast motor off and spinner removed to sow narrow swaths of bait onto land areas that are less than 25 m and greater than 10 m wide.

Palm trees growing along the shoreline commonly hang over the high tide line. To prevent bait from entering the marine environment, overhanging palms will be baited by hand (Wegmann et al. 2008) rather than with the helicopter and bait hopper. Bait bolas – two cotton sacks filled with 12.5 g of bait each and connected by 50 cm of twine – will be slung into every third and every stand-alone palm crown that is overhanging the water. Any bait observed by field crews in the marine environment would be taken out.

6.2.4 Coverage of baiting gaps

In cases where it is evident or suspected that a portion of the targeted land area greater than 5 m x 10m did not receive full coverage from aerial or hand baiting, there will be supplemental, systematic broadcast by hand or helicopter to fill in the gap.


Legend
Palmyra2010_BaitingBlocks
Narrow
BaitType
Hand
Interior
Bait Station
Directional
Void
1
2
3
4
5
6
7
8
9
10
11
12
0 250 500 1,000
Meters

Figure 5. A depiction of the sequencing of, and strategy for, bait application during the Palmyra rat eradication. The atoll is divided into 12 blocks, and the different bait application techniques are represented by different colors: light blue = full swath baiting ("interior"), green = directional baiting, dark blue = narrow swath baiting, yellow = hand baiting, and red = use of bait stations. Note, the camp area (large red region in Block 2) will be treated with hand baiting and bait stations.

6.2.5 Resuming baiting after unplanned stops

Bait will be applied to the atoll according to a section-by-section plan, so that an unexpected halt to baiting operations will result in a minimized unbaited edge for the previously baited block(s) (Figure 5). When baiting resumes after the application was halted due to poor weather conditions, mechanical failure or other unforeseen logistical problems, the following guidelines direct how far back into previously baited areas baiting should commence to target rats that may have reinvaded treated areas.

Time delay	Strategy to resume baiting
1 day	At boundary of previous drop
2-3 days	2-4 swath widths behind the boundary (20-80 m)
> 3 days	4-6 swath widths behind the boundary (80 – 160m)

6.2.6 Bait application tracking

Paper-based and electronic bait tracking worksheets will be used to track and document all aspects of the bait application: aerial broadcast, hand broadcast, canopy baiting, bait stations, and structure baiting (see Appendix B). The bait tracking worksheets will be managed by the GIS team (see Section 8) and will be utilized by the Implementation Advisory Group (see Section 8) to assess and guide the bait application process. In addition to the bait application worksheets, a records keeper will keep a written log of all radio traffic occurring during bait application operations; this log will be used to double check the bait application worksheet.

6.2.7 Baiting of Cooper Island

For Cooper Island, bait will be applied to the coastal block with the directional swath bucket, and each pass will be baited at 100% of the target sowage rate. A second, non-overlapping pass will be made with a directional swath bucket along the inland edge of the coastal block – this block will be baited at 50% of the target sowage rate and will be overlapped by 50% of a swath laid down by the full swath bucket (Figure 6). With the full swath bucket, each bait swath will overlap the previous swath by approximately 50 percent to prevent the formation of gaps between baiting lines. The runway on Cooper Island will not be baited as it is not a refuge for rats and it is the primary roosting site for Palmyra's shorebird populations (Figure 7). Other exclusions from the aerial baiting will include the camp area, inland bodies of water, and small islets that are prominent shorebird roosting sites: Rust, Pillbox, and Dadu islets.

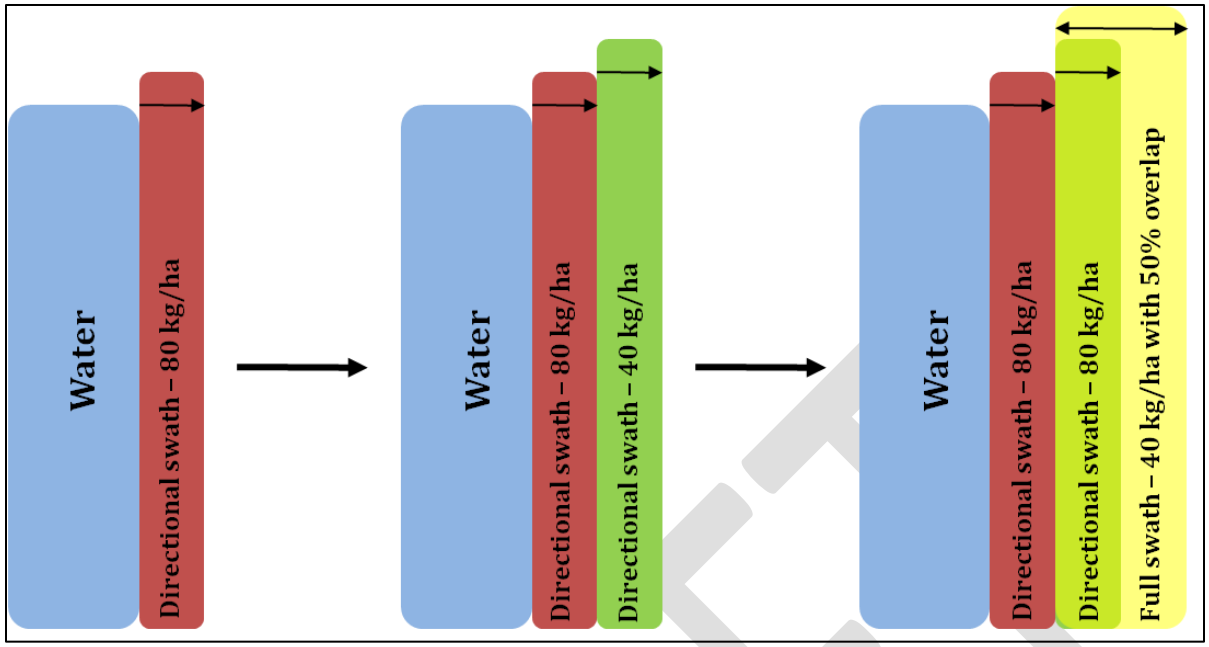


Figure 6. A depiction of the bait application strategy that will be used to transition from treatment of the coastal block to treatment of the interior block. The shapes to the left of the water indicate baiting blocks that are over the treatment area. The arrows at the top of the blocks indicate the relative direction of the bait flow from the baiting bucket. The flight lines will be along the left edge of the swaths that are sown with the directional swath bucket, and they will be down the center of the swaths that are sown with the full swath bucket.

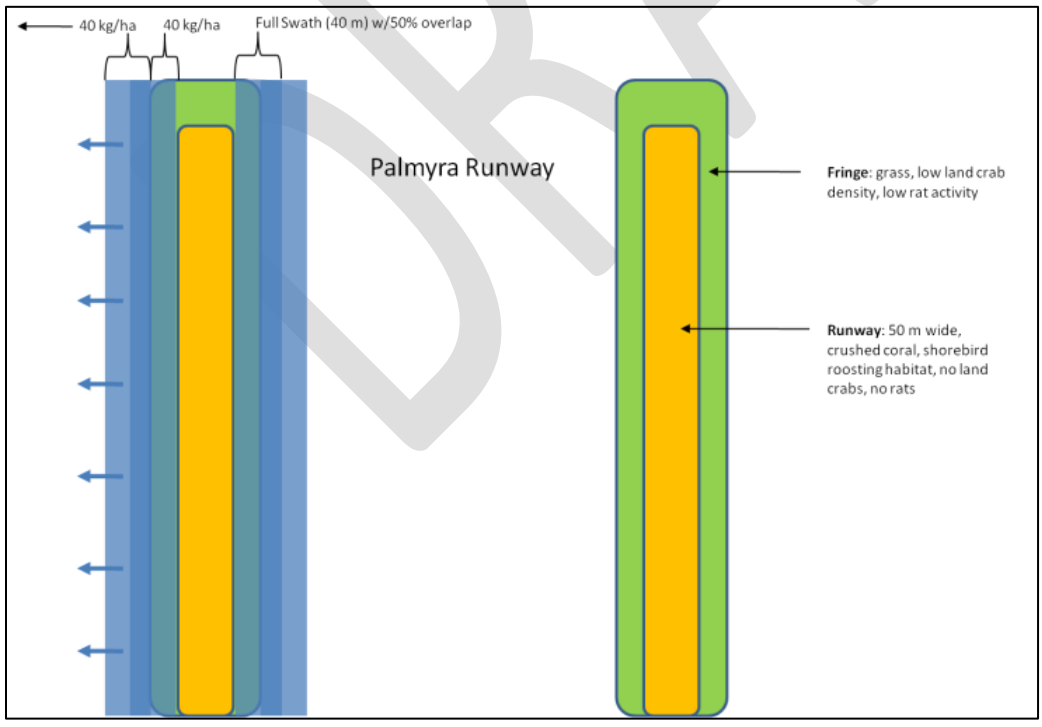


Figure 7. Strategy for excluding the runway on Cooper Island from the aerial bait application

6.2.8 Baiting of land areas other than Cooper Island

Other land areas will be treated with both the directional swath bucket, and the narrow swath bucket. All aerial bait application will be guided by a TracMap® GPS guidance system that shows baiting coverage and cautions the pilot against baiting outside predetermined areas. Adjustments in bait flow rates, helicopter speed, and flight lines will be made as is necessary to meet the optimal application rate, and while staying within the bait application limits legally required by the bait product's FIFRA registration.

6.3 Hand broadcast

Concurrent to the aerial bait application, four to eight personnel trained in hand broadcast baiting (Wegmann et al. 2008) will treat land areas that are too narrow for aerial treatment and the camp area – 2.7 ha (Figure 8). The hand broadcast team will apply bait at the prescribed application rates at each pre-determined baiting point. The hand broadcast team will take care to ensure that the bait spread is uniform and that there are no gaps between the hand broadcast area and the aerial broadcast area. Areas slated for hand broadcast will be treated directly after the adjacent area is treated by aerial broadcast. Bait will also be broadcast directly inside abandoned buildings at a rate that does not exceed the specifications of the bait product use label. After a building has been baited it will be marked (waypointed) with a GPS unit and physically marked with flagging tape or spray paint. Sixty abandoned structures have been located and mapped (Figure 9); additional structures that are found during eradication activities will be mapped and treated accordingly.

Figure 8. The camp area exclusion from the aerial broadcast treatment. The camp area (2.7 ha) will be treated by hand broadcast of bait to the ground and palm canopy, and placement of bait stations in and directly around buildings.

Figure 9. Abandoned structures (red circles) that will be treated by hand broadcast during the Palmyra rat eradication.

6.4 Bait stations

As a precautionary measure, bait stations containing 25W bait pellets will be placed around the research station, the wharf, and at select shorebird roosting sites (120 g/station x 50) (Figure 10). Bait stations will be at a density that is in compliance with the 25W product use label. Bait stations will be loaded with 120 g of 25W bait pellets (the same bait that would be used for the broadcast portion of the bait application) at the onset of the bait application. All stations will be checked every five days, and bait will be refreshed as needed, and at least every two weeks for two months. All bait stations will be put in place at least four weeks prior to the operation.

Figure 10. Areas that will be treated with bait stations during the Palmyra Atoll rat eradication

6.4.1 Bait station placement guidelines for commensal buildings

Tamper and crab-resistant bait stations will be placed in and around inhabited buildings in the camp area 6 weeks prior to the initiation of the bait broadcast. The buildings that will be treated with bait stations (and snap traps and glue boards for inside use only) are listed in Table 5, and shown in Figure 11. All bait stations locations have been mapped (waypointed). The following protocols were used to situate the stations and reduce a neophobic response by rats when the stations are activated.

1. Bait station quantities and spacing
    a. Quantity of stations around the outside of each building
        i. 1 station for every 400 ft^2 of building
    b. Quantity of stations inside each building
        i. 1 station for every 200 ft^2 of building
    c. Station spacing
        i. Space stations 5 – 50 m apart

2. Bait station placement
    a. Placement of stations around the outside of buildings
        i. Place each station on an overturned 5 gal bucket or other (slippery plastic) stand crabs cannot climb.
            1. Secure each station to the stand with a cable tie, string, or wire.

ii. Stations should be placed along the edges of buildings and (if possible) in the shade and/or under some type of protective cover
    1. Placing the stations in a protected location will increase the probability that rats will access the stations due to rat preference for covered/protected habitat
    2. The bait stations themselves do not need to be covered or sheltered from rain/sun
iii. Mark each station placement with flagging tape, permanent marker, or by some other means

b. Placement of stations inside buildings
    i. Place each station on the floor and against a wall – rats are more likely to run along walls than across an open space
    ii. Stations should be placed near points where rats are expected to enter or exit the building – e.g., near the back doors at the galley.
    iii. If the building contains potential sources of food for rats (dishwasher, food prep area, food stores, shorebird feed, pet feed, etc.), stations should be placed close to the dishwasher, stored food, feed, etc.
    iv. Stations should be placed out of the way of everyday foot traffic.

Table 5. Location and quantity of bait stations, glue traps, and snap traps for buildings and structures in the camp area

Building ID	Building name	Building use.	Ft²	Bait Stations			Glue traps	Snap traps
				Outside	Inside	Total	Inside	Inside
B10	Laboratory/Office	Dry Lab and FSM/FWS offices	1500	4	8	12	8	8
B11	Recycling Conex	Staging for waste recycling	320	2	2	4	2	2
B21	Generator Shed	Primary power and water production.	200	1	1	2	1	1
B23	Scuba Shack	Storage for and staging for scuba operations, scuba tanks filling.	375	1	2	3	2	2
B25	Gasoline tent	400 gallon storage tank and refueling station	96	0	0	1	0	0
B26	Lumber storage	Lumber storage	120	0	1	1	1	1
B29	Kayak tent	Kayak storage	360	1	2	3	0	0
B31	Yacht Club	Movie room/bar, weight room, HAM radio station , ping pong table room	1200	3	6	9	6	6
B33	Dock shed	Staging for boat operations.	60	1	1	2	0	0
B35	Snorkel tent	Snorkel equipment storage, science equipment staging	480	2	2	4	2	2

Building ID	Building name	Building use.	Ft²	Bait Stations			Glue traps	Snap traps
				Outside	Inside	Total	Inside	Inside
B36	Storage Conex	Galley and boat operations storage	160	2	1	3	1	1
B37	Galley storage	Primary Galley storage, Freezer/Refrigeration/dry good/ janitorial	1300	4	7	11	7	7
B38	Toilet house	Only station toilets	200	1	1	2	1	1
B40	Galley	Kitchen, Food serving, and dining area	1600	4	8	12	8	8
B41	Shower house	Showers/sinks, laundry/dryers	1400	4	7	11	7	7
B49	Storage bunker	Storage for Gasoline barrels, propane tanks, bulk building material	1600	4	8	12	0	0
B6	Maintenance Shop	Maintenance work shop and material storage, vehicle storage,	2000	5	10	15	0	0
B7	Chemical storage	Hazardous chemical storage.	50	1	1	2	0	0
C1	Cabin 1	Crew	100	1	0	1	1	1
C2	Cabin 2	Crew	100	1	0	1	1	1
C3	Cabin 3	Crew	100	1	0	1	1	1
C4	Cabin 4	Crew	100	1	0	1	1	1
C5	Cabin 5	Crew	100	1	0	1	1	1
C6	Cabin 6	Crew	100	1	0	1	1	1
C7	Cabin 7	Crew	100	1	0	1	1	1
C8	Cabin 8	Crew	100	1	0	1	1	1
C9	Cabin 9	Crew	100	1	0	1	1	1
C10	Cabin 10	Crew	100	1	0	1	1	1
C11	Cabin 11	Crew	100	1	0	1	1	1
C12	Cabin 12	Crew	100	1	0	1	1	1
C13	Cabin 13	Crew	100	1	0	1	1	1
C14	Cabin 14	Crew	100	1	0	1	1	1
C15	Cabin 15	Crew	100	1	0	1	1	1
C16	Cabin 16	Crew	100	1	0	1	1	1
L13	North Beach platform.	North Beach BBQ.	100	0	1	1	0	0
L32	Boat Dock	Boat Dock	1200	0	4	4	0	0
L42	Lanai	Lanai	100	0	2	2	0	0
L64	Ripple wharf	Ripple wharf	6500	16	0	16	0	0

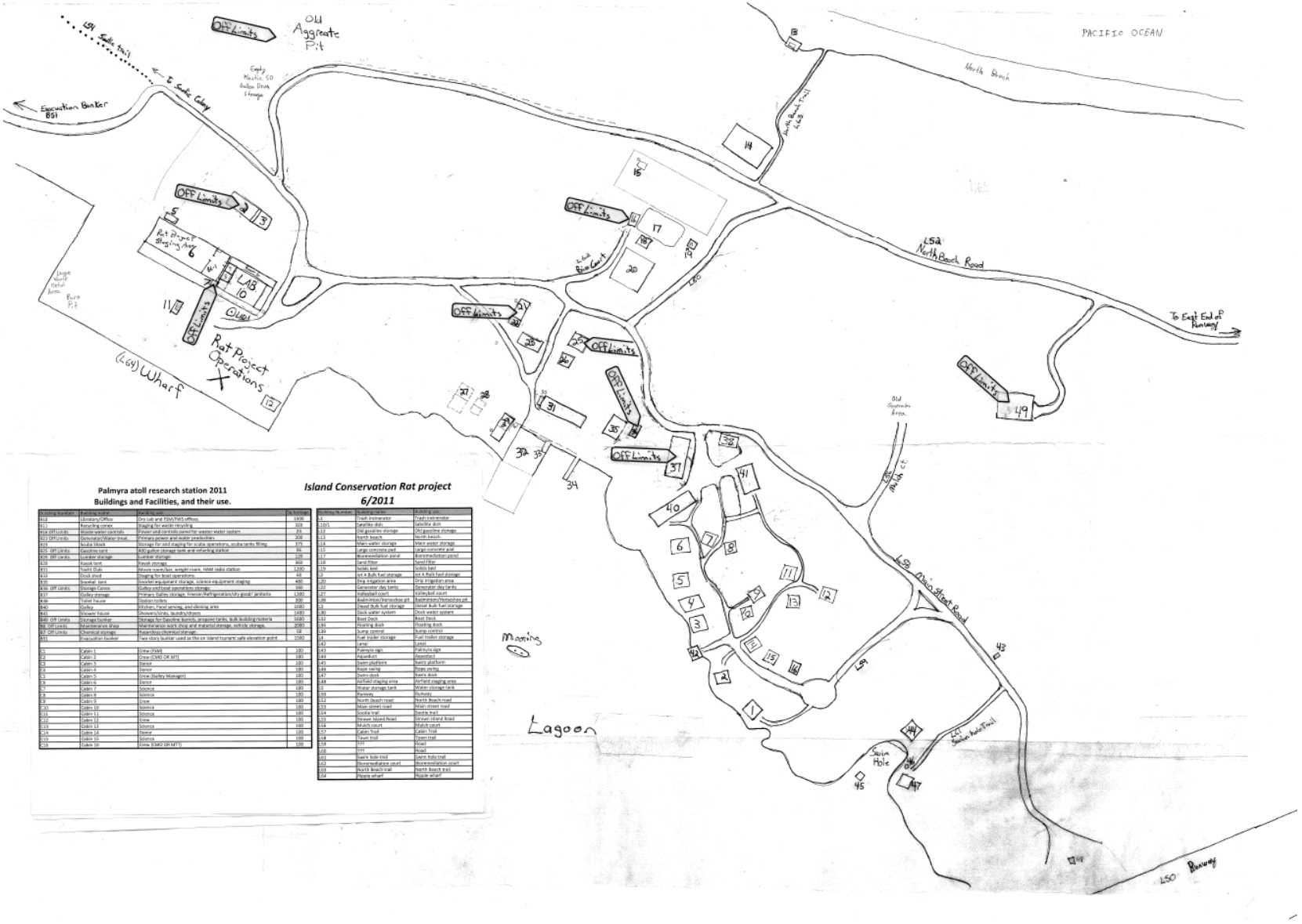


Figure 11. A representation of the TNC camp on Cooper Island with building numbers and major features.

6.5 Criteria for selecting bait application methods

The following script explains the criteria by which different bait application methods will be selected. The script uses the type of treatment area as the primary factor (underlined), and then describes the bait application process through an ordered presentation of the following factors: bait application method (e.g., hand broadcast), sowage rate (e.g., 80 kg/ha) and sowage features (e.g., 5 m swath, 0% overlap), treatment of gaps in the initial application, and exclusions from bait application. The aerial baiting components of this script pertain to the first bait application; for the second bait application, sowage rate values will change from 80 kg/ha to 75 kg/ha, and from 40 kg/ha, to 37.5 kg/ha.

1. Land 1 – 10 m wide and the Camp area
    a. Hand broadcast
        i. 80 kg/ha, 5 m swath, 0% swath overlap
            1. Follows aerial treatment of adjacent blocks - occurs within 2 hours of aerial treatment
        ii. Exclusions
            1. Active seabird nests on the ground
                a. 2 m exclusion of bait broadcast around each nest
            2. Water bodies
                a. 1 m exclusion of bait broadcast along the edge of the water body
                b. Exclusion of bait broadcast below the high water line
            3. Inhabited structures
                a. 1 m exclusion of bait broadcast around each inhabited building, no bait broadcast inside inhabited buildings

2. Land > 10 m wide
    a. Aerial broadcast
        i. Land 10 – 25 m wide
            1. Narrow swath bucket
                a. 80 kg/ha, 5 m swath, 0% swath overlap
        ii. Land > 25 m wide except for Cooper Island
            1. Coast & Interior
                a. Directional swath bucket
                    i. 80 kg/ha, 20 m swath, 0% swath overlap
            2. Gaps
                a. Narrow swath bucket
                    i. 80 kg/ha, 5 m swath, 0% swath overlap
        iii. Cooper Island
            1. Coast
                a. Directional swath bucket
                    i. Outside pass
                        1. 80 kg/ha, 20 m swath, 0% swath overlap
                    ii. Inside pass

1. 40 kg/ha, 20 m swath, 0% swath overlap, 50 % overlap with Interior passes - assuming 20 m "throw-forward" at the beginning and end of each Interior line

2. Interior
    a. Full swath bucket
        i. 40 kg/ha, 40 m swath, 50% swath overlap

3. Gaps > 5 m wide and 10 m long
    a. 0 kg/h recorded
        i. Narrow swath bucket
            1. 80 kg/ha, 5 m swath, 0% swath overlap
    b. 40 kg/ha recorded
        i. Narrow swath bucket
            1. 40 kg/ha, 5 m swath, 0% swath overlap

iv. Exclusions
1. Cooper Island Runway
    a. Full swath bucket
        i. 40 kg/ha, 40 m swath along outside edge of runway, 50% overlap starting 20 m out from edge of runway
            1. The grass fringe surrounding the runway (20 m) will receive 40 kg/ha
                a. Subsequent treatment (40 kg/ha) by hand or with the directional bucket may occur if bait is rapidly consumed in this area.

2. Camp
    a. Full swath bucket
        i. 40 kg/ha, 40 m swath centered on the camp exclusion boundary, 50% overlap starting 20 m inside the camp exclusion boundary
            1. 50% overlap with the hand baited area will result in 80 kg/ha treatment across the camp exclusion boundary

3. Inland water bodies
    a. Land 10-25 m wide
        i. Narrow swath bucket
            1. 80 kg/ha, 5 m swath around the edge of the water body
                a. 1 m exclusion of bait broadcast around the edge of the water body

4. Land > 25 m wide except Cooper Island
    a. Directional swath bucket
        i. 80 kg/h, 20 m swath along the edge of the water body
            1. Gaps > 5 m wide and 10 m long

a. Narrow swath bucket
i. 80 kg/ha, 5 m swath, 0% overlap

5. Coast
a. Exclusion of bait broadcast below the high water line

3. Abandoned structure
a. Hand Broadcast
i. Up to 200 g of bait broadcast into structures less than 2,500 ft^2, up to 450 g of bait broadcast into structures greater than 2,500 ft^2.

4. Palm crown overhanging water
a. Canopy bait
i. Crown overhanging ocean-facing shoreline that is inaccessible by foot
1. Air
a. 50 g bait bola dropped into every stand alone crown, or every 3rd interconnected crown
ii. Crown overhanging lagoon-facing shoreline
1. Ground
a. 50 g bait bola shot into every stand alone crown, or every 3rd interconnected crown

5. Inhabited structure
a. Bait Stations
i. Inside
1. 1 station for every 19 sq m of building space, 120 g of bait per station
ii. Outside
1. 1 station for every 37 sq m of building space, 120 g of bait per station
b. Traps (glue, snap)
i. Inside
1. 1 trap (glue and snap) for every 37 sq m of building space

6. Shorebird roosting islets not treated by broadcast baiting (Rust, Pillbox, Dadu)
a. Bait Stations
i. 1 - 2 stations per islet, 120 g bait/station

7 SHOREBIRD PROTECTION

7.1 Population Monitoring to identify optimum rodenticide broadcast schedule that will minimize shorebird exposure to bait.

Surveys will be conducted pre-broadcast to detect migration pulses and stabilization of summer numbers once all migrants have departed. Remaining birds will be captured when shorebird numbers remain low for 3 days. Weekly high tide counts serve as an index to shorebird numbers at Palmyra and have been done continuously since 2009. The high tide counts will occur once per week during the months leading up to the implementation, and will be carried out daily starting two weeks prior to the implementation. Atoll wide low tide counts are done once per month

depending on available staff. The low tide counts are a census of all the shorebirds at Palmyra, and will be conducted twice in the month prior to the implementation, and once during the week before the implementation during the best tide available. Results from the high tide counts and low tide counts will inform the timing of the shorebird capture.

7.2 Capture of over-summering shorebirds for protective captive care

Capture sites have been identified on the 1,800 m crushed coral runway, North Beach, tidal flats and known roosting sites. The utility of any particular capture location will depend on the tide, time of day, weather and bird behavior. Methods of capture to be employed include: decoys and call playback in combination with net-guns, mist-nets, noose carpets, drop nets and a catapult net.

7.3 Handling Protocols

Once shorebirds are captured they will be covered with a towel to reduce stress and banded. Morphological measurements, blood, and feather samples will also be taken. Birds will be placed in a plywood transport box (18"x16"x16") and transported to the aviary. Before release into the aviary, birds will have primary feathers trimmed to restrict flight and reduce the chance of injury. Bristle-thighed Curlews are unusual among shorebirds in that they go through a flightless period when they molt and are scheduled to molt 1 to 2 months after they are released from protective care.

7.4 Aviary Facilities

The aviary frame is made of 1" metal conduit that is divided into ten 10' x 8' pens (Total = 50' x 16') and covered with 70% shade cloth. The bottom outside edge will be covered with a 2' aluminum sheeting to act as a visual barrier and to prevent rats and crabs from entering the aviary. The structure will be attached to the ground with concrete anchors. The flooring will consist of rubberized matting (Elephant Bark™) that sits on top of a 6" layer of sand. The aviary will be outfitted with an irrigation system that will provide periodic water flow over the floor during the day. This will prevent overheating, aid in cleaning, and help the birds maintain their feathers. Natural and artificial visual barriers within the aviary and along the outside will give birds the opportunity to hide and will help reduce the urge to pace. Each pen will have a capture door to aid in capture. The aviary will be situated within the aerial broadcast treatment area. Following each broadcast, pellets will be removed from the roofs of the aviaries, and from a 1 m swath around the base of the aviary.

7.5 Bird Care Personnel

The veterinary doctor and wildlife biologists will monitor behavior, food consumption, water intake, temperature, ventilation, fecal output, signs of capture myopathy, and stress of the birds three times a day. Behavioral observations will be made from a blind and activity and noise will be restricted in the vicinity of the aviary. Birds with significant loss in body weight will be given gavage treatment. If a bird shows increasing signs of stress, the veterinarian will treat it as appropriate. Talking and visitation by nonessential personnel will be prohibited. The number of birds captured and put in each pen will depend on the levels of intra-specific aggression they show. Birds in the aviary will be offered fresh and salt water, trout chow, locally collected seeds and invertebrates (collected prior to the bait application), hard-boiled egg yolk, and

vitamin/mineral supplements. Unconsumed food and water will be removed from the aviary each day.

7.6 Post-eradication Protocol

After the risk of exposure to residual rodenticide has become negligible, healthy birds will be released with their aviary mates at their respective capture sites. The released birds will not be disturbed but will be monitored with a spotting scope or binoculars. Sightings of the color-banded birds will be recorded during the weekly high tide shorebird count. Food bowls will be placed at release sites to provide supplemental feeding opportunities for birds with clipped primaries until they molt and are again flighted. Post-eradication feedings will occur at the same time of day as they did when the birds were kept in the aviaries.

8 OPERATIONS TEAM

The operations team for the Palmyra rat eradication will entail 38 personnel who will fill 50 positions, with most staff filling more than one position. Reporting will follow the command structure from the bottom up (Figure 12).

The Incident Advisory Group (IAG), lead by the Incident Commander (IC), will be the primary decision making body during the operation. The Operations Advisory Group (OAG), lead by the Deputy Incident Commander, will ensure that decisions made by the IAG are carried out in the operation, and that key operational issues are known to the IAG. The IC, the Baiting Chief, and the Operations Planning and Intelligence Director will represent the IAG at OAG meetings. If IAG makes a decision about the operation that conflicts with the Operational Plan, the decision and the conflict will be documented (see Appendix

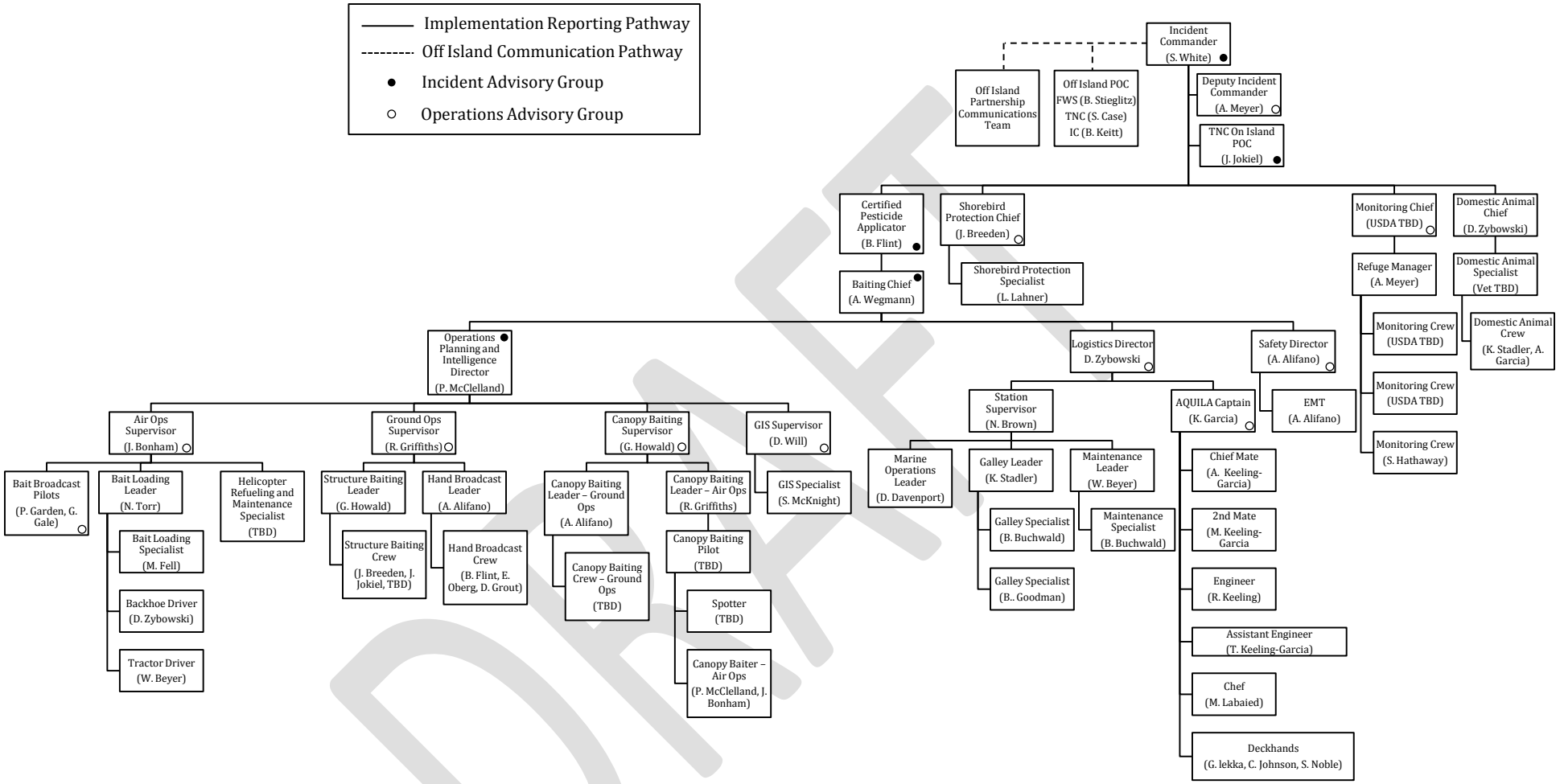


Figure 12. Command structure for the Palmyra rat eradication operations team.

8.1 Position descriptions and responsibilities

Brief descriptions of each position are given below. A more detailed explanation of positions including the inherent roles and responsibilities will be provided to personnel prior to the operation.

Incident Commander (IC)

The IC is ultimately responsible for the entire operation, all Chiefs report to the IC.

Deputy Incident Commander (DIC)

The DIC will assume responsibility for the operation if the IC is no longer able to do so.

TNC On Island Point of Contact

The TNC On Island Point of Contact will represent TNC's interests during the operation, will partake in IAG meetings.

Off Island Partnership Communication Team

The Off Island Partnership Communication Team will receive reports from the IC, and will be responsible for communications with media.

Off Island Point of Contact

The Off Island Points of Contact will be available for consultation on operational, regulatory, or partnership issues that need an audience that is larger than the IAG. The Off Island Support person may be included on IAG discussions and debriefs.

DOI Certified Pesticide Applicator (CPA)

The CPA ensures that the pesticide application follows federal (EPA, FIFRA) and DOI regulations. The CPA is on site for the entire bait application. The CPA reports to the IC.

Baiting Chief (BC)

The BC is responsible for all aspects of the bait application section, including logistics and safety. The BC reports to the CPA and the IC.

Shorebird Mitigation Chief (SMC)

The SMC is responsible for all aspects of the shorebird capture and care section. The SMC reports to the IC.

Shorebird Care Specialist (SCS)

The SCS, a wildlife veterinarian, supervises and is directly involved in the capturing of and caring for Bristle-thighed Curlews and Pacific Golden Plovers. The SCS reports to the SMC.

Monitoring Chief (MC)

The MC is responsible for all aspects of the monitoring section. The MC reports to the IC.

Supervisory Wildlife Biologist (SWB)

The SWB, a USFWS biologist, ensures that the monitoring actions are in compliance with Refuge policy and have minimal impact to native flora and fauna. The SWB reports to the MC.

Monitoring Crew (M-Crew)

The M-Crew works with the MC and SWB to carry out the monitoring tasks. M-Crew personnel report to the MC.

Domestic Animal Chief (DAC)

The DAC is responsible for all aspects of domestic animal section. The DAC reports to the IC.

Domestic Animal Specialist (DAS)

The DAS, a wildlife veterinarian, supervises the care of the domestic animals (1 dog, 2 cats) and ensures that they are removed from risk of exposure to rodenticide. The DAS reports to the DAC.

Domestic Animal Assistant (DAA)

The DAA's work with the DAS to ensure that the domestic animals are cared for according to the guidelines determined by the DAC and DAS. The DAA's report to the DAS.

Operations Planning and Intelligence Director (OPID)

The OPID is responsible for the bait application unit, including ground and air operations, and GIS intelligence. The OPID reports to the BC.

GIS Supervisor (GSU)

The GSU is responsible for recording, summarizing, and reporting the GPS-based data generated during aerial and ground baiting operations, and is specifically responsible for the data generated by the air operations. The GSU reports to the OPID.

GIS Specialist (GSP)

The GSP works with the GSU to manage the GPS-based data generated during baiting operations, and is specifically responsible for the management of data generated by ground operations. The GSP is will exchange memory sticks with the Broadcast Baiting Pilots during air-based baiting operations. The GSP reports to the GSU.

Ground Operations Supervisor (GOS)

The GOS is responsible for all ground-based bating operations during the two bait applications, including hand broadcast baiting and structure bating. The GOS reports to the OPID.

Hand Broadcast Leader (HBL)

The HBL is responsible for all hand broadcast operations, including the hand broadcast treatment of the camp area. The HBL is responsible for training and equipping personnel involved in hand broadcast operations. The HBL reports to the GOS.

Hand Broadcast Crew (HBC)

The HBC works with the HBL to complete all hand broadcast assignments. HBC members report to the HBL.

Structure Baiting Leader (SBL)

The SBL is responsible for all structure baiting operations, including the baiting of inhabited structures in camp and abandoned structures throughout the atoll. The SBL is responsible for training and equipping personnel involved in structure baiting operations. The SBL reports to the GOS.

Structure Baiting Crew (SBC)

The SBC works with the SBL to complete structure baiting assignments. SBC members report to the SBL.

Air Operations Supervisor (AOS)

The AOS is the site controller for helicopter operations and will be the point of contact for the helicopter pilots during baiting operations. During aerial baiting operations, the AIS will relay bait bucket load statistics to the GS. The AOS will report to the OPID.

Broadcast Baiting Pilot (BBP)

The BBP is responsible for all aspects of the helicopter during aerial baiting operations. The BBP is responsible for the aerial application of bait in accordance with the bait application plan. The BBP will consult with the OPID and BC on the bait application plan. While piloting the helicopter, the BBP reports to the AOS.

Helicopter Refueling and Maintenance Specialist (HRMS)

The HRMS is responsible for the maintenance of the helicopters and refueling the helicopters during air operations. The HRMS will supervise the reassembly and disassembly of the helicopters when they are removed from and put back in the shipping containers. The HRMS works with the pilots to identify and address helicopter maintenance needs. During air operations, the HRMS reports to the AOS.

Bait Loading Leader (BLL)

The BLL is responsible for the loading of the bait bucket during air baiting operations, including the staging of bait pods, the securing of pod lids and empty bulk bags, and loading the bait bucket with the prescribed amount of bait. The BLL reports to the AOS.

Bait Loading Specialist (BLS)

The BLS works with the BLL to stage bait pods, secure pod lids and empty bulk bags, and load the bait bucket. The BLS reports to the BLL.

Backhoe Driver

The Backhoe Driver lifts the bulk bags from the pods and positions them over the bait bucket. The Backhoe Driver reports to the BLL.

Tractor Driver

The Tractor Driver moves full bait pods from the Pod Storage Bay to Staging Area 1 and from Staging Area 1 to Staging Area 2 (Appendix A). The Tractor Driver reports to the BLL.

Canopy Baiting Supervisor (CBS)

The CBS is responsible for all aspects of the canopy baiting operation, including air and ground operations. The CBS directs the canopy baiting operation from the command center. The CBS reports to the OPID.

Canopy Baiting Leader – Ground Operations (CBL-G)

The CBL-G is responsible for the implementation of the ground-based canopy baiting operation. The CBL-G orients personnel to canopy baiting techniques and directs the ground-based canopy bating effort from the field. The CBL-G reports to the CBS.

Canopy Baiting Crew – Ground Operations (CBC-G)

The CBC-G works with the CBL-G to implement the ground-based canopy baiting operation. CBC-G personnel report to the CBL-G.

Canopy Baiting Leader – Air Operations (CBL-A)

The CBL-A is responsible for the implementation of the air-based canopy baiting operation. The CBL-A orients personnel to canopy baiting techniques and directs the air-based canopy baiting effort from the field. The CBL-A reports to the CBS.

Canopy Baiting Pilot (CBP)

The CBP is responsible for piloting the helicopter during air-based canopy baiting operations. The CBP will work with the CBL-A to develop a flight plan. The CBP reports to the CBL-A.

Spotter

The Spotter rides in the helicopter during air-based canopy baiting operations and observes the bait application. The Spotter reports to the CBP.

Canopy Baiter - Air Operations (CB-A)

The CB-A is responsible for the placement of canopy baits ("bolas") in designated palm crowns. The CB-A reports to the CBP.

Logistics Director (LD)

The LD is responsible for the logistical aspects of the operation, including station facilities and assets, and the alliance between the station and the support vessel. The LM reports to the BC.

Station Supervisor (SS)

The SS is responsible for the functioning of the station, including all station facilities and assets. The SS reports to the LD.

Marine Operations Leader (MOL)

The MOL oversees all small boat operations, including boat-based transportation of field staff and equipment, boat maintenance, and providing personnel with boat operation training. The MOL reports to the SS.

Galley Leader (GL)

The GL is responsible for the operation of the station's housing facilities, including the galley, the shower house, toilet house, and the laundry. The GL reports to the SS

Galley Specialist (GS)

The (GS) assists the GL with the operation of the station's housing facilities. The GS reports to the GL.

Maintenance Leader (ML)

The Maintenance Leader is responsible for the operation and care of the station's assets, including the power and water systems, vehicles and heavy equipment, and structures. The ML reports to the SS.

Maintenance Specialist (MS)

The MS works with the ML to care for the station's assets. The MS reports to the ML.

M/V AQUILA Captain

The Captain of the AQUILA is responsible for the vessel and the vessel's crew, for directing the offloading and loading of project supplies and equipment, for transporting personnel to and from the project site, and for housing personnel during the operation.

M/V AQUILA 1st Mate

The 1st Mate of the AQUILA works with the Captain to manage the vessel and the associated responsibilities. The 1st Mate will assume responsibility of the vessel if the Captain is no longer able to do so. The 1st Mate reports to the Captain.

M/V AQUILA Crew

The Crew of the AQUILA work with the 1st Mate and Captain to maintain the vessel and support the operation. The Crew report to the Captain.

Safety Director (SD)

The SD's responsibilities include: ensuring that personnel are briefed on safety issues and plans, that personnel have access to appropriate PPE, that safety issues are addressed and resolved, and that the medics are prepped to respond to a medical emergency. The SM reports to the BC.

EMT

The EMT will assist personnel with minor to moderate medical needs, and will be the primary care giver and liaison with off-site medical advisors during medical emergencies. The EMT reports to the SD.

Incident Advisory Group (IAG)

The IAG will include the IC, and the Chiefs; Supervisors, Directors, and other personnel will be brought into IAG meetings when needed. The IAG will be lead by the IC, and the IC will facilitate daily IAG meetings. The IAG will coordinate with the OAG to ensure that implementation happens according to plan.

Operations Advisory Group (OAG)

The OAG will include field directors and other key personnel. The DIC will facilitate daily OAG meetings, and the IC, BC, and OPID will attend OAG meetings to establish a link between the IAG and OAG; other personnel will be brought into OAG meetings as needed. The OAG will implement operational directives from the IAG and will inform the IAG of operational issues that need to be addressed.

9 OPERATIONS COMMUNICATION PLAN

Communication between project personnel will be via VHF radio and will be structured to reduce the amount of traffic to any one individual. Without a clear communications plan that is strictly followed, communication channels can be easily overwhelmed or personnel may find it difficult to sift out extraneous information during operations based communications. The communication plan mirrors the incident command structure, allowing for diffusion of information through the appropriate personnel channels.

Information should move freely up and down the chain of command, utilizing the "talk up one and down one" concept; meaning personnel need to talk up the command chain one slot to their supervisor and down one to everyone they supervise. However, this should not prevent Operational Groups from communicating and sharing information.

A total of 23 portable VHF radios will be required to support the PARRP operation (Table 6). Portable radios will be programmed to operate on ten unique channels (Figure 13). Channels will be assigned for communication with and between six operational groups: Command, Ground Ops, Air Ops, Logistics, Monitoring, and Emergency. Personnel will be briefed on radio use and procedures prior to operating in the field. A pocket card will be distributed to all personnel outlining the schedule of radio frequencies and the radio call signs for all project positions (Figure 14).

General Radio Procedures

- Be specific: Before transmitting, know what you are going to say.

- Indicate objectives: Personnel should know exactly where to go, to whom they should report, the task and its objective.

- Use clear tone/effective rate: Speak clearly at a normal rate, not too fast or too slow.

- Well timed/spaced transmissions: Prioritize your messages. Do not waste valuable airtime with unimportant messages and insignificant details. Maintain an awareness of the overall situation and how you fit in. Wait until a message transaction has been completed before transmitting.

- Pause between concurrent messages: A pause makes it clear when one message has been completed and another started. It will also give other personnel a chance to transmit important messages.

Making a Transmission

Transmission procedures should ensure that messages are received and comprehended. Radio tranmissions are initiated when the intended receiver indicates readiness to receive a message. The

message is transmitted and the receiver restates the message to confirm that it was understood. If correct, the original sender confirms, completing the communications sequence. For example, an exchange between the Ground Ops Supervisor and the Struture Baiting Supervisor would follow these five steps:

1. "Structure Baiting Supervisor, this is Ground Ops Supervisor on Marine 1A."

2. “Ground Ops Supervisor, Structure Baiting Supervisor.” (Sructure Baiting Sup. transmitting)

3. “Move your team to structure 43 and begin application.” (Ground Ops Sup. transmitting)

4. “Team to structure 43, begin application.” (Structure Baiting Sup. transmitting)

5. “Affirmative.” (Ground Ops Sup. transmitting)

Emergency Traffic

The phrase “emergency traffic” is used to gain priority access to the emergency channel or an operational channel (if needed). The phrase is transmitted by the personnel in need, causing the Safety Manager to defer to the caller until normal traffic can resume.

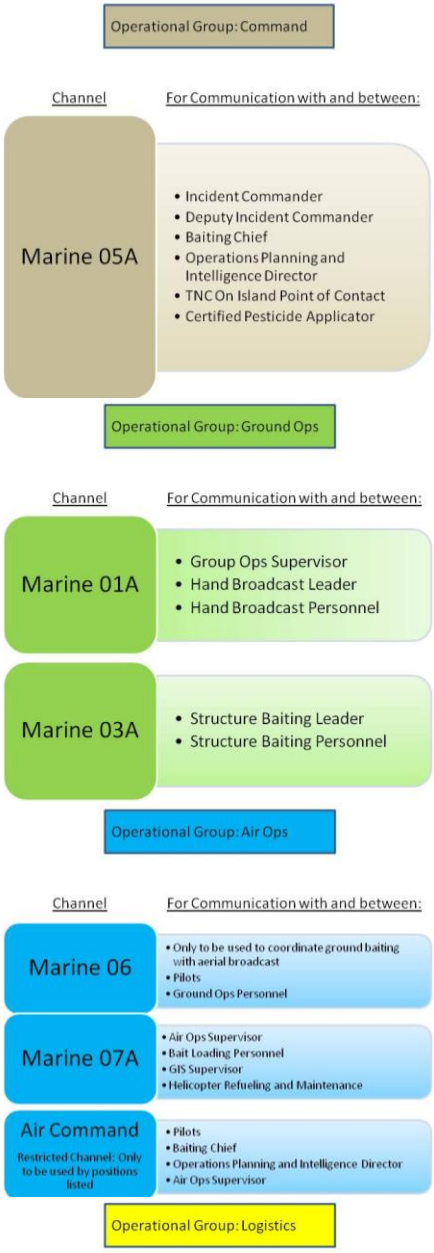
An example exchange:

1. “All personnel, standby for emergency traffic.” (This statement gains priority access)
2. “Safety Manager, this is Monitoring Chief on Marine 16.”
3. “Monitoring Chief, Safety Manager.”
4. “Need immediate medical attention at location X, possible heat exhaustion.”
5. “Medical attention needed for heat exhaustion at location X.”
6. “Affirmative.”

Table 6. Portable VHF radios and radio headsets (blue shading) required during the PARRP Operations.

Position	Radios needed	Source of Radios
Incident Commander	1	USFWS
Deputy Incident Commander	1	USFWS
Shorebird Mitigation Chief	1	USFWS
Shorebird Care Specialist(s)	1	USFWS
Monitoring Chief	1	IC
Certified Pesticide Applicator	1	USFWS
Baiting Chief	1	IC
Safety Director	1	IC
Logistics Director	1	IC
Station Supervisor	1	TNC
Marine Operations Leader	1	TNC
Galley Leader	1	TNC
Galley Specialist	1	TNC
OPI Director	1	IC
Air Ops Supervisor	1	IC
Bait Loading Leader	1	IC
Bait Loading Specialist	1	IC

Position	Radios needed	Source of Radios
Backhoe Driver	0	
Tractor Driver	1	IC
Helicopter R&M(s)	1	IC
Ground Ops Supervisor	1	IC
Structure Baiting Leader	1	IC
Structure Baiting Crew	1	TNC
GIS Supervisor	1	IC
Radios provided by IC	**13**	
Radios provided by TNC	**5**	
Radios provided by USFWS	**5**	
TOTAL RADIOS NEEDED	**23**	
TOTAL HEADSETS NEEDED	**6**	IC


Operational Group: Command
Channel
For Communication with and between:
Marine 05A
• Incident Commander
• Deputy Incident Commander
• Baiting Chief
• Operations Planning and Intelligence Director
• TNC On Island Point of Contact
• Certified Pesticide Applicator
Operational Group: Ground Ops
Channel
For Communication with and between:
Marine 01A
• Group Ops Supervisor
• Hand Broadcast Leader
• Hand Broadcast Personnel
Marine 03A
• Structure Baiting Leader
• Structure Baiting Personnel
Operational Group: Air Ops
Channel
For Communication with and between:
Marine 06
• Only to be used to coordinate ground baiting with aerial broadcast
• Pilots
• Ground Ops Personnel
Marine 07A
• Air Ops Supervisor
• Bait Loading Personnel
• GIS Supervisor
• Helicopter Refueling and Maintenance
Air Command
Restricted Channel: Only to be used by positions listed
• Pilots
• Baiting Chief
• Operations Planning and Intelligence Director
• Air Ops Supervisor
Operational Group: Logistics
Channel
For Communication with and between:
Marine 09
• Station Personnel
• Boat Operators
• Animal Care Personnel
• Vessel
Marine 08
• All Personnel
• Open channel to be used during times of high radio traffic

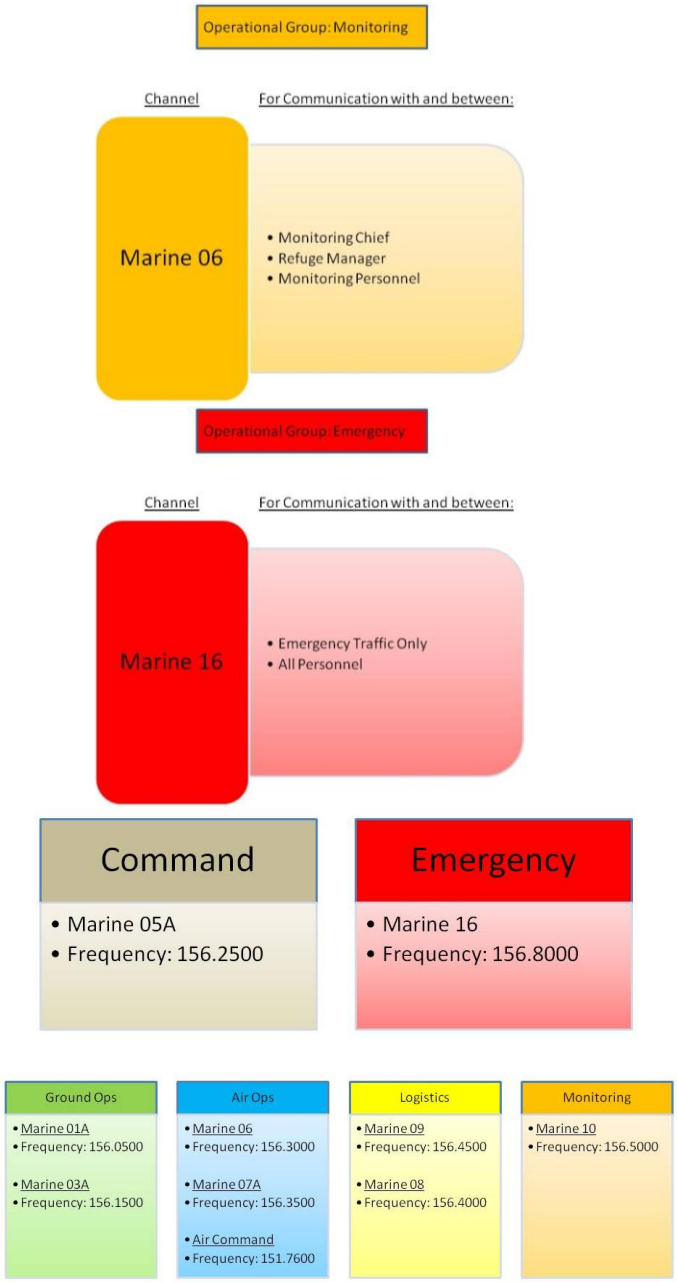


Figure 13. PARRP Radio Channels by Operational Group

Group	ID	Who	Frequency
Command	Marine 05A	Incident Command	156.2500
Ground Ops	Marine 01A	Hand Broadcast Personnel	156.0500
	Marine 03A	Structure Baiting Personnel	156.1500
Air Ops	Marine 06	Pilots, Ground Ops	156.3000
	Marine 07A	Air Ops Personnel	156.3500
	Air Command	Pilots, Incident Command	151.7600
Logistics	Marine 09	Station/Vessel/Animal Care	156.4500
	Marine 08	Open Channel	156.4000
Monitoring	Marine 10	Monitoring Personnel	156.5000
Emergency	Marine 16	All Personnel	156.8000

Radio Call Sign	Name	Contact On
Incident Commander	S. White	Marine 05A
Deputy Incident Commander	Redundant staff	Marine 05A
Baiting Chief	A. Wegmann	Marine 05A
OPI Director	P. McClelland	Marine 05A
TNC 1	Redundant staff	Marine 05A
Certified Applicator	Redundant staff	Marine 05A
Ground Ops Supervisor	R. Griffiths	Marine 01A
Hand Broadcast Leader	A. Alifano	Marine 01A
Hand Broadcast 1	B. Flint	Marine 01A
Hand Broadcast 2	E. Oberg	Marine 01A
Hand Broadcast 3	D. Grout	Marine 01A
Structure Leader	G. Howald	Marine 03A
Structure 1	J. Jokiel	Marine 03A
Structure 2	Redundant staff	Marine 03A
Structure 3	Redundant staff	Marine 03A
Canopy Baiting Supervisor	Redundant staff	Marine 01A
CB -Ground Ops Leader	Redundant staff	Marine 01A
Canopy Baiting Crew	Redundant staff	Marine 01A
Monitoring Chief	USDA TBD	Marine 10
Refuge Manager	A. Meyer	Marine 10
Monitoring 1	USDA TBD	Marine 10
Monitoring 2	USDA TBD	Marine 10
Monitoring 3	S. Hathaway	Marine 10

Radio Call Sign	Name	Contact On
Helicopter 7KR	Pilot 1	Marine 06
Helicopter 52Q	Pilot 2	Marine 06
Air Ops Supervisor	J. Bonham	Marine 07A
Bait Loading Leader	N. Torr	Marine 07A
Bait Assistant	M. Fell	Marine 07A
Backhoe 1	Redundant staff	Marine 07A
Tractor 1	Redundant staff	Marine 07A
Engineer	D. Sanderson	Marine 07A
GIS Supervisor	D. Will	Marine 07A
GIS Assistant	S. McKnight	Marine 07A
CB - Air Ops Leader	Redundant staff	Marine 07A
Shorebird Chief	J. Breeden	Marine 09
Animal Care	Vet TBD	Marine 09
Logistics Director	D. Zybowski	Marine 09
Station Supervisor	N. Brown	Marine 09
Marine Operations Leader	D. Davenport	Marine 09
Galley Leader	K. Stadler	Marine 09
Galley Assistant	Redundant staff	Marine 09
Maintenance Leader	W. Beyer	Marine 09
Maintenance Specialist	B. Buchwald	Marine 09
Aquila	Aquila Crew	Marine 09

Figure 14. PARRP Radio Pocket Card (the first table is the front of the card, the second table is the back) that all personnel will carry in the field. "Redundant staff" indicates that the associated personnel have already been assigned a radio and call sign based on one of their other roles.

10 BRIEFING, TRAINING, AND DEBRIEFING

10.1.1 Initial Briefing and Training

After all project personnel arrive at Palmyra and before the commencement of the first bait application, the briefings and training sessions described in Figure 15 will occur. The exact schedule for the initial briefings and training sessions will be determined by the IAG.

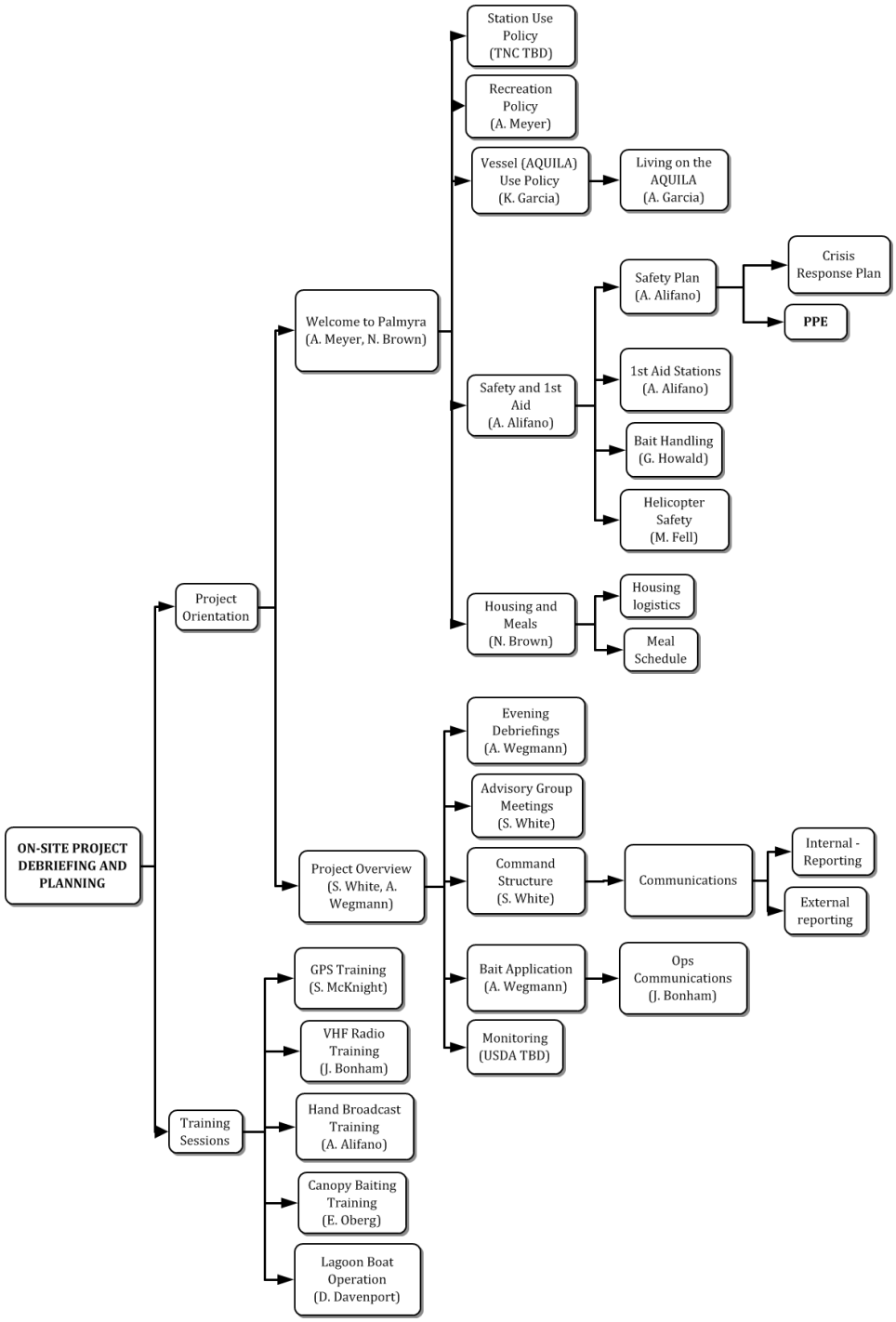


Figure 15. The process for conducting pre-bait application briefings and training sessions when the entire team is at Palmyra.

10.1.2 Hot Debriefing

On site, or "hot" debriefings will happen every evening of the operation. General debriefings will be held with all personnel (Figure 12) and will be led by the IC. The

general debriefings will primarily focus on what happened on that day. The IC will facilitate a short presentation of the actions that occurred that day, and will field questions and statements from personnel regarding the day's activities. Following the general debriefings, the IAG will meet to address issues/problems discussed during the general debriefing. Following the IAG meeting, the OAG will meet to discuss the outcome of the IAG meeting and plan the following day's activities. OAG members will be responsible for disseminating the outcome of the OAG meeting to personnel under their charge. Figure 16 presents a graphic demonstration of how the hot debriefing process will unfold.

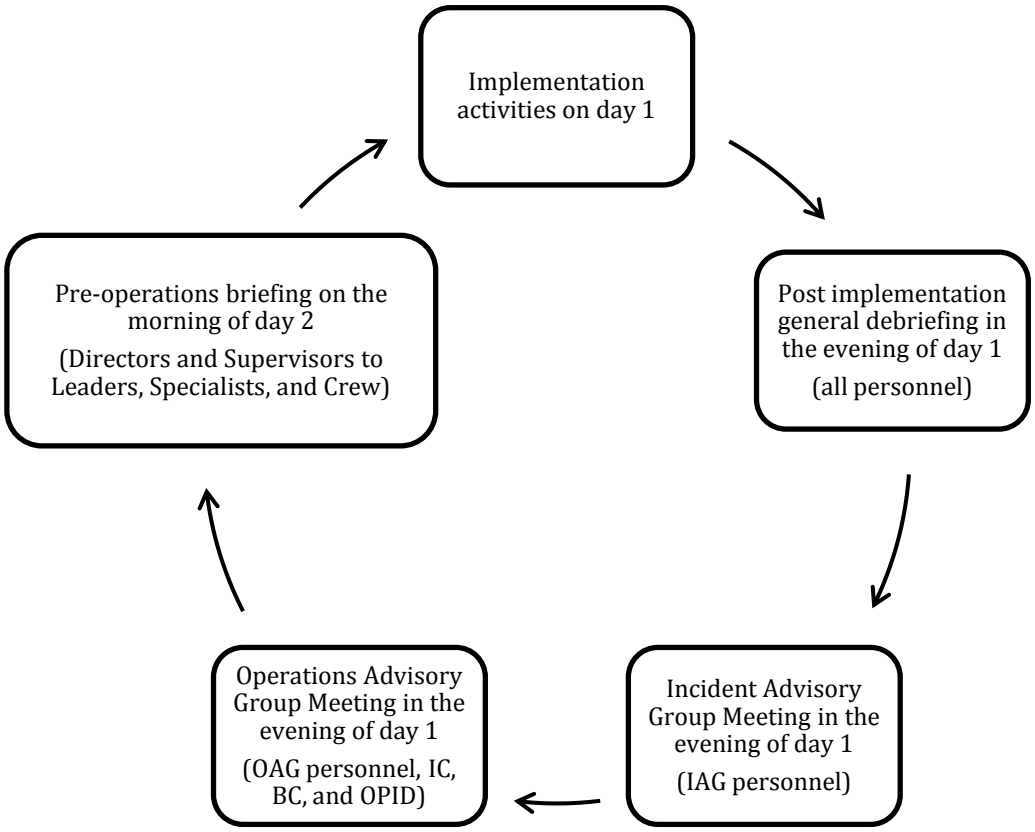


Figure 16. The process for "hot debriefing" during the operation.

10.1.3 Post Operation Audit

Following the operation, a full audit will be conducted by an outside party and the results of that audit will be recorded and disseminated to all partners and stakeholders.

11 TIMING

11.1 Biological window

This operation will be implemented when the non-target species that are at the greatest risk of harmful exposure to rodenticide (shorebirds) are least abundant at Palmyra – during the summer breeding season: June through July (Gill et al. 1990, Marks et al. 2002).

12 MONITORING

Monitoring of the eradication action will occur according to the eradication Monitoring Plan (Pitt et al. 2011)

13 HEALTH AND SAFETY

13.1 Safety Plan

(Refer to the Helicopter Operations Plan – Appendix A, and the Palmyra Atoll Restoration Project Safety Plan)

14 LOGISTICS

The support vessel will transport two helicopters, 50 tons of bait, and an assortment of equipment and supplies between Seattle and Palmyra. Through a partnership with the Eco-Oceania Pty and the Royal Society for the Protection of Birds, we have linked the Palmyra rat eradication with two subsequent rat removal programs in the tropical Pacific: Birnie and Enderbury Islands in the Phoenix Islands and Henderson Island in the Pitcairn Islands (Figure 17). The same vessel, helicopters, and roll equipment that will support the Palmyra project will continue on to the Phoenix Islands and then to Henderson Island. By sequencing the projects, the costs of the vessel and helicopter charters are reduced for each project, expertise is shared between projects, and the amount of fuel required to complete the three-project tour is several times less than what would be required to complete each eradication as a standalone project

14.1 Supplies and equipment to/from Palmyra

All supplies for the implementation will be shipped to Seattle and staged at a storage location (TBD). Prior to the departure, fuel (Jet-A, gas, oil, and propane) will be delivered to the vessel and loaded aboard. The Project Manager and vessel Captain will determine an arrangement to facilitate the loading of bait and additional supplies and equipment in Seattle. All supplies will be loaded onto the vessel before it departs Seattle for Honolulu. The vessel will take ten days to cruise from Seattle to Honolulu, and an additional 4 days for transit to Palmyra from Honolulu. After the eradication has been completed, the vessel will transit from Palmyra to Apia, Samoa.

Table 7. Operations schedule to departing Palmyra for Apia:

Date	Project	Project Leg	Activity	Notes
Day -7	Palmyra	HNL-PA	Transit	Arrive at Palmyra in the late afternoon
Day -6	Palmyra	PA	Operation	Offload supplies, bait, fuel
Day -5	Palmyra	PA	Operation	Offload supplies, bait, fuel
Day -4	Palmyra	PA	Operation	Offload supplies, bait, fuel
Day -3	Palmyra	PA	Operation	Offload supplies, bait, fuel
Day -2	Palmyra	PA	Operation	Offload supplies, bait, fuel
Day -1	Palmyra	PA	Operation	Offload supplies, bait, fuel
Day 0	Palmyra	PA	Operation	1st bait application - broadcast
Day 1	Palmyra	PA	Operation	1st bait application - broadcast
Day 2	Palmyra	PA	Operation	1st bait application - broadcast
Day 3	Palmyra	PA	Operation	1st bait application - canopy
Day 4	Palmyra	PA	Operation	1st bait application - canopy
Day 5	Palmyra	PA	Operation	1st bait application - canopy
Day 6	Palmyra	PA	Operation	Eradication monitoring
Day 7	Palmyra	PA	Operation	Eradication monitoring
Day 8	Palmyra	PA	Operation	Eradication monitoring
Day 9	Palmyra	PA	Operation	Eradication monitoring
Day 10	Palmyra	PA	Operation	Eradication monitoring
Day 11	Palmyra	PA	Operation	Eradication monitoring - weather contingency day
Day 12	Palmyra	PA	Operation	Eradication monitoring - weather contingency day
Day 13	Palmyra	PA	Operation	Eradication monitoring - weather contingency day
Day 14	Palmyra	PA	Operation	2nd bait application - broadcast
Day 15	Palmyra	PA	Operation	2nd bait application - broadcast
Day 16	Palmyra	PA	Operation	2nd bait application - broadcast
Day 17	Palmyra	PA	Operation	2nd bait application - Canopy / Loading AQUILA
Day 18	Palmyra	PA	Operation	2nd bait application - Canopy / Loading AQUILA
Day 19	Palmyra	PA	Operation	2nd bait application - Canopy / Loading AQUILA
Day 20	Palmyra	PA	Operation	Load supplies, equipment - weather contingency day
Day 21	Palmyra	PA	Operation	Load supplies, equipment - weather contingency day
Day 22	Palmyra	PA	Operation	Load supplies, equipment - weather contingency day
Day 23	Palmyra	PA	Operation	Load supplies, equipment
Day 24	Palmyra	PA-AP	Transit	AQUILA and operations team depart Palmyra
Day 25	Palmyra	PA-AP	Transit	

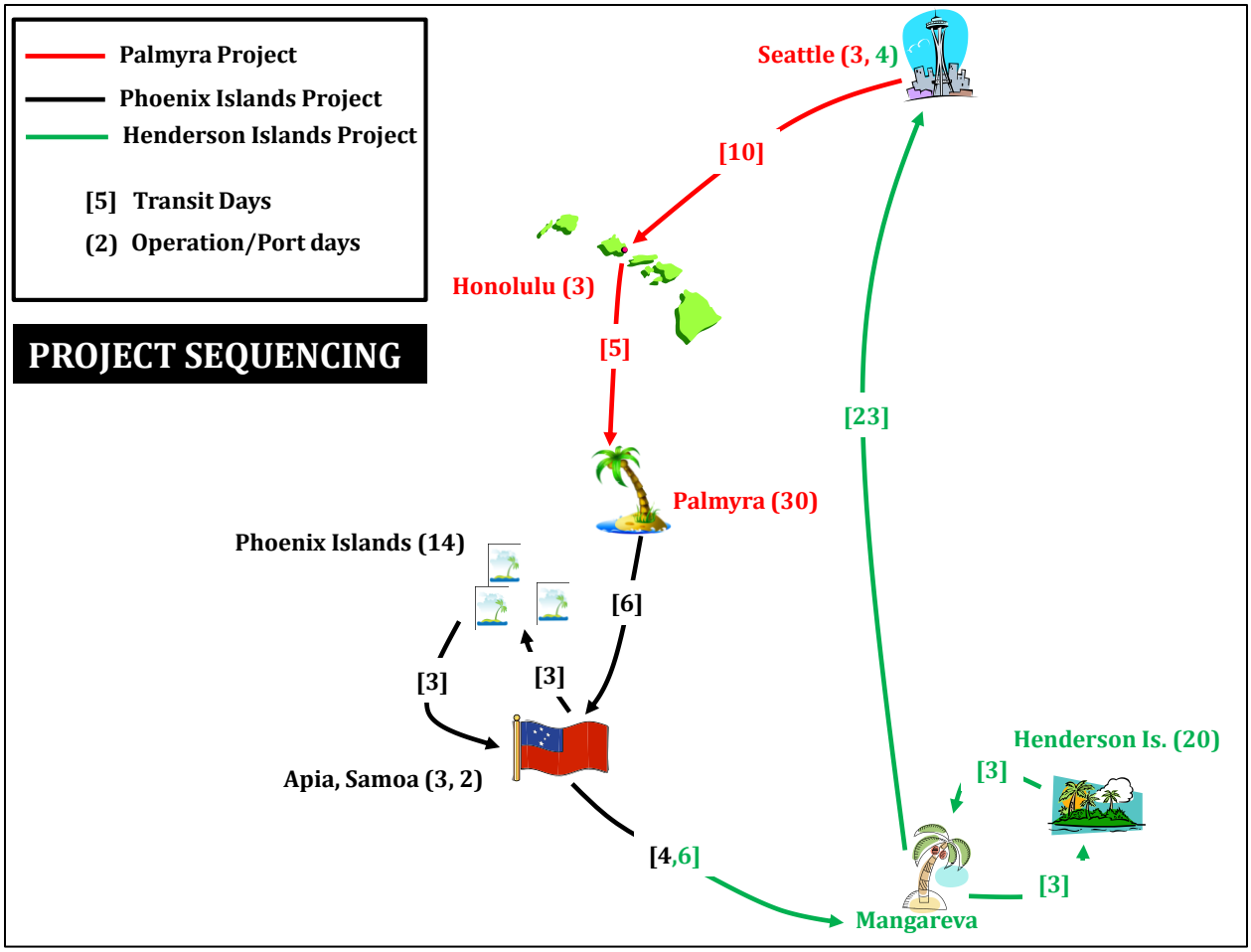


Figure 17. A representation of the sequencing of rat eradication projects at Palmyra Atoll, the Phoenix Islands, and Henderson Island. The same vessel, helicopters, and role equipment will be used by all three projects.

14.2 Personnel to/from Palmyra

An Advance Team will arrive at Palmyra via a charter flight one week prior to the eradication to prep the station. At this time, the water catchment facilities will be secured, shorebirds will be captured and placed in the holding facility, and the preparation and staging of equipment will occur. Several personnel will board the vessel at port in Honolulu and transit to Palmyra with the vessel crew. The rest of the operations team will meet in Honolulu and transit to Palmyra on a second flight (Table 8).

Table 8. Transport schedule for project personnel. Personnel listed in the Command Structure (Figure 11) who do not appear in this table will be at Palmyra prior to the operation, and will remain after the operation.

M/V AQUILA				Chartered flight			
Transportation leg	**Count**	**Transportation leg**	**Count**	**Transportation leg**	**Count**	**Transportation leg**	**Count**
Honolulu to Palmyra		**Palmyra to Apia**		**Honolulu to Palmyra**		**Palmyra to Honolulu**	
5/30/2011	**15**	**7/4/2011**	**21**	**6/1/2011**	**12**	**6/30/2011**	**15**
Kale Garcia		Kale Garcia		Alex Wegmann		Graeme Gale	
Tanner Keeling-Garcia		Tanner Keeling-Garcia		Aurora Alifano		Gregg Howald	

Mckenzie Keeling-Garcia	Mckenzie Keeling-Garcia		Pete McClelland	Richard Griffiths
Mehdi Labaied	Mehdi Labaied		Dave Zybowski	Sean McKnight
Gromyko Lekka	Gromyko Lekka		Dennis Davenport	Mike Fell
Chris Johnson	Chris Johnson		Jordan Jokiel	Dave Zybowski
Sam Noble	Sam Noble		Will Beyer	Dennis Davenport
Rich Keeling	Rich Keeling		USDA 1	Jordan Jokiel
Anj Keeling-Garcia	Anj Keeling-Garcia		USDA 2	Ben Buchwald
Dave Will	Alex Wegmann		Beth Flint	Ned Brown
Erik Oberg	Aurora Alifano		Jim Breeden	USDA 1
Jake Bonham	Dan Grout		Lesanna Lahner	USDA 2
Nick Torr	Dave Will		**6/6/2011**	**10** USDA 3
Mike Fell	Erik Oberg		Dan Grout	Amanda Meyer
Dave Sanderson	Jake Bonham		Graeme Gale	Susan White
	Nick Torr		Gregg Howald	**7/20/2011** **2**
	Pete McClelland		Peter Garden	Bob Gooding
	Peter Garden		Richard Griffiths	Lesanna Lahner
	Dave Sanderson		Sean McKnight	
	Beth Flint		Bob Gooding	
	Stacie Hathaway		USDA 3	
			Susan White	
			Stacie Hathaway	

After the implementation, several personnel will remain at Palmyra to conduct environmental and efficacy monitoring; the rest of the implementation team will transit back to Honolulu on a chartered flight or to Samoa on the support vessel.

14.3 Role equipment

14.3.1 Vessel

The M/V AQUILA, a 165 foot converted crabbing vessel from Seattle, WA, will be contracted to transport equipment and supplies to and from Palmyra. The vessel is capable of: transporting all of the bait, equipment, and supplies in freight containers on the deck of the vessel and in the below-deck holds, 2 helicopters (in 40' containers), and 12,500 gallons of Jet-A fuel. The vessel crew have previous experience with supporting a rodent eradication project (Rat Island), and have visited Palmyra several times.

14.3.2 Helicopter

Two Bell 206 Jet Ranger helicopters will be contracted from Pathfinder Aviation in North America. Each machine will be fitted with the necessary hardware and switching gear to carry and operate the bait buckets. Also, a TracMap GPS system that has been developed specifically for baiting operations will be installed in each machine. The TracMap system

allows for easy uploading and downloading of files without downtime and can easily import void zones, create boundary buffers, end of line buffers and point zones.

Helicopter disassembly and packing will require removal of the rotors, mast and skids. The helicopters will be secured inside 40' containers for transport. The helicopters will already be outfitted with the necessary equipment for the eradication prior to packaging and shipment. Two pilots with expertise in aerial rodent eradications will conduct the aerial broadcast. The pilots will be legally able to work within the U.S., and will possess all required FAA licenses and endorsements.

14.3.3 Bait buckets

Three Spreader buckets specifically designed for the broadcast of pelletized bait have been purchased by Island Conservation. These buckets were designed and built by Helicopters Otago, New Zealand. Empty weight of the bucket is 282 lb (128 kg) with a maximum internal bait capacity of 700 lb (318 kg). Each bucket has been calibrated for effective swath width and sowage (flow) rates. The buckets are interchangeable and spare parts sufficient to rebuild the mechanical components of a bucket will be taken to Palmyra. The bait buckets will be shipped from Portland, OR to Seattle, WA where they will be loaded onto the vessel.

15 OPERATION TIMELINE

The implementation phase of PARRP will begin in September 2010 and end in September 2011 (Figure 18). The discrete activities that will occur during the implementation are displayed in Table 9.

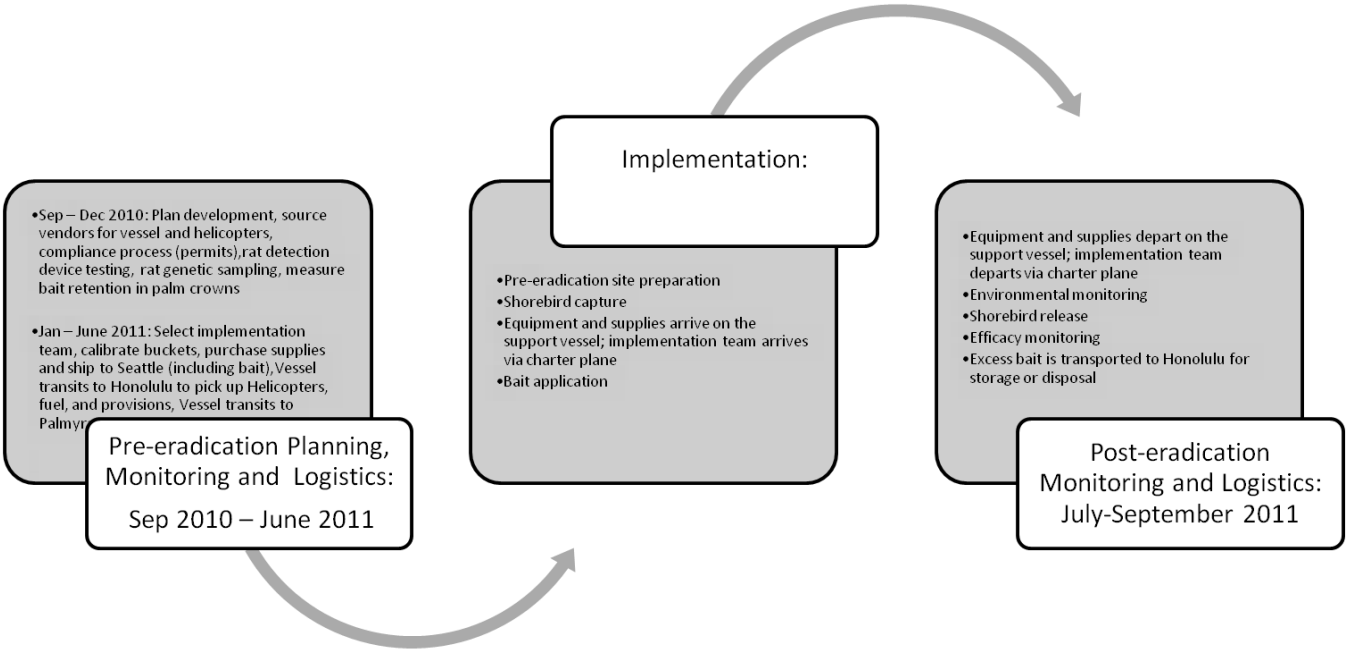


Figure 18. Operations timeline for the implementation phase of the rat eradication at Palmyra.

Table 9. Activity chart for the implementation phase of the Palmyra rat eradication project.

Implementation Timeline		Implementation Day																													
	-10 to -7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Activity																														
Strike team arrives at Palmyra	X																													
Prep station for operation	X	X	X	X	X	X	X																							
Vessel arrives at Palmyra		X																												
Offload equipment/supplies		X	X	X																										
Operations team arrives at Palmyra				X																										
Vessel moves from wharf to mooring			X																											
Establish bucket loading site				X	X	X	X																							
Aerial bait application								X	X	X												X	X	X						
Hand bait application								X	X	X												X	X	X						
Commensal bait application								X	X	X												X	X	X						
Arm bait stations								X																						
Check bait stations								X		X		X		X		X		X		X		X		X		X		X		X
Refresh bait in bait stations																						X								
Canopy bait overhanging palms										X	X	X	X	X										X	X	X	X	X		
Demobilize aerial baiting operation																									X	X	X			
Vessel moves from mooring to wharf																												X	X	
Load vessel																												X	X	
Vessel departs Palmyra[1]																														X
Operations team[2] departs Palmyra																														X

[1]Four extra days have been allotted to the operation as "contingency" time. [2]Some personnel will remain to continue care for captured shorebirds and continue several monitoring actions.

16 DEMOBILIZATION

16.1 Excess bait disposal

Excess bait will be left on island to support the treatment of a residual population of rats if one is found after the eradication operation has finished. All bait will be appropriately labeled and stored in a dry location under control of FWS. Unused bait will be sent back to Honolulu in February 2012, and will be disposed of in a manner that is in accordance with FIFRA regulations.

16.1.1 Supplies, equipment and infrastructure (TBD)

The fate of supplies and equipment will be determined prior to the implementation of this project

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18 APPENDIX A: HELICOPTER OPERATIONS PLAN

18.1 Loading Zone (LZ)

The LZ will be located on Ripple wharf and serve as the location for all ground based activities associated with aerial operations. The LZ shall consist of one bait loading zone, one refueling pad, and two helicopter parking pads. The LZ will be outfitted with multiple wind indicators and each pad marked for aerial identification to ensure clear communication and safety between ground personnel and pilots. The perimeter of the LZ will be identified and marked using strung pennant flagging to ensure site security during operations; DOI employees will not enter the LZ when active flight operations are taking place. Additionally, a minimum of three 20-pound 40-B:C fire extinguishers will be available for placement at active pads. The set-up and layout of the LZ will be directed by the Air Operations Supervisor (AOS), with recommendations made by the pilots.

The LZ will also host a work station, located in the Dry Lab, equipped for monitoring of the helicopter GPS data during the operation. The equipment at the LZ work station will include: computers and printers (main and backup sets), island maps (paper and laminated), whiteboard, VHF radios. Additionally, a kit for first aid and crash rescue will be established at the LZ.

18.1.1 Helicopter Storage

When not flying, the helicopters will be parked and stored at the designated parking pads of the LZ, unless a more suitable area is identified following recommendations by the pilots, Helicopter Refueling and Maintenance Specialist (HRMS), and the Station Supervisor. Anchoring systems will be installed according to and under the direct supervision of the pilots and/or HRMS. Anchoring systems for helicopters may include: concrete anchors for belly hook attachment; tie point attachments from the skids, blades and mast; a pole support system for reducing blade mobility; and a combination of earth auger and duckbill anchoring systems.

The helicopter storage location will also be where the HRMS services the helicopters at night and where role equipment will be staged when not in use. All equipment required to maintain the helicopters while in the field, including, but not limited to, ladders, floodlights, tooling and wash down/decontamination supplies, aircraft auxiliary power unit, etc. will be supplied by the helicopter operator.

In the event of a major storm, helicopters may seek emergency shelter in the TNC warehouse. Prior to initiating the bait application, the HRMS and pilots will examine the warehouse location to determine the protocol for movement and storage of the helicopter in the warehouse.

18.2 Communications (Air Ops)

Communication between pilots and ground crew will be via VHF radio and structured to reduce the amount of traffic to pilots and the AOS. All team members will be briefed on radio use and the schedule of radio frequencies prior to the start of operations. Radios are required for all members of the Air Operations team. See the Operations Communications Plan in the Operational Plan for more detail on communications related to Air Ops.

18.3 Weather forecasts

The NOAA-National Weather Service (NWS) will be utilized as the source for weather predictions. The primary means of acquiring forecast information will be through the following web pages:

- http://www.prh.noaa.gov/hnl/pages/aviation.php
- http://www.prh.noaa.gov/hnl/pages/marine.php

Due to the isolated location of the operational area, a specific weather forecast product is not readily available. However, general trends and potential disruptive weather can be acquired through the combination of marine and aviation forecasts. The AOS is responsible for receiving daily weather forecasts and communicating these to the Baiting Chief (BC), Operations Planning and Intelligence Director (OPID), and pilots. In the event that further weather forecasting is desired, the Incident Commander (IC) will maintain a communication schedule with a NOAA-NWS representative from the Weather Forecasting Office in Honolulu, HI.

18.4 Aerial Operations Safety

It is essential that all aviation operations be planned with the utmost consideration given to safety and operational efficiency. Missions can be accomplished safely and efficiently, provided that a high degree of pre-planning, risk analysis, and management is applied. Many users have developed Standard Operating Procedures (SOP) that streamline the planning process, incorporate the lessons learned from others experience, and utilize the best practices that balance the demands for safety and efficiency.

Helicopter safety is the responsibility of every individual on the project; however oversight of helicopter-specific safety is the responsibility of the helicopter vendor and pilots. Given the remote location, helicopter operations on the island are considered high risk. To ensure that a high standard of safety is maintained during the project a separate document (*Island Conservation Helicopter Operations SOP, July 2008)* will be utilized. This document details general helicopter safety procedures, flight following, and emergency or crash response procedures. Additionally, the helicopter vendor will provide an Aviation Safety Plan detailing emergency equipment and response. All safety protocols and procedures will follow standard FAA guidelines.

Safety procedures covered in the Island Conservation Helicopter SOP include external load operations, bait handling & loading, and aerial bait broadcast. The SOP also includes, but is not limited to, the following:

- Method for the identification of all hazards, including new hazards.
- How these hazardous can be eliminated, or reduced.
- Detail safety equipment and training required for both the positioning and aerial work operations for both flight crews and ground crews.
- Nominate a person responsible and accountable for safety on site.
- Method for dealing with emergencies.
- Method of reporting incidents and accidents.

The following information serves as an overview of aerial operations safety procedures and guidelines to be followed on this project. Refer to *Island Conservation Helicopter Operations SOP, July 2008* for full detail.

18.4.1 Hazard Identification and Mitigation

The OPID and AOS will work jointly with the pilots to manage hazards associated with aerial operations. Common hazards associated with a helicopter mission –crew fitness, distraction, mission focus, communication, weather, takeoff or landing weights, landing areas, other aircraft, wire and other obstructions – must be identified and controls provided to mitigate the hazard(s).

Preflight project planning for baiting operations should be intensive because the aircraft and crew are placed in a less forgiving environment. The BC will aid the pilots in aerial hazard identification, creating a hazard map if necessary, and will ensure high-level reconnaissance is made prior to low-level flight

18.4.2 Flight Following (on island)

Flight following requirements will be clearly identified, including check-in procedures, time and locations, individuals responsible for flight following, radio frequencies to be used, and any special circumstances requiring check-ins. The flight following personnel must document position reports to assist in locating an overdue or missing aircraft.

Flight following on island will be coordinated by the OPID, in accordance with the vendor company's Aviation Safety Plan. The HRMS or designee will have radio contact with the pilots; check-in intervals will be determined by the OPID and pilots prior to operations commencing. Check-ins during flights will be documented by the HRMS or designee. A standardized flight plan form will be provided by the aircraft vendor. Completed flight plans will be kept on hand at the LZ.

18.4.3 Overdue Aircraft/Emergency Response

Aircraft mishap, accident and emergency will be managed by the vendor helicopter contractor, unless otherwise arranged. Overdue or missing aircraft will be managed by the vendor helicopter contract. Protocols for aircraft accident reporting and management, and procedures for overdue or missing aircraft should be detailed in the vendor company's Aviation Safety Plan.

18.4.4 Personnel Experience/Training

Inexperience with aerial operations could potentially present safety concerns, as well as reduce operational efficiency. Priority will be given to staffing aerial operation positions with personnel who posses significant aviation experience. If positions are to be filled by in/under-experienced personnel, those team members must complete a helicopter training program combining classroom and field practical, specific to the work being done on the island.

18.4.5 Personnel Transport

Extensive personnel transport is not anticipated for the project. However, if the need arises, the safe transport of personnel in helicopters is of the highest priority. Utilizing standard procedures will ensure we meet the objective of transporting personnel safely and efficiently.

- All passengers should receive a safety and mission briefing prior to take-off.
- Only passengers essential to the mission will be onboard the helicopter.
- DOI employees will not be transported by helicopter.
- During passenger transport operations, load calculations and standards shall be adhered to.
- As a general rule, only the Pilot(s) shall be onboard helicopters when conducting external load operations. The Pilot has final authority regarding carrying an aircrew member during external load operations.

18.4.6 Personnel Protective Equipment (PPE)

18.4.6.1 Helicopter

Personnel working around operating helicopters will wear the following PPE:

- Fire resistant or all-natural fiber clothing (long-sleeved shirt and pants, or flight suit)
- High visibility vest/jacket
- Hardhat with chinstrap, or flight helmet
- Fire resistant or leather gloves
- All leather boots
- Eye protection
- Hearing protection

During refueling operations, the HRMS will wear appropriate PPE for dispensing aviation fuel, including 'non-static' clothing.

18.4.6.2 Bait Handling and Loading

All personnel that handle bait or monitor the bait application in the field will meet or exceed all requirements for PPE described on the bait's EPA pesticide label. In addition to the required helicopter PPE, the Bait Loading Leader and the Bait Loader Driver will wear disposable dust masks or respirators when filling the bait buckets.

18.4.7 Marshalling / Crash Rescue

The AOS is responsible for directing helicopters during bait reloading operations and relaying helicopter traffic updates to ground staff. The AOS should direct the pilot by radio and remain visible to the pilot at all times. In the event of an aircraft emergency in the LZ, the AOS can respond quickly utilizing the pad's fire extinguisher and initiating crash rescue procedures.

18.5 Aerial Broadcast Implementation

18.5.1 Aerial Ops Command Structure

The command structure of personnel for the aerial broadcast operation is shown Section 8 of the Operational Plan. This diagram is intended to be as closely representative of the actual structure as possible, anticipating that actual roles may change prior to or during aerial baiting operations. The roles and responsibilities of the field team during the aerial baiting operations are listed in Section 8.1 of the Operational Plan. While the specific tasks required during the aerial baiting operations are fixed, additional tasks may be required of the field team during the aerial baiting operations. Of note, the AOS will serve as the Site Controller for the LZ; however if multiple aircraft are operating within the LZ at one time, separate site controllers will be needed to manage each aircraft. Individuals may also be rotated between non-specialist roles (e.g. Bait Loading Specialist) depending on the needs of the team or operations on any given day.

18.5.2 Commencement of Application

Prior to initiating aerial baiting operation, an operation checklist will be prepared by the AOS and reviewed by the BC and OPID, to ensure that all equipment has been adequately and safely installed. The checklist will also be reviewed and approved by the Incident Advisory Team. Following approval, the authorization to commence aerial baiting operations will be given to the baiting pilots. While the BC will be responsible for detailing daily flight activities, the decision to fly on any given day will ultimately be made by the baiting pilots and will depend on suitable weather conditions for safe, effective baiting.

18.5.3 Daily decision to apply bait

Every day following the authorization to commence will be treated as an opportune window for aerial bait application, unless declared otherwise. Before dawn each day the IC, BC, OPID, AOS, and baiting pilots will consult on local weather conditions and forecasts to assess whether they are suitable for baiting. If conditions are deemed suitable, the team will proceed with preparation and positioning for baiting (see *Daily schedule of events* below).

Poor weather conditions may cause baiting operations to be halted, changed, or delayed. Daily baiting will be delayed (or discontinued if flying has already commenced) if the weather is unsuitable, and/or the pilots feel it is no longer possible to continue flying in a safe manner.

Weather conditions in which baiting may be halted or delayed are:

- wind speeds average 25 knots or gusts to over 30 knots
- visibility conditions in the area being treated are obscured by low clouds, inhibiting the pilot's ability to safely operate
- conditions of heavy rain (loading bait buckets in heavy rainfall may cause "gumming" of bait and potentially cause bait bucket to jam or clog)

18.5.4 Daily schedule of events

18.5.4.1 Pilot preparation:

The BC will discuss the daily flight plan with the pilots and the Incident Advisory Team the night before flying, in order to maximize all optimal weather conditions for aerial baiting. The daily flight plan will be based on several criteria, including: the predicted weather forecast, the area(s) of the island previously treated, the prioritization criteria for applying bait, and the current stage of the operational timeline.

The pilots will also complete a weight and balance calculation prior to each helicopter flight. The pilots may use a pre-calculated mission weight and balance if the information is current and it is reviewed prior to departure. The pilots will also complete a load calculation on the first flight of each day. The load calculation is valid for flights between similar points of elevation, temperature, and fuel loads.

18.5.4.2 Air Ops team preparation:

If conditions have been deemed suitable for dropping bait the AOS will notify the team and preparations will begin for baiting. Daily preparations will include:

- Team briefing of weather forecast
- Team briefing of action plan for the day
- Review of task requirements of team members
- Radio check

Once preparations are complete the Air Ops team and helicopters will be positioned to begin baiting. If weather conditions are not suitable for flying the team will stand-by, awaiting a briefing to inform the team of the updated action plan and assign tasks for the day. All team members will be on stand-by during days of no flying in the event weather conditions become suitable for flying.

18.5.5 Bait-bucket Loading Procedures

The bait loading team will consist of 5 people: The AOS (site controller), the BLL, a Bait Loading Specialist, the Backhoe Driver, and the Tractor Driver. Prior to beginning bait operations for the day, the AOS and BLL will oversee that the loading site is properly prepared for operations, including ensuring an adequate amount of bait for the planned daily operation (determined by the BC) is present at Staging Area 1 (SA1), and all required safety equipment is in place. The Tractor Driver will move pods from SA1 to SA2. At SA2, the lid will be removed from the pod and the bulk bag will be attached to the bucket of the Backhoe.

Once the bait in the bucket has been sown, or the targeted area has been treated, the pilot will notify the AOS via radio and return for reloading at the LZ. When the helicopter arrives to the loading site the AOS will direct the pilot in placing the bucket for reloading. An aerial baiting operation requires adherence to standard practices similar to those for external cargo load operations. The bait loading team should remain clear of the loading area until the AOS signals that the bucket is placed into position; no other personnel should be near the site unless approved

by the AOS. The bucket should be placed on the ground by the pilot at the designated loading spot before bait is loaded, and not be pulled into position by the loaders. The bucket should always remain between the bait loading team and the helicopter.

Prior to reloading the bucket at the LZ, the BLL will check the bottom of the bucket for an approximate fistful amount of bait remaining from the previous bucket load – this residual bait is an indicator that the actual area baited was recorded by the GPS tracking system. The remaining contents of the bucket will be indicated to the AOS. If no bait remains in the bottom of the bucket prior to reloading, the OPID will be consulted and the pilot may be required to re-bait a portion of the previously treated area.

When the bucket is on the ground and the remaining contents checked, the Backhoe Driver will approach the bucket with the bulk bag. The BLL will assist the Backhoe Driver in positioning the bulk bag over the bucket, once the bulk bag is in place the BLL will pull the release to fill the bucket with bait. After emptying the bulk bag, the Backhoe Driver and BLL will move away from the bucket ensuring the empty bulk bag is secure and preventing the bulk bag from being blown away or interfering with the helicopter. The Bait Loading Specialist will roll up empty bulk bags and secure them in a predetermined location. When bait loading has been completed, the AOS may signal the pilot to begin movement of the bucket. As the bucket is lifted, ground personnel should keep out of the flight path to avoid injury. The AOS must pay close attention as the helicopter lifts up and tension is applied to the bucket line, if there is a problem with the bucket, the AOS should communicate appropriately with the pilot. Once the helicopter departs the LZ, the bait loading team will immediately attach another bulk bag to the Backhoe and reposition in preparation for the next bucket loading.

18.5.6 Aerial Data

18.5.6.1 Baiting

At each bucket reload the pilot will communicate via radio to the AOS the amount of area (measured in ha) that was previously treated with bait. The AOS will relay this information, along with the amount of bait dispensed to the GIS Supervisor (GSU), to be recorded into a bait-application monitoring spreadsheet.

18.5.6.2 GPS

On aerial baiting days, GPS information will be downloaded after the first 3 bucket loads applied by each pilot, allowing for any possible errors in flight lines, GPS logging, or bait application rates to be detected. Once the systems are verified, GPS information will be downloaded as required by the OPID or BC.

18.5.6.3 Flight Log

A log of all flight activity and onboard passengers will be kept by the GSP, and will include significant aviation activities such as: time helicopter begins flying, time when helicopter arrives back to reload, refueling events, all engine shut downs, arrival/departure times, and passenger manifests. The GSP will maintain the log via direct observations at the LZ and refueling area, or by radio communications with the AOS. A copy of the log will be kept at the point of departure.

Should the GSP be unable to observe and document flight activities, another designated person will maintain the flight log.

18.5.7 Refueling

Helicopter refueling will occur in the designated fuel area at the LZ. During helicopter refueling, the bait bucket motor will be refueled with unleaded fuel dispensed from a small jerry can. Fueling will be the responsibility of the Helicopter Refueling and Maintenance Specialist. The fuel trailers will be appropriately positioned with the refueling equipment and nozzle bonded to the helicopter before starting the refueling operation. To control spills, self-closing nozzles will be used and not blocked open or dragged along the ground. Additionally, a fuel catchment pan will be placed beneath the helicopter to prevent spillage onto the ground.

18.6 Canopy Baiting Air Operations (Short-Haul)

The following information serves as an overview of short-haul procedures and guidelines to be followed. Refer to *Helicopters Otago Ltd, Human Slung Operations* and the *Department of the Interior Helicopter Short-Haul Handbook, February 2010 (351 DM 1)* for full detail.

18.6.1 Definition

Short-haul: To transport one or more persons suspended beneath a helicopter (**HEC** – human external cargo.)

18.6.2 PPE

PPE shall be worn in accordance with the DOI Helicopter Short-Haul Handbook during short-haul training and operations.

18.6.3 Operations

All flight operations have a certain inherent degree of risk associated with them. Training and the judicious use of available resources, including helicopters, can help reduce the degree of risk associated with a particular mission. Risk assessment and the fact that it must be an on-going process during an operation are vitally important to a short-haul program. Risk assessment is the subjective analysis of physical hazards and operational procedures used to arrive at a GO/NO-GO decision. Risk assessments support informed GO/NO-GO decisions, which are the responsibility of line management. The pilot retains final authority for a GO/NO-GO decision when safe operation of the aircraft is a factor.

18.6.3.1 Personnel

Operational personnel shall consist of the Canopy Baiting Pilot (CBP), Spotter, and Canopy Baiter-Air Operations (CB-A). Ground support will include the Canopy Baiting Leader-Air Operations (CBL-A), as well as a site controller, and the Helicopter Refueling and Maintenance Specialist.

18.6.3.2 Briefing

A briefing shall be provided by the CBL-A prior to short-haul operations and must include the pilot and all persons involved in the operation. As a minimum, the following shall be addressed during the mission briefing:

- Risk Assessment
- Nature of the Mission
- Location
- Terrain
- Weather
- Landing Areas
- Individual Responsibility
- Hazards
- Safety Considerations
- Emergency Procedures

NOTE: Risk assessment is an on-going process, to be applied throughout the operation.

18.6.3.3 Communication

The CBP shall maintain two-way communication with the Spotter, CB-A and ground crew at all times. In the event of the loss of two way communication, the use of standardized hand signals will be used to conduct operations.

18.6.3.4 Canopy Bait Application

Prior to commencement of baiting, the Spotter and CB-A will conduct a safety check of themselves and each other (buddy check). Inspection will work from head to toe and will adapt to specific equipment used. The CBP shall rig the helicopter with the necessary equipment. The Spotter will complete a secondary check of the rigged equipment prior to commencing operations. A final buddy check will be completed immediately prior to actual short-haul operation commencing.

Coordination between the CBP, Spotter, and CB-A is essential for the safe and efficient completion of short-haul missions. During lift-off and canopy bait application it is important that the CB-A communicate to the CBP what is occurring on the end of the line. After lift-off the CBP will position the CB-A over the treatment area. The CB-A will communicate with the CBP to provide direction for positioning and proper application of the bait into the palm crowns. After the selected crown is baited, the CB-A will advise the CBP, who will in turn reposition to the next application location. The spotter is responsible for assisting the pilot in determining proximity of obstacles, as well as be alert to other hazards. Care will be taken to monitor the status of the CB-A. To prevent fatigue, alternate CB-A's will be rotated through as conditions dictate.

18.6.4 Emergency Procedures

Preplanning for emergency procedures is a critical component of risk management. Accordingly, Canopy Baiting-Air Operations personnel and project management must evaluate and discuss, in depth, the variety of potential scenarios and actions that may best mitigate any associated hazards. It is imperative that potential emergency scenarios, actions and reactions likely required of all involved personnel are discussed as thoroughly as possible prior to flight.

"Takeoffs are optional, landings are mandatory!"

For detailed information concerning Emergency Procedures refer to the *Department of the Interior Helicopter Short-Haul Handbook (351 DM 1).*

19 APPENDIX B: BAIT TRACKING WORKSHEET

Load Number	Application Number	Block ID(s)	Helicopter ID	Bucket Type	Disc Size	Bait Out (kg)	Bait In (kg)	Cumulative TracMap Area (ha)	Notes
1	A1D1*	2	N8E	D80	60	200	0	2.5	

*Example values (red text) presented for Load 1

20 APPENDIX C: DEVIATION FROM OPERATIONAL PLAN FORM

Deviation from the Operational Plan Form: Palmyra Atoll Rat Eradication Project

Requested by		**Change #**	
Topic		**Date Submitted**	

Description of Change:

Potential EPA Label violation? ☐ YES ☐ NO
If no, why not – point to the label instruction that made you conclude "NO". If "YES," why?

Need to call USDA/USEPA for consultation on label interpretation? ☐ YES ☐ NO
If "NO," why not? If "YES", who called, when? Attach notes from discussion.

Effect on Non-target risk, Efficacy, and Project Cost		
Non-target risk	**Efficacy**	**Project Cost**

Fish and Wildlife Service Approval:

Name: _____ Signature _____ Title: _____ Date: _____

The Nature Conservancy Approval:

Name: _____ Signature _____ Title: _____ Date: _____

Island Conservation Approval:

Name: _____ Signature _____ Title: _____ Date: _____