Baker Island National Wildlife Refuge

Comprehensive Conservation Plan

Prepared by:

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Approved: ______________________ Sept 24, 2008

Regional Director, Region 1 **Date**

Baker Island National Wildlife Refuge
Comprehensive Conservation Plan
Approval Submission
U.S. Fish and Wildlife Service, Region 1

In accordance with the National Wildlife Refuge System Administration Act, as amended, the U.S. Fish and Wildlife Service completed a Comprehensive Conservation Plan (CCP) for Baker Island National Wildlife Refuge (Refuge). The purpose of this CCP is to specify a management direction for the Refuge for the next 15 years. The goals, objectives, and strategies for improving Refuge conditions—including the types of habitat we will provide, partnership opportunities, and management actions needed to achieve desired conditions—are described in the CCP. The Service's preferred alternative for managing the Refuge and its effects on the human environment, are described in the CCP as well.

This CCP is submitted for the Regional Director's approval by:

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Don Palawski, Project Leader ——— Date
Pacific Remote Islands National Wildlife Refuge Complex

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Regional Chief, National Wildlife Refuge System

FINDING OF NO SIGNIFICANT IMPACT

Baker Island National Wildlife Refuge Comprehensive Conservation Plan

Unincorporated U.S. Territory, Central Pacific Ocean

The U.S. Fish and Wildlife Service (Service) has completed the Comprehensive Conservation Plan (CCP) and Environmental Assessment (EA) for Baker Island National Wildlife Refuge (Refuge). The CCP will guide management of the Refuge for the next 15 years. The CCP and EA describe the Service's preferred alternative for managing the Refuge and its effects on the human environment.

Decision

Following comprehensive review and analysis, the Service selected Alternative B in the draft EA for implementation because it is the alternative that best meets the following criteria:

- Achieves the mission of the National Wildlife Refuge System.
- Achieves the purposes of the Refuge.
- Will be able to achieve the vision and goals for the Refuge.
- Maintains and restores the ecological integrity of the habitats and plant and animal populations at the Refuge.
- Addresses the important issues identified during the scoping process.
- Addresses the legal mandates of the Service and the Refuge.
- Is consistent with the scientific principles of sound wildlife management.
- Can be implemented within the projected fiscal and logistical management constraints associated with the Refuge's remote location.

As described in detail in the CCP and EA, implementing the selected alternative will have no significant impacts on any of the natural or cultural resources identified in the CCP and EA.

Public Review

The planning process incorporated a variety of public involvement techniques in developing and reviewing the CCP. This included three planning updates, meetings with partners, and public review and comment on the planning documents. The details of the Service's public involvement program are described in the CCP.

Conclusions

Based on review and evaluation of the information contained in the supporting references, I have determined that implementing Alternative B as the CCP for management of Baker Island National Wildlife Refuge is not a major Federal action that would significantly affect the quality of the human environment within the meaning of section 102(2) (C) of the National Environmental Policy Act of 1969. Accordingly, the Service is not required to prepare an environmental impact statement.

This Finding of No Significant Impact and supporting references are on file at the Pacific Remote Islands National Wildlife Refuge Complex, 300 Ala Moana Blvd, Room 5-211, Honolulu, Hawaii, 96850 and U.S. Fish and Wildlife Service, Division of Planning and Visitor

This Finding of No Significant Impact and supporting references are on file at the Pacific Remote Islands National Wildlife Refuge Complex, 300 Ala Moana Blvd, Room 5-211, Honolulu, Hawaii, 96850 and U.S. Fish and Wildlife Service, Division of Planning and Visitor Services, 911 NE 11th Avenue, Portland, Oregon, 97232. These documents can also be found on the Internet at http://pacific.fws.gov/planning/. These documents are available for public inspection. Interested and affected parties are being notified of our decision.

Supporting References

U.S. Fish and Wildlife Service. 2007. Baker Island National Wildlife Refuge: Draft Comprehensive Conservation Plan and Environmental Assessment.

U.S. Fish and Wildlife Service. 2008. Baker Island National Wildlife Refuge: Comprehensive Conservation Plan.

Regional Director

Sept 24, 2008
Date

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Chapter 1: INTRODUCTION

Introduction

This document is a Comprehensive Conservation Plan for Baker Island National Wildlife Refuge (Baker). The CCP guides management of refuge operations, site visitation, and habitat restoration for the 15-year life of the plan. Guidance within the CCP is in the form of goals, objectives, strategies (Chapter 3), and wilderness study findings (Appendix F). The CCP was revised as appropriate based upon public comments. The refuge manager of the Pacific Remote Islands National Wildlife Refuge Complex (Remotes Complex) in Honolulu, Hawaii, is responsible for implementing the CCP.

The U.S. Fish and Wildlife Service

Baker is managed by the Service, within the U.S. Department of the Interior. The Service is the primary Federal entity responsible for conserving and enhancing the Nation's fish and wildlife populations and their habitats. Although the Service shares this responsibility with other Federal, State, tribal, local, and private entities, the Service has specific trust resource responsibilities for migratory birds, threatened and endangered species, certain anadromous fish, certain marine mammals, coral reef ecosystems, wetlands, and other special aquatic habitats. The Service also has similar trust responsibilities for the lands and waters it administers to support the conservation and enhancement of all fish and wildlife and their associated habitats.

National Wildlife Refuge System

President Theodore Roosevelt established Pelican Island, Florida as the first national wildlife refuge in 1903. Since that time, the number of refuges has expanded to include 548, totaling approximately100 million acres. These refuges, found in every state and several U.S. Territories, are administered collectively as a national system of lands with the specific mandate of managing for "wildlife first." This System is the largest collection of lands specifically managed for fish and wildlife conservation in the Nation and perhaps the world. The "wildlife first" mandate of the System means the needs of wildlife and their habitats take priority on refuges, in contrast to other public lands that are managed for multiple uses. The following is a description of some of the most relevant acts and policies that guide the management of the System.

National Wildlife Refuge System Administration Act of 1966, as amended

The NWRS Administration Act defines a unifying mission for all refuges, including a process for determining compatible uses on refuges, and requiring that each refuge be managed according to a CCP. The NWRS Administration Act expressly states that wildlife conservation is the priority of System lands and that the Secretary shall ensure that the biological integrity, diversity, and environmental health of refuge lands are maintained. Each refuge must be managed to fulfill the specific purposes for which the refuge was established and the System mission. The first priority of each refuge is to conserve, manage, and if needed, restore fish and wildlife populations and habitats according to its purpose. The Service has statutory authority under the NWRS Administration Act to regulate activities that occur on water bodies "within" a refuge. The NWRS Administration Act requires a CCP be completed for each refuge and that the public has an opportunity for active involvement in plan development and revision. It is Service policy that each CCP is developed in an open public process.

National Wildlife Refuge System Mission and Goals and Purposes (601 FW1)

In July 2006, the Service issued a policy (601 FW 1) which included the NWRS mission statement and NWRS goals, and described how refuge purposes are determined.

The NWRS Administration Act established the following statutory mission for the System:

> "The mission of the System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans."

The administration, management, and growth of the System are guided by the following goals (601 FW 1, July 2006)…."

- Conserve a diversity of fish, wildlife, and plants and their habitats, including species that are endangered or threatened with becoming endangered.
- Develop and maintain a network of habitats for migratory birds, anadromous and interjurisdictional fish, and marine mammal populations that are strategically distributed and carefully managed to meet important life history needs of these species across their ranges.
- Conserve those ecosystems, plant communities, wetlands of national or international significance, and landscapes and seascapes that are unique, rare, declining, or underrepresented in existing protection efforts.
- Provide and enhance opportunities to participate in compatible wildlife-dependent recreation (hunting, fishing, wildlife observation and photography, and environmental education and interpretation).
- Foster understanding and instill appreciation of the diversity and interconnectedness of fish, wildlife, plants, and their habitats.

Lastly, the NWRS Administration Act describes refuge purposes, and how these guiding principals for the refuge are located and documented.

Appropriate Refuge Uses (603 FW1)

This policy (603 FW 1), published in July 2006, provides a national framework for determining appropriate refuge uses. Serving as a "prescreening" for proposed uses of a national wildlife refuge prior to a compatibility determination (see below); this policy requires—for most uses—a written finding of appropriateness by the refuge manager based on 11 criteria. Findings of appropriateness require concurrence by the State for refuges located within state boundaries. These criteria include:

- Promotes safety of participants, other visitors, and facilities.
- Promotes compliance with applicable laws, regulations, and responsible behavior.
- Minimizes or eliminates conflicts with fish and wildlife populations or habitat goals or objectives in a plan approved after 1997.
- Minimizes or eliminates conflicts with other compatible wildlife-dependent recreation.
- Minimizes conflicts with neighboring landowners.
- Promotes accessibility and availability to a broad spectrum of the American people.
- Promotes resource stewardship and conservation.
- Promotes public understanding and increases public appreciation of America's natural resources and our role in managing and protecting these resources.
- Provides reliable/reasonable opportunities to experience wildlife.
- Uses facilities that are accessible and blend into the natural setting.
- Uses visitor satisfaction to help define and evaluate programs.

Compatibility (603 FW2)

Lands within the System are different from other, multiple-use public lands in that, with few exceptions, they are closed to all public access and use unless specifically and legally opened (603 FW 2). No refuge use may be allowed unless it is determined to be compatible. A compatible use is one that, in the sound professional judgment of the refuge manager, would not materially interfere with or detract from the fulfillment of the mission of the Service or the purpose of the refuge. The NWRS Administration Act identifies six wildlife-dependent recreational uses: hunting, fishing, wildlife observation, photography, environmental education, and interpretation. When compatible, these six uses become priority uses of the System. As priority public uses, they receive special consideration over other general public uses in refuge planning and management.

Biological Integrity, Diversity, and Environmental Health (601 FW3)

The NWRS Administration Act directs the Service to "ensure that the biological integrity, diversity, and environmental health of the System are maintained for the benefit of present and future generations of Americans…" This policy (601 FW 3) is an additional directive for refuge managers to follow while achieving refuge purpose(s) and System mission. It provides for the consideration and protection of the broad spectrum of fish, wildlife, plants, and their habitat resources found on refuges and associated ecosystems. When evaluating the appropriate management direction for refuges, refuge managers would use sound professional judgment to determine their refuges' contribution to maintenance and, where possible, restoration of biological integrity, diversity, and environmental health (BIDEH) at multiple landscape scales. Sound professional judgment incorporates field experience, knowledge of refuge resources, refuge functions within an ecosystem, applicable laws, and best available science, including consultation with others both inside and outside the Service.

Wilderness (602 FW 3)

Service planning policy (602 FW 3) requires the conduct of a wilderness review in association with the development of a refuge CCP. The wilderness review process has three phases: inventory, study, and recommendation. After first identifying lands and waters that meet the minimum criteria for wilderness during the inventory phase, the resulting wilderness study areas are further evaluated to determine if they merit recommendation from the Service to the Secretary of the Interior (Secretary) for inclusion in the National Wilderness Preservation System. A more complete discussion of wilderness inventory, study, and recommendation is included in Appendix F.

General Guidelines for Wildlife-Dependent Recreation (605 FW1)

This set of policies (605 FW 1-7), published in July 2006, defines the System's wildlife-dependent recreation policy, provides guidelines used to manage wildlife-dependent recreation on refuge lands and identifies visitor service standards.

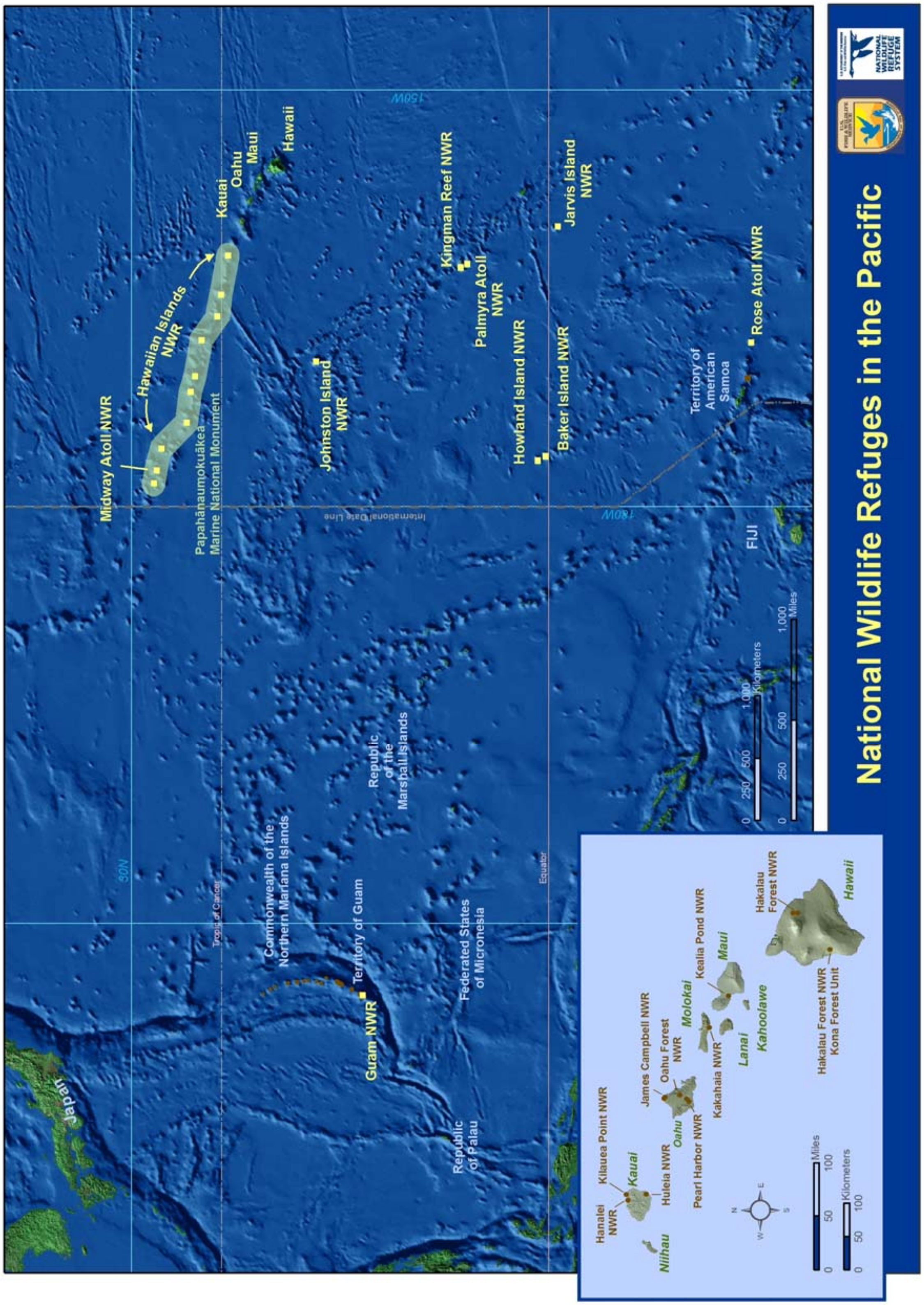
National Wildlife Refuges in the Pacific

Nineteen individual NWRs are scattered across the central and western Pacific Ocean, with several refuges located on the main Hawaiian Islands and others found from Guam to American Samoa (Figure 1.1). The Hawaiian and Pacific Islands NWR Complex, which provides administrative guidance and oversight for these 19 refuges, is located in Honolulu, Hawaii. This Complex also co-manages the newly established Papahānaumokuākea Marine National Monument, along with the National Oceanic and Atmospheric Administration and the State of Hawaii.

Within this administrative structure is a subset of seven refuges known as the Remotes Complex. The Remotes Complex straddles the Equator near the center of the Pacific Ocean. They are farther from human population centers than any other U.S. area and represent one of the last frontiers and havens for fish and wildlife in the World. These remote refuges are the most widespread collection of coral reef and seabird/shorebird protected areas on the planet under a single country's jurisdiction. Only one of these seven refuges, Palmyra Atoll NWR, has on-island dedicated staff members. Remotes Complex staff, located within the complex office in Honolulu, manage all the remaining refuges, including Baker. Staff, funding, and logistical support are often shared among these remote refuges to help defray operational costs.

The Baker CCP identifies several management strategies that are dependent upon activities and staff support from the Remotes Complex office, ship transportation support from other Federal agencies, or the establishment of partnerships with other organizations. Because of the great distances involved in traveling to these remote refuges, most management activities, including the simple act of visiting a refuge, are sometimes planned to occur concurrently during the same voyage. For this reason, cost estimates for management activities at Baker are pro-rated amongst the seven Remotes Complex refuges.

Figure 1.1 Map of National Wildlife Refuges in the Pacific.



Refuge Establishment, Purpose, and Boundary

Refuge Establishment

Baker Island is an unincorporated territory under the sovereignty of the United States. The Secretary of the Interior has broad authority over the territories of the United States by virtue of the Act of March 1, 1873, (43 U.S.C. 1458) which transferred general authority "…to perform all duties in relation to the Territories of the United States…" from the Secretary of State to the Secretary of the Interior. In addition, President Franklin D. Roosevelt signed Executive Order 7368 on May 13, 1936, also placing control and jurisdiction of Baker Island with the Secretary of the Interior. Further, pursuant to the provisions of the Reorganization Act of 1949, the Secretary of the Interior is authorized under Reorganization Plan No. 3 of 1950 to re-delegate to any officer or agency within the Department of the Interior any of the functions legally under his jurisdiction.

Under the authority of Reorganization Plan No. 3, the Secretary of the Interior, on June 27, 1974, designated Baker Island and its territorial sea extending to the 3 nautical mile (nmi) limit as a unit of the National Wildlife Refuge System to be "administered under the general regulations for the National Wildlife Refuge System published in Title 50, Code of Federal Regulations"(39 FR 27930). Section 25.21 of these regulations state that "…all areas included in the National Wildlife Refuge System are closed to public access until and unless we open the area for a use or uses in accordance with the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee), the Refuge Recreation Act of 1962 (16 U.S.C. 460k-460k-4) and this subchapter C." Baker Island National Wildlife Refuge remains closed to public access.

Refuge Purpose

Refuge purposes are often times are based upon land acquisition documents and authorities. These statements give indications for the biological reason or justification for the acquisition or land transfer. Purposes listed in acquisition authorities, or legislative acts, are often general in scope. For Baker, this general purpose is:

> "...for the development, advancement, management, conservation, and protection of fish and wildlife resources..." (16 U.S.C. 742f (a) (4)), and "...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude..." (16 U.S.C. 742f (b) (1)) (Fish and Wildlife Act of 1956).

Acquisition documents often contain more specific purpose statements. The specific purpose statement for establishment of Baker identified in the biological ascertainment report at the time of transfer to the Service is (USFWS 1973):

> "…the restoration and preservation of the complete ecosystem, terrestrial and marine. Priority must be given to allowing seabird nesting colonies to reestablish themselves on Baker so eventually they would eventually reach the great numbers which were present there prior to human occupancy and abuse of the island during the past 125 years."

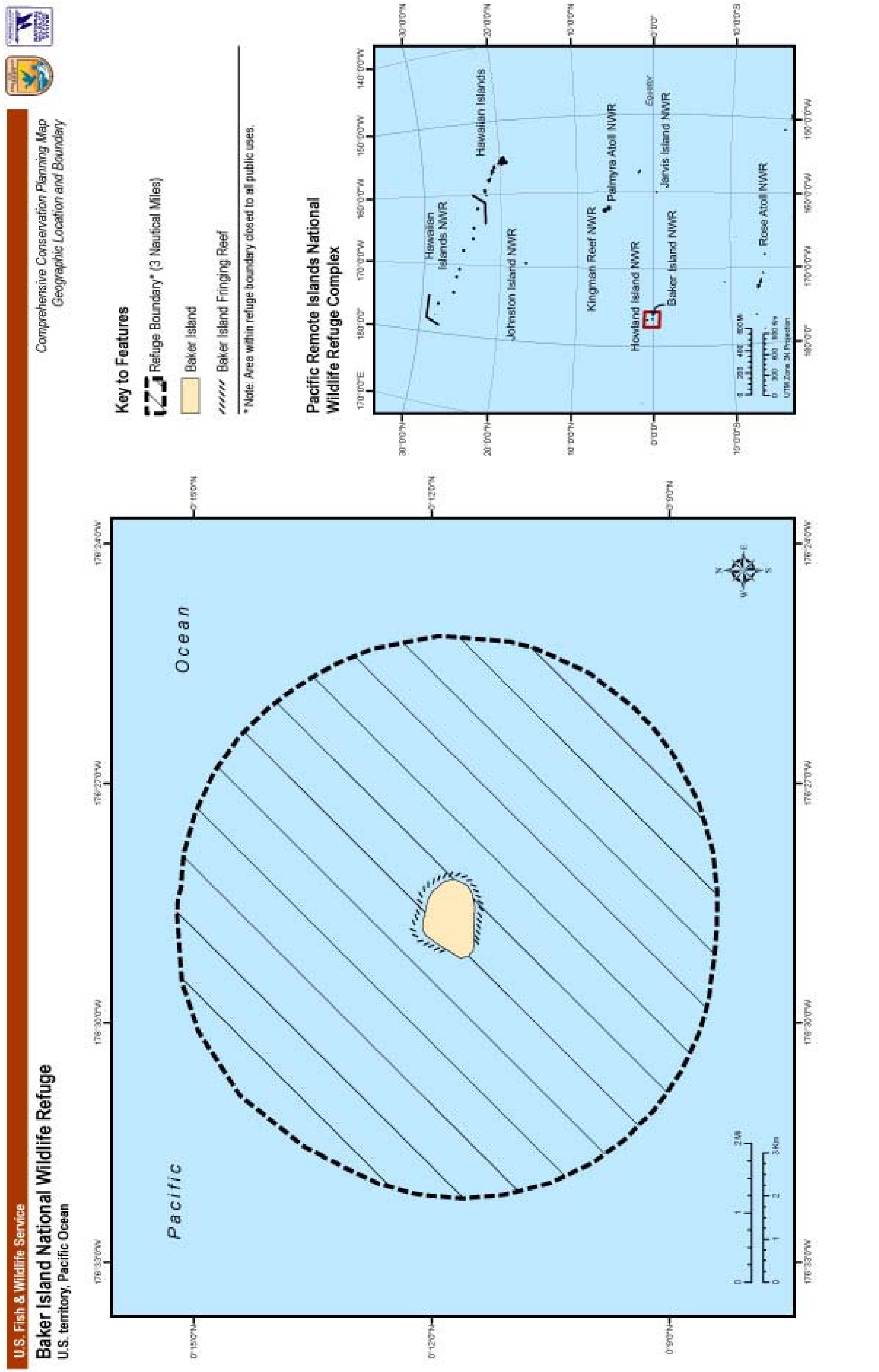
Refuge Boundary

Baker is located in the central equatorial Pacific Ocean (Figure 1.2). The boundary for Baker includes:

> "...all of Baker island…together with its territorial sea extending outward to the three-mile limit." (39 F R 27930).

The emergent land area for Baker encompasses 531 acres and submerged lands and waters within the 3-mile limit encompass 31,378 acres, for a total of 31,909 acres.

Figure 1.2 Baker Island National Wildlife Refuge: Geographic Location and Boundary.



Regional and Ecosystem Conservation Plans

Regional and ecosystem conservation plans and initiatives are also important to evaluate and incorporate into developing each CCP. These plans typically address issues or concerns that are site specific or of regional concern, and address needs more current than when the refuge was established.

Remote Islands Ecosystem Plan: Howland Island, Baker Island, and Jarvis Island National Wildlife Refuges

The ecosystem plan for Howland, Baker, and Jarvis identifies Baker as "…a model of both the sensitivity of insular ecosystems and mechanisms by which they can recover following disturbance" (USFWS 1998b). The plan further describes the refuge as being important to nesting seabirds due to the fact that other nearby islands have introduced mammals or human colonists present, thereby precluding survival of some vulnerable seabird species.

Coral Reef Initiative in the Pacific: Howland Island, Baker Island, and Jarvis Island National Wildlife Refuges

The Coral Reef Initiative for Howland, Baker, and Jarvis restates the wildlife and ecological values identified in the ecosystem plan (USFWS 1998a). This document identifies three important components of the three ecosystems: "They provide a breeding platform for pelagic birds using large areas of ocean surface, offer a migratory stopover for long distance migrating shorebirds, and furnish reef habitat for shallow water organisms."

Recovery Plan for U.S. Pacific Populations of the Hawksbill Turtle (*Eretmochelys imbricata*)

Although theoretically within the range for hawksbill turtle, little is known about their biology, foraging and nesting behavior, threats, and distribution surrounding Baker Island (NMFS and USFWS 1998a). Both the NOAA – National Marine Fisheries Service (NMFS) and the Service share responsibility at the Federal level for the research, management, and recovery of Pacific marine turtle populations under U.S. jurisdiction.

Recovery Plan for U.S. Pacific Populations of the Green Turtle (*Celonia mydas*)

Few green turtles are known to forage in the waters surrounding Baker Island and nesting is not known to occur. However, data from the area are limited and use of Baker may be greater than currently documented (NMFS and USFWS 1998b). Both NMFS and the Service share responsibility at the Federal level for the research, management, and recovery of Pacific marine turtle populations under U.S. jurisdiction.

U.S. Pacific Island Regional Shorebird Conservation Plan

This regional shorebird plan identifies Baker as being within the Central Pacific Islands Subregion (Engilis and Naughton 2004). No natural wetlands are known from this subregion; however, not only the beaches on uninhabited islands are important for shorebirds, but the entire island. Population and habitat goals for this subregion state that determining population size and trends for bristle-thighed curlews and other shorebirds, and their habitats is a management priority.

United States Shorebird Conservation Plan

This nationwide shorebird plan identifies the U.S. Pacific islands being of "...critical importance for two species of Holartic breeders, bristle-thighed curlew and Pacific golden-plover." (Brown et al. 2000). Further, this plan notes that these islands provide wintering habitat essential to the maintenance of these species as well as several other migratory shorebird species.

Seabird Conservation Plan, Pacific Region

This plan provides an overarching review, discussion, and identification of conservation priorities for seabirds in the U.S Pacific islands; ranks seabirds for conservation priority; and includes specific species accounts including their conservation needs (USFWS 2005).

Central Pacific World Heritage Project

The United Nations Educational, Scientific and Cultural Organization (UNESCO) organized and convened meetings in Honolulu in June 2003, and Kiritimati Atoll in October 2004, to seek input for a proposed multi-national World Heritage project now referred to as the Central Pacific World Heritage Project (CPWHP) (UNESCO World Heritage Centre, 2003; 2004). Additional meetings and evaluations in the U.S. and Republic of Kiribati resulted in a total of 29 atolls, islands, and reefs belonging to four nations (United States, Cook Islands, Republic of Kiribati, and French Polynesia) being proposed for the multi-site, multi-jurisdictional CPWHP. To date, the Service has not acted on this proposal, but intends to do so in the future. However, the Republic of Kiribati is drafting a World Heritage Nomination dossier for all eight Phoenix Islands under its jurisdiction to be submitted to UNESCO in early 2009. These islands are Baker's and Howland's closest neighbors.

Regional and ecosystem conservation plans and initiatives are also important to evaluate and incorporate into developing each CCP. These plans typically address issues or concerns that are site specific or of regional concern, and address needs more current than when the refuge was established.

Refuge Vision Statement

The refuge vision statement is a broad general statement that describes what the refuge staff perceives as Baker's fundamental attributes and contributions to a healthy world environment.

This statement will guide management activities for the lifespan of this plan, as well into the near future. The vision statement for Baker is as follows.

> *Baker is one of the only places in the world where the terrestrial and marine tropical island ecosystems have been restored, conserved, and protected. Although signs of past human activities are still visible on the landscape, the island now offers the opportunity to serve as a living laboratory for measuring past human impacts and the ability of nature to recover. Natural, physical, and ecological processes unfold with limited human interference and support a diverse community of native marine organisms including seabirds, marine mammals, turtles, fish, plants, corals, and other invertebrates. Nesting and foraging seabirds dominate the landscape and seascape while sheer isolation and solitude help us see our place in the natural world.*

Refuge Goals

Goal statements are succinct statements of a desired future condition of refuge resources. Goals comprise the whole of a refuge's effort in pursuit of its vision and lay the foundation from which all refuge activities arise. The goals for Baker are as follows, and will again be presented along with objectives and strategies in Chapter 3.

1. Conserve, restore, manage, and protect native terrestrial habitats that are representative of remote tropical Pacific islands, primarily for the benefit of seabirds.
2. Conserve, manage, and protect native marine communities that are representative of remote tropical Pacific islands.
3. Contribute to the recovery, protection, and management efforts for all native species with special consideration for seabirds, migratory shorebirds, federally listed threatened and endangered species, and species of management concern.
4. Restore the wilderness character of Baker's terrestrial community, and protect, maintain, enhance, and preserve the wilderness character of Baker's marine community.
5. Preserve Baker's biological, cultural and historic resources.
6. Inform and educate the public to increase their understanding of remote Pacific island NWRs wilderness values, cultural and historical resources, and their ecosystems, with special emphasis on seabirds.

Chapter 2: PLANNING, PURPOSE AND NEED, AND ISSUES

Planning Process

The CCP development process follows applicable policies contained within the Service's Fish and Wildlife Manual (Part 602 FW2.1, November 1996; Part 601 FW1, Part 603 FW1, and Part 605 FW1, June 2006), and the Wilderness Act of 1964 with respect to wilderness study and review. This CCP was completed in association with an EA and is intended to meet the dual requirements of compliance with the NWRS Administration Act and the National Environmental Policy Act (NEPA). Both the NWRS Administration Act and NEPA require the Service to actively seek public involvement in the preparation and adoption of environmental and conservation documents and policies. Furthermore, NEPA also requires the Service to consider a reasonable range of alternatives including its Preferred Alternative and the "No Action" alternative; the latter defined as continuation of current management practices.

Purpose and Need

Overall, all refuges must comply with the System mission, goals, and policies, as described in or promulgated by the National Wildlife Refuge System Administration Act of 1966 (NWRS Administration Act), as amended (16 U.S.C. 668dd-668ee). The National Wildlife Refuge System Improvement Act of 1997 amended the NWRS Administration Act. According to the NWRS Administration Act, a CCP is required to identify and describe refuge purpose(s), habitats and wildlife, archaeological and cultural values, administrative and visitor facilities, management challenges and their solutions, and opportunities for compatible wildlife-dependent recreation. The recreational activities referenced in the NWRS Administration Act as receiving special consideration during planning efforts include hunting, recreational fishing, wildlife observation, interpretation, environmental education, and photography.

The purpose of this CCP is to develop a vision, goals, and objectives for Baker, which in turn provide guidance to identify and implement management activities, or strategies, during the next 15 years. Specifically, the CCP:

- sets a long term vision;
- establishes wildlife and habitat management goals and objectives;
- establishes goals and objectives for compatible wildlife-dependent recreational and educational uses;
- identifies strategies for habitat enhancement and restoration projects;
- describes the highest monitoring and research priorities; and
- describes and evaluates wilderness values.

Baker and its management and administrative activities are managed as part of the NWRS or System within a framework provided by legal and policy guidelines. The refuge is guided by the mission and goals of the NWRS, the purpose of the refuge as described in its acquisition authority, Service policy, Federal laws and executive orders, and international treaties.

Supplemental guidance documents (e.g., resource plans) are also included in making management decisions but cannot replace or be in conflict with the purposes for which the refuge was established or the mission of the System

Planning Issues and Opportunities

Issues, concerns, and opportunities were identified through discussions with key contacts, workshop participants, core team members, other refuge staff, and through the public scoping process. The following section summarizes issues, concerns, and opportunities from all public input received throughout the planning efforts. Six issues were identified and are described below.

Issue 1: Operational Limitations

Baker is located approximately 1,690 nmi from the management staff located in Honolulu, Hawaii. On average, it takes 6-7 days to reach Baker by ship, the only method of visiting the island. The key issues and concerns affecting planning and management implementation are:

- distance from refuge headquarters;
- lack of affordable and reliable transportation;
- lack of infrastructure to support field operations;
- extreme environmental conditions; and
- safety concerns and logistical capacity to land people and equipment on island from small boats.

Issue 2: Biological and Ecological Resources

Biological and ecological information sufficient for management or conservation purposes is lacking. Due to the infrequency and limited staff time spent on Baker, biological and ecological information is not sufficient to allow for a detailed assessment of resources. The collection of baseline and long-term monitoring information should be a primary concern and the focus of management objectives.

Issue 3: External Forces

The threat of the introduction of invasive species from unauthorized visits, marine debris washing ashore and onto coral reefs, and vessel groundings are beyond current management control. Distance, lack of funds and staff, and the inability to have a more consistent presence on this refuge opens the opportunity for invasive species introductions, limits the ability to remove marine debris, and delays in the response to vessel groundings.

While it is known that past human use of the island has led to contaminants and debris being left on the island and in the surrounding surf, the extent and impact of the contamination and debris are largely unknown.

Global climate change (see Chapter 4) may also affect refuge resources, but is beyond control of refuge management staff. It is anticipated that changes in the chemical composition of the atmosphere and oceans; surface temperatures of air, land, and sea; intensity and frequency of rainfall and storm waves; and changes in sea level would have impacts on refuge resources. However, the extent and nature of these impacts is being studied and the subject of considerable academic debate.

Issue 4: Public Use Resources

The key issues related to public use are:

- adverse ecological impacts (invasive species introductions, pollution, fuel spills, trash disposal, harassment of wildlife, damage to sensitive habitats such as coral reefs);
- whether any on-site public use should be allowed;
- to what extent the use should occur; and
- how the use should be managed.

Baker Island Refuge has never been formally opened to public access and use. Administratively, public access to Baker is managed through use of a refuge-issued Special Use Permits (SUP). Several recreational user groups such as amateur radio operators, bird watchers, history enthusiasts, destination tourists, and commercial cruise vessels have expressed interest in visiting various remote Pacific island refuges. However, before a SUP could be issued, a request for public access would need to be evaluated for appropriateness and compatibility.

Issue 5: Education and Outreach

In general, Pacific island refuges are poorly recognized by the public and our partner agencies. There are few entrance signs, no boundary signs, and little published information in popular literature. Refuge boundaries are rarely portrayed on nautical charts and other maps.

The remote location and isolation of Baker and other Pacific island refuges make it difficult to conduct on-site visits for educational or interpretative purposes. Thus, most educational and interpretative opportunities are necessarily delivered remotely through various media.

In addition, general interest by the public and requests to visit remote Pacific island refuges by a growing recreational yachting community has increased recently. This interest requires the public to be better informed regarding sensitive refuge habitats, species, and regulations.

Issue 6: Communication and Cooperation

Baker's remoteness compels a growing list of partners and cooperators to be kept informed of and included in planning and management activities at Baker. Activities that staff and partner agencies/organizations share include:

- expedition planning;
- collaborative research projects; and
- protection of trust resources.

Most access for refuge staff to Baker has only been possible through the cooperation and participation with partner agencies such as NOAA and the U.S. Coast Guard. Many research interests are shared between Service and NOAA scientists, and collaborative research projects have been conducted in the past. Additionally, NOAA and the Service share trust resource responsibilities for marine turtles.

Chapter 3: MANAGEMENT DIRECTION

Overview

The Service reviewed and considered a variety of resource, logistic, social, and economic aspects important for managing the refuge when developing this long-term management plan. As is appropriate for a national wildlife refuge, resource conditions were fundamental in designing the CCP. Marine and terrestrial resources are equally important to the management of Baker, and are described more fully in Chapter 4. However, the logistics of reaching the island and associated coral reefs is the primary constraint on increasing or modifying the level of management and monitoring activity that has or currently occurs. To more fully understand this constraint, a description of the logistical requirements and refuge management activities follows.

Marine vessels capable of traveling the open ocean for extended periods are the only opportunity for transportation to Baker. In the recent years, NOAA, the U.S. Coast Guard, and private charter vessels have all provided transportation. A typical voyage originating from Honolulu, Hawaii will take approximately 6 to 7 days to arrive at Baker, possibly with intermediate stops at Palmyra Atoll or Johnston Atoll NWRs to economize on fuel and personnel costs. Once on-site, and if wind and wave conditions warrant the launch of a landing vessel (typically a small outboard type inflatable boat), the marine vessel will anchor or remain stationary during the deployment of the field camp, only venturing away from the island to complete marine surveys. The field camp itself generally consists of two individuals, typically biologists to carry out biological surveys and other duties, and camping gear consisting of tents, sleeping equipment, food, water, and needed survey equipment. Cooking gear is rarely deployed since staff is only on-island for 1 to 2 days with most of that time being engaged in work activities.

While on-island, the biologists document all bird species present, count individuals, determine if any and the extent of nesting, casually observe vegetation and record species presence or absence, or the presence of any invasive species, inspect boundary signs, inventory for the presence of invasive species, visit cultural resources, monitor and investigate contaminated sites, and collect and destroy of bird entrapments caused by rusting drums and other debris. The only active management that occurs during these site visits is: the collection and on-island stockpile of marine debris that washes ashore and poses a threat to seabirds and other wildlife that use Baker; the use of solar powered electronic calling devices to encourage additional seabird species to nest; and the development of funding proposals for island transportation and contamination monitoring and remediation. Any evidence of illegal activity such as unauthorized access is also documented. Photographs record general habitat conditions; however, further habitat assessment does not occur. Although no specific activities occur with respect to wilderness values, the simple fact that a 1 to 2 day field camp consisting of temporary lodging arrangements and minimal activity is consistent with maintaining the wilderness values of the area.

During the period that the biologists are on Baker, marine scientists from NOAA, the Service, and other partner organizations such as the University of Hawaii conduct surveys and monitoring activities of the surrounding marine environment. Some monitoring activities occur on-board the vessel, while others require the use of SCUBA equipment. All of the marine scientists, however, are based on the vessel awaiting the conclusion of terrestrial surveys or accomplishing marine surveys and thus do not come ashore. Marine scientists typically collect information on currents, weather, temperature, chemical composition of the water, and the abundance and distribution of coral and fish species. Specific marine-based surveys known as Rapid Ecological Assessments (REA) are conducted and collect ecological data such as fish species, abundance, and predator prey relationships. Data are also collected from permanently marked coral transects which document coral species, age class, and percent coral cover. These data are collected over a 2-day period (six 1-hour dives). Following the voyage, data from marine scientists are provided to the Service and includes a full range of oceanographic, bathymetric, and marine biological information.

Specific details of the management program are categorized below:

- *Baseline Monitoring of Wildlife Populations and Habitats*. Staff visits to Baker result in inventory and monitoring efforts, documenting species presence or absence, abundance, habitat condition, presence of invasive species and various other physical variables such as temperature, precipitation, wind, etc.
- *Voyage Preparation*. The logistics of providing adequate field camp supplies such as water, food, first aid, and communications occurs for each voyage.
- *Use of extraneous unnatural lighting.* Limiting and shading the lighting on vessels, camp, and nighttime operations minimizes the threat of collision and disorientation of wildlife that can be caused by light hazards.
- *Quarantine protocols and use of Integrated Pest Management (IPM)*. Visitors to Baker are required to wear new and frozen clothing and other quarantine precautions as outlined in quarantine protocols (Appendix E). The hand pulling of weeds occurs as time becomes available. Selective hand spray application of herbicides or pesticides, where appropriate, may occur.
- *Scientific Information Exchange*. Refuge staff currently attends various professional meetings and conferences related to Pacific island and marine resources. Additionally, a minimal amount of staff time is devoted to the development of peer reviewed journal articles and contributing to NOAA and Service-sponsored Web sites.
- *Preservation of Wilderness Values*. Since its establishment, Baker has been managed to preserve its wilderness values and characteristics even though it has never been proposed for wilderness designation. These values are intrinsic at this remote, uninhabited island and coral reef ecosystem. Management activities do not impinge on these values.
- *Public Access*. Since establishment, Baker has never been formally opened to public access and use. Access and public use remains closed. All individual opportunities for compatible use such as specific research projects are administered using individual SUPs.
- *Interpretation, Education, and Outreach.* Current opportunities for off-site education exist at the Maritime Museum, Honolulu, Hawaii. A hands-on exhibit representing a Pacific island refuge is maintained to educate school-aged students about seabirds, invasive species, marine debris, and the National Wildlife Refuge System (System). Interpretative displays are also used periodically at conventions and professional meetings.
- *Protection and Preservation of Cultural Resources*. Cultural resources remain intact and in situ. Field camps are situated to avoid impacts to cultural resource sites.

Archaeological reconnaissance to avoid impacts to cultural resources is required prior to management activity that would potentially disturb surface or subsurface resources.

- *Waste Disposal at Sea*. Disposal of waste in refuge waters is prohibited.
- *Waste Disposal on Island.* All waste from food products, equipment, and containers that is brought onto the island is removed during demobilization. Depending upon the duration of the site visit, human excrement will be either bagged, stored in a chemical toilet, or decomposed using portable biodegradable toilets, all of which are subsequently removed during field camp demobilization.
- *Refuge Boundary*. There are no proposed changes to the refuge boundary.
- *Baseline Contaminant Monitoring*. Refuge staff conduct baseline observations of known contaminated sites and record changes in condition since last site visit.
- *Cultural Resources Inventory.* Presence and condition of cultural resources on Baker is re-evaluated.
- *Wilderness Study Area*. A recommendation for Wilderness Study Area (WSA) designation is postponed until a Legislative Environmental Impact Statement (LEIS) and wilderness proposal are developed for all other remote Pacific island national wildlife refuges (NWRs) as part of their CCP processes.
- *Marine ecosystem monitoring*. Funding requests are required for additional exploration of deep slope resources by a ship equipped with a remotely operated vehicle (ROV) or manned submersible to operate at depths between 150 -3,000 feet.
- *Seabird Nesting Restoration*. Electronic calling devices are deployed and used as seabird nesting attraction stimuli designed to encourage nesting by Phoenix petrels (*Pterodroma alba*) and Polynesian storm petrels (*Nesofregetta fuliginosa*). These electronic call devices consist of solar powered speakers broadcasting calls of both species in suitable areas of the island. Both of these small ground-nesting Procellariforms are severely depleted or extirpated throughout much of their range. The absence of cats and rats at Baker Island makes it an ideal site within the species' original range to restore a breeding population of each of these petrel species.
- *Contaminant Investigation Proposal.* Refuge staff work cooperatively with Regional Office staff to develop funding and operational proposals to quantify contaminant concerns on Baker in preparation for remediation activities.

Once field operations are complete, or the weather becomes increasingly inclement, the field camp is demobilized and all equipment and personnel are transported back to the research vessel. Typically, the other two equatorial refuges (Howland and Jarvis) are also visited in this same manner. Travel time between Howland and Baker is 5 hours, and Baker and Jarvis is 4-5 days. Once the three surveys are completed, or at least attempted, the voyage continues with approximately 6 to 7 days to travel back to Honolulu, possibly with intermediate stops at Palmyra Atoll or Johnston Island NWRs, or continuing on for 4 days to Rose Atoll NWR and American Samoa where voyage scientists and biologists can be exchanged and then fly back to Honolulu. In total, it is expected that in order to visit Baker, Howland, and Jarvis, for 1 to 2 days per refuge, a biologist or marine scientist needs to devote 20 to 26 days total travel. Trip reports are completed, distributed, and filed once field staff return to the Honolulu office.

The only difference between the management condition prior to the completion of the CCP, and the actions described in this CCP is an increase in the frequency of staff visits from once every two years to once every year. In order to meet the increase in the number of site visits, refuge staff in Honolulu is administratively burdened to seek additional funding sources and develop partnerships for additional visits. This may take the form of producing internal project proposals (RONS), or seeking funding support through grants or partnerships with other agencies, research institutions, and non-government organizations. Overall, wildlife and habitat management activities remain consistent. The only additional terrestrial management activity is promoting nesting use by seabird species with the use of solar powered electronic calling devices. Polynesian storm-petrels calls would be placed near the coral slab habitat on the north beach crest. Increased monitoring in the marine environment depends upon partnership opportunities developed with NOAA, the University of Hawaii, or other partners. At a minimum, marine scientists would resurvey REAs and other transects. Transportation to and from the island relies upon NOAA or other partners. Public use and access remains closed.

The ability of the Service to meet the mission of the System, "…to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans."; and the refuge purpose of "…the restoration and preservation of the complete ecosystem, terrestrial and marine. Special consideration must be given to the protection of nesting seabird populations." is limited. A one to two day visit to the island once every year does not provide the opportunity for refuge staff to complete anything other than basic biological surveys of species presence or absence. Restoration, preservation, or protection of terrestrial and marine ecosystems, or nesting seabirds is not possible. However, lack of projected budget and staffing preclude management staff from increasing management activity beyond what is described in this CCP. If, during the lifetime of this plan, budget and staffing become available to pursue an increased level of management activity then the CCP will be reevaluated.

Goals, Objectives, Strategies, and Rationale

Goals and objectives are the unifying elements of successful refuge management. They identify and focus management priorities, resolve issues, and link to refuge purposes, Service policy, and the Refuge System Mission.

A CCP describes management actions that help bring a refuge closer to its vision. A vision broadly reflects the refuge purposes, the Refuge System mission and goals, other statutory requirements, and larger-scale plans as appropriate. Goals then define general targets in support of the vision, followed by objectives that direct effort into incremental and measurable steps toward achieving those goals. Finally, strategies identify specific tools and actions to accomplish objectives.

The goals for Baker over the next 15 years under the CCP are presented on the following pages. Each goal is followed by the objectives that pertain to that goal. The goal order does not imply any priority in this CCP. Some objectives pertain to multiple goals and have simply been placed in the most reasonable spot. Similarly, some strategies pertain to multiple objectives. Following the goals, objectives, and strategies is a brief rationale intended to provide further background information pertaining to importance of an objective relative to legal mandates for managing units of the System including refuge purpose, trust resource responsibilities (federally listed threatened and endangered species and migratory birds), and maintaining/restoring biological integrity, diversity, and environmental health.

Goal 1: Conserve, restore, manage, and protect native terrestrial habitats that are representative of remote tropical Pacific islands, primarily for the benefit of seabirds.

Objective 1a: Conserve, manage, and protect habitat for nesting seabirds.
Upon CCP approval and throughout the life of the CCP, conserve, manage, and protect a mosaic of approximately 531 acres of terrestrial habitat consisting of 31 acres of beach and beach strand, 300 acres as short grass and forbs, and 200 acres as bare ground on Baker Island as nesting habitat for 11 seabird species.
Strategies Applied to Achieve Objective
Conduct and record incidental observations of invasive species.
Adhere to strict quarantine protocols for all island visitors (see Appendix E).
Monitor contaminated areas. Remove entrapment hazards due to marine and other human debris not considered to be historically important.
Rationale:
The 11 nesting seabird species on Baker use all island habitats (see Chapter 3.9.1 and Appendix B). Masked and brown boobies prefer to nest on bare, open ground. Gray-backed, sooty, and white tern; and brown and blue-grey noddy also nest on the surface, but are tolerant of vegetated areas. Lesser frigatebirds, typically known as a shrub nesting species, are found exclusively on the ground at Baker. Red-tailed tropicbirds prefer shaded areas and can be found nesting on the surface, under coral slabs, or in shrubs. Red-footed booby and great frigatebird are the only two exclusive shrub nesting species. However, due to the few shrubs on Baker, red-footed boobies have been seen to nest on the ground. The Seabird Conservation Plan – Pacific Region (USFWS 2005) recognizes remote Pacific islands as providing important and varied breeding habitat, specifically Baker as being important for ground nesting species. Additionally, the plan recognizes that near-shore waters provide areas of upwelling currents with important food resources for seabirds. Maintaining the island free of mammalian predators, invasive insects, and invasive plants is critical for seabird survival (USFWS 2005). Strict quarantine protocols have been previously established for all island visitors in order to eliminate the threat of introducing invasive plants, insects, and animals (see Appendix E). Marine and other human generated debris poses an entrapment and entanglement threat for multiple wildlife species. Destruction of rusting drums and stockpiling debris can reduce the overall area impacted, thereby reducing the threat.

Objective 1b: Increase baseline information on terrestrial habitat.
Within 15 years of the CCP approval, conduct monitoring to determine vegetation species presence/absence and distribution on Baker Island.

Strategies Applied to Achieve Objective
Document presence/absence of island vegetation.
Coordinate with Regional Office GIS staff to assess and/or develop remote sensing capability to map and monitor island habitats.
Rationale:
In general, insufficient time has been spent on Baker to adequately quantify the habitat, and how this habitat relates to seabird biology. Collection of baseline biological information is essential to adequately understand and manage the refuge. Although it is known that the 11 nesting seabird species use all habitats on Baker, this information has only been obtained from the short duration, infrequent visits (1 to 2 days every 2 years) to the island. There has been no quantitative assessment of breeding species habitat associations. The distribution and delineation of habitats itself has been estimated, but never been quantified. Remotely collected data may provide an option for data collection in the absence of being capable of visiting Baker.

Objective 1c: Survey and monitor refuge to document contamination.
Within 10 years of the CCP approval, monitor approximately 100 acres of known contamination and survey remainder of island to determine if contamination level is above the EPA threshold value for designation on the NPL under CERCLA.
Strategies Applied to Achieve Objective
Document presence and extent of known contamination.
Coordinate with the responsible parties such as the Coast Guard to conduct the Site Investigation.
If the responsible parties are not willing to conduct the Site Investigation, obtain Service funding through the Refuge Cleanup Fund.
Coordinate with regional office contaminants staff to develop funding/operational package to conduct monitoring activity.
Coordinate and consult with EPA in design and conduct of follow-up Site Investigation.
Rationale:
In general, insufficient time has been spent on Baker to adequately quantify the extent of contamination on Baker. A Site Investigation is used by EPA to determine if areas of the island or surrounding waters are unacceptably contaminated. If so, the responsible parties for the contamination, i.e., Navy, Army, and the Coast Guard will have the responsibility to clean up the site. To date, the Site Investigation conducted by Foster Wheeler in 1998 was inconclusive and unacceptable to EPA and the Service. The Service now has the responsibility to determine if Baker meets CERCLA criteria. Further and follow up monitoring is required by the Service before NPL determination can be made.

Objective 1d: Remediate contaminated areas of Baker
Within 15 years of the CCP approval, begin remediation activities on all contaminated areas of Baker.
Strategies Applied to Achieve Objective
Cooperate and coordinate with the U.S. Coast Guard or Army to remediate contaminated areas of Baker.
Institute a long-term monitoring program after remediation

If required, develop a Service funding request for cleanup through the Refuge Cleanup Fund.
Rationale:
A Site Investigation is used by EPA to determine if areas of the island or waters are unacceptably contaminated. If so, the responsible parties for the contamination, (i.e., the Navy, Army, and the Coast Guard) have the responsibility to clean up the site. To date, the Site Investigation conducted by Foster Wheeler in 1998 was inconclusive and unacceptable to EPA and the Service to determine if Baker meets NPL criteria. If these criteria are met, then it will increase the priority for remediation by the responsible parties. For the Navy and Army, responsibility for Formerly Used Defense Sites (FUDS) has been delegated through the Defense Environmental Restoration Act (DERA) to the U.S. Army Corps of Engineers (ACOE). Unfortunately, Baker can not meet the criteria used by FUDS to become a priority site. Therefore, the ACOE through FUDS will not be able to remediate contaminated lands or waters at Baker. Remediation will only be possible through the Coast Guard environmental program or if funding becomes available through the Service's Refuge Cleanup Funds. It will be incumbent upon Service staff to work cooperatively with the responsible parties or their delegates and the EPA to coordinate and complete remediation activities.

Goal 2: Conserve, manage, and protect native marine communities that are representative of remote tropical Pacific islands.

Objective 2a: Conserve, manage, and protect marine habitat.
Upon CCP approval, conserve, manage, and protect approximately 31,378 acres of submerged lands consisting of an estimated 3,000 acres coral reef and 28,378 acres of deep water/pelagic habitat on Baker.
Strategy Applied to Achieve Objective
Continue and expand partnership with NOAA and other research institutions to manage coral reef ecosystems.
Rationale:
The conservation and protection of the Nation's coral reefs is becoming increasingly important for agencies with responsibility to manage and conserve those (Executive Orders 13089 and 13158). Because the refuge boundary for Baker extends to 3 nmi from the island shoreline, all coral reefs are contained within the refuge boundary. Threats to the coral reef system include invasive species such as crown-of-thorns starfish and marine debris (e.g., abandoned fishing gear, sunken landing craft) that collects on corals, smothering or breaking them. The responsibility for protecting, managing, and conserving coral reef ecosystems is shared with NOAA. The Service and NOAA often participate in joint management activities throughout the Pacific; however, no active management activities have occurred at Baker.

Objective 2b: Increase baseline information on marine community.
Within 15 years of CCP approval, monitor: coral species density, diversity, and size and spatial distribution; fish species presence/absence and habitat associations; turtle species presence/absence; marine mammal species presence/absence; and oceanographic conditions in relation to climate change effects.
Strategies Applied to Achieve Objective
Conduct and record incidental observations of corals, fish, turtles, marine mammals, and their habitats.

Accompany NOAA or other scientific partners on marine surveys.
Conduct REA and resurvey permanent transect sites to document coral, fish and turtle density, diversity, distribution, and habitat associations.
Develop proposals and conduct deep slope marine surveys by ROV or manned submersible to document presence/absence, abundance and distribution of deep slope coral and fish species.
Rationale:
The status of marine resources in much of the Refuge is still largely unknown. Unless weather conditions preclude the work marine surveys are conducted throughout the entire time that the marine transport vessel is at Baker. Additionally, since most site visits to Baker are aboard NOAA research vessels, the purpose of these voyages is to conduct marine surveys and studies. Consequently, a full compliment of up to 20 marine researchers and 40 support staff contribute to conducting marine surveys across all alternatives. As a result, marine surveys are more comprehensive than terrestrial surveys on Baker. REAs and permanent transect resurveys constitute baseline monitoring of the marine ecosystem, and are one component of all alternative strategies. Additional surveys (e.g., marine mammals, deep slope), as described beginning with Alternative B can be achieved as components of cooperative efforts with other agencies or research organizations. As an example, little is known of marine mammal use surrounding Baker, although it is known that some species are found in the vicinity. The Marine Mammal Commission has encouraged the Service to generate partnerships with NOAA to help document baseline information. Developing additional partnerships with NOAA or other organizations may also assist in meeting terrestrial objectives by providing the opportunity for additional trips to Baker.

Goal 3. Contribute to the recovery, protection, and management efforts for all native species with special consideration for seabirds, migratory shorebirds, federally listed threatened and endangered species, and species of management concern.

Objective 3a: Develop baseline migratory bird and other species information.
Within 10 years of CCP approval, conduct monitoring to determine: seabird species presence/absence, relative abundance, breeding chronology, distribution, and habitat use; presence/absence of shorebirds; presence/absence and distribution of sea turtles; and presence/absence of terrestrial invertebrates on Baker Island. The desired conditions by which this will be met is understanding of the complete annual chronology for 5 of 11 nesting seabird species; population trend data over the 10-year period for all 11 nesting seabird species; and the presence/absence and distribution of shorebirds, turtles and other terrestrial invertebrates.
Strategy Applied to Achieve Objective
Record incidental observations of all species presence/absence, relative abundance, and distribution.
Rationale:
The Seabird Conservation Plan (USFWS 2005) repeatedly recognizes the importance of the U.S. Pacific Islands in providing predator-free seabird nesting and roosting environments.

Their protected status, in concert with nearby marine forage resources contribute to their importance. The Seabird Conservation Plan further identifies population monitoring inventories as insufficient to accurately detect or monitor populations, suggesting instead that a rigorous collection of population data is needed. In addition to Baker being recognized as important habitat for seabirds, the U.S. Pacific Islands Regional Shorebird Conservation Plan (Engilis and Naughton 2004) recommends determining baseline information for bristle-thighed curlews, and other species, as the goal of the Central Pacific Islands Subregion. The endangered species recovery plans for both species of turtles indicate that little is known about their biology in the central Pacific. Data on other terrestrial wildlife species found on Baker Island are lacking.

Objective 3b: Restore breeding populations for 2 seabird species.
Within 10 years of CCP approval, establish up to 5 nesting pairs each of Phoenix petrel (*Pterodroma alba*) and Polynesian storm-petrel (*Nesofregetta fuliginosa*) during a minimum of 3 consecutive years on Baker Island.
Strategy Applied to Achieve Objective
Implement and maintain electronic calling devices to promote nesting.
Rationale:
The Seabird Conservation Plan (USFWS 2005) recognizes the Polynesian storm-petrel may flourish on Baker, as well as Jarvis and Howland, due to the removal of mammalian predators from the islands. The Phoenix petrel is known from the Phoenix Islands, but does not currently inhabit Baker, though it is thought that they did historically. A recommendation of the Plan is expand efforts to assess habitat suitability and restore populations through translocation to predator-free U.S. islands such as Baker. While the physical translocation of species to Baker is not being suggested, electronic calling devices are designed and have been successful in attracting and establishing nesting seabird colonies to other islands.

Objective 3c: Develop baseline data and understand turtle use of Baker.
Upon CCP approval, monitor hawksbill and green turtles to document any nesting sites, all adjacent coral reef and nearshore water foraging sites, and overall population density and distributions.
Strategies Applied to Achieve Objective
Record incidental observations of nearshore turtle use.
Develop partnership with NOAA for study of turtles at Baker.
Rationale:
There is currently little information related to use of Baker resources by sea turtles, though it is known that they do use refuge habitats. Turtles have been photographed in the water during joint Service/NOAA expeditions since 2000. Data collected over the life of this plan would help to establish a baseline understanding of sea turtle populations in the central Pacific.

Objective 3d: Expand baseline information on marine community.
Upon CCP approval, monitor globally-depleted marine species populations such as giant clams (*Tridacna* sp.), bumphead parrotfish (*Bolbometapon muricatum*), Napoleon wrasses

(*Cheilinus undulatus*), large groupers (e.g., *Cephalopholis* sp., *Epinephelus* sp., *Variola* sp.), sharks (e.g., *Carcharhinus* sp., *Triaenodon* sp., *Negaprion* sp., *Galeocerdo* sp.), and corals (Anthozoa, Hydrozoa) to document presence/absence, relative abundance, distribution, and size/age structure on Baker.
Strategies Applied to Achieve Objective
Conduct marine surveys such as REA and permanent monitoring transect resurveys
Solicit partnership for survey of deep slope habitat.
Rationale:
Many marine species of commercial importance have been globally depleted. Protected areas such as Baker still provide refugia. However, illegal fishing activity has been noted surrounding several Remotes refuges. Baker, as well as other remote island refuges provide the opportunity to study and protect the marine ecosystem.

Objective 3e: Develop baseline scientific information on marine mammal use of Baker.
Within 10 years of CCP approval, increase scientific understanding of marine mammal presence and use of Baker marine waters. The desired conditions by which this will be met will be to document all marine mammal use of nearshore waters.
Strategies Applied to Achieve Objective
Incidental observations of marine mammals
Solicit partnership for study of marine mammals at Baker.
Rationale:
NOAA, Service, Oceanic Institute, University of Hawaii, and Bishop Museum marine biologists have collected data on marine species of concern since 2000. Only anecdotal information exists on marine mammal use of the waters surrounding Baker Island. Studies elsewhere in the Pacific, however, indicate that waters surrounding small islands may support distinct local populations of marine mammals. It is also important to understand the threats human activity may pose to this important resource (Marine Mammal Commission. pers. comm.).

Goal 4. Restore the wilderness character of Baker's terrestrial community, and protect, maintain, enhance, and preserve the wilderness character of Baker's marine communities.

Objective 4a: Protect, enhance, and maintain wilderness values.
Upon CCP approval, continue to preserve and enhance the wilderness values (e.g., size, naturalness, solitude, supplemental values) of Baker. Achievement of this objective will be evaluated by assessing loss, degradation, or improvement of values that qualified or eliminated it for potential designation (see Appendix F).
Strategies Applied to Achieve Objective
Use minimum tools necessary to manage refuge resources.
Continue to manage Baker as wilderness.
Monitor values of naturalness and solitude.
Rationale:
Baker has been and is managed as a wild, natural area due to its remote location and limited human presence, even though the terrestrial portion of the refuge suffers from historic human

impacts. Human generated debris, some containing contamination, remains from past occupations. Additionally, debris such as discarded fishing nets continuously washes ashore. This debris impinges upon the wilderness value of naturalness. A cultural resource review is required prior to removal of any human debris, which may be considered a cultural resource. Marine areas of Baker have been identified as meeting the criteria for a Wilderness Study Area (Appendix F). Completion of the wilderness review process and as appropriate development of a LEIS will be pursued for all Pacific remote island refuges once their CCPs have been completed. In the interim, the area identified as a suitable WSA would continue to be managed as wilderness. All management activities would be conducted in such a manner as not to detract from the wilderness values identified in the Wilderness Inventory.

Goal 5: Preserve Baker's biological, cultural and historic resources.

Objective 5a: Protect cultural resources.
Upon CCP approval, continue to protect existing cultural resources. The desired conditions by which this will be met will be to document any change in condition of the Baker day beacon, or other recognized cultural/historical resource.
Strategy Applied to Achieve Objective
Record incidental observations of condition of cultural resources.
Rationale:
Restricting human use of Baker would maintain cultural resources by limiting the opportunity for invasive species establishment, and reducing the opportunity for unauthorized collection or disturbance. In order to keep cultural resource sites protected, the locations and descriptions of fragile cultural resources would not be made available to the public.

Objective 5b: Enhance Law Enforcement Capabilities
Upon CCP approval, seek to improve partnerships with the NOAA Office of Law Enforcement to increase enforcement capacity. The desired conditions by which this will be met will be to formalize interagency agreements and develop remote surveillance techniques to document unauthorized access to the refuge.
Strategies Applied to Achieve Objective
Establish joint enforcement operational protocols with NOAA Office of Law enforcement.
Evaluate the effectiveness of deploying acoustical devices to detect ship traffic in the vicinity of the refuge.
Rationale:
Rationale: Enhancing law enforcement capability to detect and prosecute unauthorized access would preserve biological and cultural resources by limiting the opportunity for invasive species establishment and deterring unauthorized collection or disturbance.

Objective 5c: Enhance Knowledge of cultural resources.
Within 10 years of CCP approval, undertake appropriate surveys to identify important cultural and historical resources.
Strategy Applied to Achieve Objective
Coordinate with Regional Office cultural resource staff to develop funding package to conduct

monitoring activity.
Rationale:
In order to keep cultural resource sites protected, the locations and descriptions of fragile cultural resources would not be made available to the public. Any maintenance activity and establishment of new seasonal or annual field camps would require approval from appropriate archeological resource professional (e.g., Service Regional Archeologist).

Goal 6: Inform and educate the public to increase their understanding of remote Pacific island NWRs wilderness values, cultural and historical resources, and their ecosystems, with special emphasis on seabirds.

Objective 6a: Provide off-site education and interpretation opportunities.
Within 3 years of CCP approval, develop an off-site educational opportunity for the public to learn about Pacific Island refuge wilderness values, cultural and historical resources, tropical island ecosystems, seabirds, and coral reefs. The desired conditions by which this will be met will be through publications, educational programs, displays, or other media.
Strategies Applied to Achieve Objective
Develop, with External Affairs office, Honolulu, an interpretative brochure for all remote Pacific island refuges.
Rationale:
While it is important for the public to understand and appreciate the resource values associated with remote island refuges, it is logistically difficult to do this on-site at Baker and still protect the island's wildlife, habitats, wilderness values, cultural and historical resources, and visitor's safety. For these reasons, interpretative or educational opportunities for the public to learn and appreciate the values of remote Pacific island refuges and resources will be provided primarily as off-site programs and interpretative brochures.

Objective 6b: Increase understanding of impacts of global climate change.
Within 15 years of CCP approval, increase scientific understanding of the impacts of global climate change on tropical island ecosystems, specifically as these impacts relate to seabird nesting and foraging sites. The desired conditions by which this will be met will be the development of one research project.
Strategy Applied to Achieve Objective
Coordinate with NOAA to evaluate changes in sea surface temperatures and sea level in the vicinity of Baker over the next 15 years in relation to seabird nesting success.
Rationale:
It is increasingly important to understand the impacts that global climate change might have on central Pacific Ocean islands and the wildlife resources they support such as seabird nesting habitat and coral reefs. In order to determine if management activities are necessary to offset the impacts of global climate change at Baker, refuge staff needs a baseline from which to measure future change.

Chapter 4. REFUGE AND RESOURCE DESCRIPTION

Geographic/Ecosystem Setting

Baker Island NWR (Baker), located 12 nmi north of the Equator at approximately latitude 0º13' N and longitude 176º31' W is a northwest outlier island of the Phoenix Island Archipelago. It is included in the central Pacific subregion of the Polynesian Region of the Pacific Basin. This subregion, the largest of four in the Polynesian Region, is the most remote part of the tropical Pacific and includes only low-lying reef islands, atolls, and submerged reefs. Vegetation patterns are determined by the highly variable but normally low rainfall levels found along the Equator in the central Pacific. In turn, the arid weather and ocean circulation patterns impose limits on floating seed plant dispersal strategies. Baker falls in the central Pacific dry zone with rainfall less than 40 inches per year, and thus "cannot support any forest or closed woody vegetation" (Mueller-Dombois and Fosberg 1998). The nearest landmasses are Howland Island 32 nautical miles (nmi) to the north, and McKean Island 350 nmi to the southeast. Both islands are also in the Phoenix Islands. The eight Phoenix Islands under the jurisdiction of the Republic of Kiribati (including McKean) are the next closest neighbors to Baker, up to 480 nmi to the southeast. The next closest landmasses outside the Phoenix Islands are the Gilbert Islands with Beru Island closest to Baker at 420 nmi to the southwest. Tarawa Atoll, the capitol of the Republic of Kiribati, is 600 nmi to the west in the central Gilbert Island Archipelago.

Climate

General climate and related oceanographic conditions in the central Equatorial Pacific

The climate associated with Baker can be generalized as being arid, warm, and tropical with moderate breezes and light to moderate rainfall. Although differences in climate exist among the islands, climate-monitoring stations are not readily available in the equatorial Pacific. Consequently, current site-specific data are lacking for most central Pacific locations, or have only been collected for a short period of time. In order to describe the weather conditions on Baker Island, weather-monitoring data are taken from historic on-site weather data, or from the closest weather monitoring station.

There are several climatic factors that influence weather on Baker: trade winds, rainfall, and oceanic currents. Trade winds are surface winds that typically dominate airflow in tropical regions and predominate from the east at Baker between 13 to16 miles per hour (mph). Atmospheric pressure gradients range from high pressure areas located near latitude 30º N. and latitude 30º S., to the low pressure band located near latitude 5º N., driving both the northeast and southeast trade winds. This area of low pressure located just north of the Equator is referred to as the 'doldrums' or the Intertropical Convergence Zone (ITCZ) and lacks these prevailing trade winds because the northeast and southeast tradewinds collide or converge and rise upward.

Solar heating also allows the moist air mass of the ITCZ to rise, thus cooling the air mass and producing a band of heavy precipitation several degrees to either side of the ITCZ (Wallace and

Hobbs 1977). Baker normally lies south of the ITCZ. Changes in these typical patterns occur seasonally along a north-south axis and during periodic events known as the El Niño Southern Oscillation (ENSO) along an east-west axis. During an ENSO event, the ITCZ shifts east toward unusually warmer waters. This shift typically leads to lighter wind speeds and variability in rainfall depending upon geographic location in the central Pacific region (USFWS 2001, USFWS 1998a, Vitousek et al. 1980).

Prevailing ocean currents surrounding Baker also influence weather patterns on the island by moderating the surrounding surface air temperatures. These currents, except the Equatorial Undercurrent (EUC), and North Equatorial Countercurrent (NECC), also roughly mimic the direction of the trade winds. The eastward-flowing NECC is a relatively narrow surface current that seasonally meanders between latitude 5º and 10º N, flows counter to the major westward-flowing currents of the northern and southern hemispheres, and is situated just below the ITCZ (USFWS 2001). In a sense, the NECC is a return flow of surface seawater running down-slope back towards the eastern Pacific because of the lack of trade winds that would otherwise drag surface waters in the opposite direction. Baker lies south of the NECC and is rarely directly influenced by the current.

The westward-flowing current lying north of the NECC is known as the North Equatorial Current (NEC) and is not known to influence current and weather patterns near Baker. Just south of the NECC is the westward-flowing South Equatorial Current (SEC). Baker is most always within the flow regime of the SEC.

Baker also lies in the path of the subsurface easterly flowing Equatorial Undercurrent (EUC) also referred to as the Cromwell Current. As the EUC strikes the submerged western slopes of Baker Island, nutrient rich waters are deflected upward, enriching the primary productivity of the surface waters surrounding Baker. These upwelling waters from the EUC are slightly cooler than adjacent sea surface waters and may moderate the effects of localized and periodic sea surface warming events.

Baker climate and related oceanographic conditions

Baker's location on the Equator puts it squarely within the arid southeast trade wind belt except during an ENSO and other periodic fronts or storms when rainfall may be higher and winds more variable. Baker is also in an area with high probability of mesoscale eddy formation and intra-annual variation due to north-south movement of the ITCZ and inter-annual variation due to variation in strength of the ENSO (Longhurst and Pauly 1987).

There are very little weather data available from Baker. Weather observations were made during the military occupation of Baker and Howland Islands from 1935-1945 (USAEC 1963). However, these military records could not be located. A single reconnaissance trip to Howland and Baker Islands by the Logistics Planning Group of Holmes & Narver Inc, for the Atomic Energy Commission in October 1963, recorded seawater temperatures between 86ºF and 87ºF (USAEC 1963). Air temperatures during that time period ranged from 80ºF to 94ºF with an average of 85ºF. Wind speeds during this visit averaged 13 mph with a range of 6 to 23 mph. In winter, the average daily range of air temperature is reported as 78ºF to 88ºF, and during summer the average daily range is 78ºF to 90ºF (NOAA 1991). Kanton Atoll (formerly Canton Island) is located in the Phoenix Islands at 02º46' South latitude and 171º43' West longitude, and is the nearest (370 nmi) historic weather station to Baker (NOAA 1991, USFWS 1998a). Weather data at Kanton support the conclusions of arid conditions in the northern Phoenix Islands. The Kanton Atoll weather station reported total annual rainfall is approximately 30 inches annually (NOAA 1991) with precipitation consistent throughout the year. The trade winds, low rainfall, high equatorial sunshine and high evapo-transpiration levels all combine to produce a relatively arid climate at Baker, except during some anomalous storm and wind conditions.

Global Climate Change

A continuously growing body of unequivocal scientific evidence has emerged supporting the anthropogenic nature of current global climate change. During the 20th century, the global environment experienced variations in average worldwide temperatures, sea levels, and chemical concentrations. Global air temperatures on the earth's surface have increased by 1.3°F since the mid 19th century (IPCC. 2007a). Eleven of 12 years from 1995 to 2006 are the warmest on record since 1850 (IPCC 2007b). Global water temperatures have increased by 0.31º F on average in the upper 300 m during the past 60 years since 1948 and changes in ocean heat content have penetrated as deep as 3000 meters (Levitus et al. 2005). Subsequently, sea levels rose approximately 1.7 mm (0.07 in) ± 0.5 mm/yr during the 20th century (IPCC. 2007a); this rate rose dramatically to 3.1 mm (0.122 in) ± 0.7mm/yr since 1993 (IPCC 2007b). While the concept of climate change is widely accepted, the extent and impact of future changes as well as the exact source (natural or human induced) remains a debate (OPIC 2000). Emerging consensus contends that increasing quantities of greenhouse gases (GHGs) in the atmosphere, especially carbon dioxide (CO_2), are beginning to affect climate and may be the dominant force driving recent warming trends. The amount of GHGs globally has grown due to human activities since pre-industrial times, with an increase of 70% between 1970 and 2004 (IPCC 2007b). Carbon dioxide has increased by about 80% in the same time period. The atmospheric concentrations of CO_2 and methane in 2005 were 379 ppm³ and 1774 ppb, respectively. These amounts greatly exceed concentrations recorded in the global environment over the last 650,000 years (IPCC, 2007a). Other emissions and GHGs from human activity have enhanced the heat trapping capability of the earth's atmosphere, causing warmer temperatures. Although the increase in carbon dioxide is largely attributed to fossil fuel use, land use changes have also increased the amount of cleared land surfaces, thereby reflecting more solar radiation (IPCC 2001, IPCC 2007a, IPCC, 2007b).

Global forecasting models offer a variety of predictions based on different emission scenarios. OPIC (2000) suggests that a further increase in GHG emissions could double atmospheric concentrations of CO_2 by 2060 and subsequently increase temperatures by as much as 2 to 6.5°F over the next century. Recent model experiments by the IPCC (2007a) show that if GHGs and other emissions remain at 2000 levels, a further global average temperature warming of about 0.18°F per decade is expected. Sea-level rise is expected to accelerate by two to five times the current rates due to both ocean thermal expansion and the melting of glaciers and polar ice caps. Consequently, patterns of precipitation and evaporation may be altered. These changes may lead to more severe weather, shifts in ocean circulation (currents, upwelling), as well as adverse impacts to economies and human health (OPIC 2000, IPCC 2001, Buddemeier et al. 2004, IPCC 2007a). Hansen, et al. (2008) propose that current models may underestimate the slower feedback processes such as ice sheet disintegration, vegetation migration, and greenhouse gas release from soils and that these factors may come into play in this century. These changes will have a significant effect on the national wildlife refuges in the tropical Pacific. The changing global environment and the implications this may have for ecological and geological processes in the Central Tropical Pacific are important considerations for future management of trust resources there. The four areas of impact linked to global climate change that may have the greatest potential effect on Baker Island NWR and its wildlife are sea level rise, weather and ocean circulation changes, ecological disruptions and coral bleaching due to increased ocean temperature, and oceanic chemical composition change.

Vitousek (1994) reported, “Changes in both climate and biological diversity are known with less certainty than are changes in $C0_2$ concentrations, global biogeochemistry or land use.” Because temperature is more variable both spatially and temporally than $C0_2$ concentration, it is difficult to separate human-caused vs. natural background variation. However, it is certain that increasing concentrations of $C0_2$ and other greenhouse gasses will cause increasing climate change (Vitousek, 1994).

The equatorial locale for Baker places it near the path of anomalous water current and surface wind conditions during ENSO events, but the paucity of weather and oceanographic data at Baker renders it difficult to assess the impacts and trends of global climate change at the island. The upward deflection of cool subsurface waters into shallow water by the upwelling effects of the EUC further complicates an assessment of climate change effects, because this phenomenon has been rarely reported outside of the three equatorial refuges (Howland, Baker, Jarvis).

The insular nature of both the terrestrial and coral reef habitats of Baker will result in the same high vulnerability of resident organisms that is seen in range restricted or mountaintop species elsewhere (Parmesan, 2006).

Sea Level Rise

While global temperature is projected to rise by 3.6 to 9ºF and sea level to rise by more than 31.5 inches during the next two centuries, sea levels have fluctuated by an order of 328 feet over the past 18,000 years as natural background variation and thawing out from the last ice age (Michener et al. 1997). Contributions to sea level rise by climate change are ice-sheet melting, alpine glacier melting and thermal expansion of the sea. Sea levels have risen by 4-8 inches during the past century (Michener et al. 1997). The Intergovernmental Panel on Climate Change (IPCC 2001) predicted a sea level rise of 3.5 inches to 34.6 inches by the year 2100 unless greenhouse gas emissions were reduced substantially. They also suggested that continuing greenhouse gas emissions could trigger polar ice-cap melting after 2100 accompanied by sea level rise greater than 16 feet. More recent modeling indicates that melting could occur faster than the IPCC predicted (Overpeck, et al. 2006).

Evidence also suggests that the world’s oceans are regionally divisible with regard to historic fluctuations in sea level. Localized variations in subsidence and emergence of the sea floor and plate-tectonics activity prevent extrapolations in sea level fluctuations and trends between different regions. While researchers in IPCC (2007a) state that water levels in the equatorial Pacific are rising at a rate of 1.2 to 2 mm per year, it may not be possible to discuss uniform changes in sea level on a global scale, or the magnitude of greenhouse gas-forced changes as these changes may vary regionally (Michener et al. 1997). As an example, tide gauge records on the Atlantic coast indicate a sea level rise of .06 to .16 in/year over the past century, whereas, they have indicated a .35 to .39 in/year increase along the Gulf coast of the United States (Michener et al. 1997).

Increases in sea level and associated increases in storm surges and storm intensity will affect Baker Island. Shoreline erosion and salt water intrusion into subsurface freshwater aquifers have been noted throughout the Pacific (Shea et al. 2001). Due to the deep marine slopes directly adjacent to Baker Island, increases in sea level could significantly erode shorelines and overall island surface area since opportunities for accretion of lands do not exist. Loss of breeding habitat for seabirds, wintering grounds for migratory shorebirds, and habitat for native plants, and land crabs are predicted at current rates of sea level rise.

Ocean Temperature Increases

Most climate projections suggest that more intense wind speeds and precipitation amounts will accompany more frequent tropical typhoon/cyclones and increased tropical-sea surface temperatures in the next 50 years (Walther et al. 2002, IPCC, 2007). The third IPCC (2001) has concluded, with "moderate confidence" that the intensity of tropical cyclones is likely to increase by 10 to 20 percent in the Pacific region when atmospheric levels of CO_2 reach double pre-industrial levels (IPCC 2001). One model projects a doubling of the frequency of 4 inches per day rainfall events and a 15-18 percent increase in rainfall intensity over large areas of the Pacific (IPCC 2001). The IPCCl (2007) states that it is "more likely than not" that the rise in intense tropical cyclones is due to anthropogenic activity.

Above normal mean sea surface temperatures have been shown to cause bleaching and mortality in corals both in nature and in the laboratory with bleaching generally occurring in shallower waters (Floros et al. 2004). Coral bleaching, the expulsion of symbiotic zooxanthellae from coral polyps and subsequent loss of photosynthetic pigments is the result of both natural and anthropogenic stresses. Although corals may pale in response to seasonal increases in sea surface temperature, there has been a higher frequency of large scale bleaching events since the 1980s (Nicholls et al. 2007). The most severe global bleaching event ever recorded occurred in 1997-98 when over 50 countries showed signs of bleaching (Grimsditch and Salm 2005). Many species of coral currently exist in the upper limits of their specific temperature range; thus, an increase in average sea surface temperatures (even by 1.8 or 3.6ºF) over a sustained period has been shown to cause mass bleaching, especially in shallow waters habitats (Grimsditch and Salm 2005). Other variables have also been implicated in bleaching and mortality events, including, extended periods of high temperatures, low wind velocity, clear skies, calm seas, low rainfall, high rainfall, salinity changes, high turbidity or acute pollution. Floros et al. (2004) goes on to note that, "The causes of coral bleaching are debatable, but widely thought to be the result of a variety of stresses, both natural and human-induced, that cause the degeneration and the loss of the colored zooxanthellae from the coral tissues."

Bleaching episodes in equatorial islands appear to be linked to the ENSO. Widespread bleaching events occurred during the El Niños of 1982-83, 1987-88, and 1997-98 (Buddemeier et al. 2004). During the warm phase of ENSO, or El Niño, sea-surface temperatures are usually warm, trade winds weak, and sea level decreases in the western Pacific (IPCC 2001, Buddemeier et al. 2004). These combined factors result in a dramatic increase in coral bleaching (Buddemeier et al. 2004). While El Niño events have increased in intensity and frequency over the past decades, some longer-term records have not found a direct link to global warming (Cobb et al. 2003) and do not predict significant changes in El Niño; however, they do suggest an evolution toward more "El Niño-like" patterns (Buddemeier et al. 2004). Most climate projections reveal that this trend is likely to increase rapidly in the next 50 years (Walther et al. 2002).

If coral reef ecosystems do not acclimate to projected thermal stresses, more frequent bleaching events and widespread mortality will occur. The ability of coral reef ecosystems to withstand these impacts will depend on the extent of degradation from other anthropogenic pressures and the frequency of future bleaching events (Nicholls et al. 2007).

Field observation of corals at Baker, Howland, and Jarvis during five separate expeditions from 2000-2006 indicate that corals may be recovering from a bleaching event that took place during the previous few years (1997-1998). Corals continued to increase in cover and sizes, based upon observations during all subsequent (post 2000) visits, including those at permanent transect sites (Maragos 2008; Maragos et al. 2008a & 2008b, Miller et al. 2008). Although coral bleaching was predicted to occur at Jarvis in 2003 based upon NOAA satellite based temperature and wind data, no evidence of bleaching was reported there during the early 2004 and 2006 visits (Maragos 2000-2006, unpublished data). One possible explanation is that the cool upwelling waters of the EUC are buffering the effects of the otherwise warmer seawater temperatures at the island.

Tudhope (2000) sampled 6 cores obtained from 2 large, 3-4 meter *Porites* coral heads at Jarvis in 1999 to track sea surface temperature and coral growth rates over several or more decades using stable oxygen isotope as a measure of Sea Surface Temperature. He found a good correlation between this measure and the NINO3.4 Index, which is one of the most widely used and reliable indicators of the status of ENSO. The results of their work at Jarvis and at four other tropical sites in the Line and Cook Islands contributed to demonstrating linkages between the tropics and the North Pacific over hundreds of years (D'arrigo et al 2005). Hawaii Undersea Research Laboratory (HURL) submersible dives at Jarvis in July 2005 revealed many deep-water corals, and samples of some were taken for climate change and paleo-climate analyses. The results of these analyses are not yet available.

Oceanic Acidification and Atmospheric Chemistry

Glacial and interglacial periods in the Earth's history, as measured from deep Antarctic ice cores, reveal cyclical fluctuations in the concentration of global CO_2. However, recent increases fall outside the range of peak prehistoric CO_2 levels. Current atmospheric CO_2 concentrations are at their highest levels in more than 160,000 years, with humans emitting 25 billion tons of CO_2 annually (Buddemeier et al. 2004). The rate of increase is also five to ten times more rapid than any of the sustained changes in the ice-core record (Vitousek 1994). The higher the concentration of CO_2 in the atmosphere, the greater the amount of CO_2 dissolved in the surface ocean. When CO_2 dissolves in seawater it forms carbonic acid (H_2CO_3), a weak acid that releases additional hydrogen ions and increases the acidity of the ocean. In order to buffer this acidity, the hydrogen ions react with carbonate (CO_3^{2-}) ions and convert them to bicarbonate ions (HCO_3^-). However, this buffering ability has diminished due to the rapid rising CO_2 concentrations and the global seawater pH has decreased by 0.1 units since 1750, with regional variations (Royal Society 2005, IPCC 2007). Models predict that over the 21st century average surface ocean pH will continue to fall between 0.14 and 0.35 units (IPCC 2007a).

Increased atmospheric CO_2 and ocean acidification affect marine organisms. As the concentration of carbonic acid and bicarbonate ions rises, the concentration of carbonate ions decreases. Many corals and marine organisms use calcium (Ca^{2+}) and carbonate ions from seawater to secrete $CaCO_3$ skeletons (Buddemeier et al. 2004, IPCC 2007). Change in carbon dioxide levels will increase the partial pressure of carbon dioxide in seawater, thus reducing the over-saturation of aragonite, a form of calcium carbonate that is the major building block for coral reefs (Vitousek, 1994). On a transect in the Pacific Ocean that ran very near Jarvis, Feeley et al. (2004) show that the aragonite saturation horizon is shallow and is shoaling compared to the pre-industrial aragonite saturation horizon. This reduces the width of the zone in which marine organisms have optimum aragonite concentrations for shell-building. The result of this is uncertain but is thought to reduce the rate at which corals can deposit calcium carbonate, thus reducing the rate at which coral reefs will be able to keep up with any increases in sea level. A lowered calcification rate means calcifying organisms (corals) may grow skeletons at a slower rate, lower density, and/or decreasing strength. Thus, changes in global seawater chemistry reduce the ability of corals to successfully compete for space and increase susceptibility to breakage (Grimsditch and Salm 2005). In addition to changes in the carbonate system, changes in ocean chemistry may affect the availability of nutrients and toxins to marine organisms.

It should also be noted that chemical composition changes in the atmosphere may also affect terrestrial ecosystems. For instance, the quantity of nitrogen available to organisms affects species composition and productivity. Increase in nitrogen can alter species composition by favoring those plant species that respond to nitrogen increases (Vitousek, 1994). Increased carbon dioxide can also affect photosynthetic rates in plants, change levels and characteristics of secondary compounds in plant tissues, change plant species composition, lower nutrient levels, and lower weight gain by herbivores.

Geology and Soils

Baker is a low-lying, nearly level island surrounded by a narrow shallow fringing reef and with a broader submerged reef terrace off the east side of the island. The submarine slopes descend steeply to great depths beyond the fringing reefs. Surface deposits on the island consist of calcareous sands and coral rock. The small central depression of the island is likely the result of the combined effects of guano mining more than a century ago. The island was likely formed as a result of submarine volcanic activity and changes in the earth's crust caused by continental tectonic plate movement, including emergence of a high volcanic island, its later subsidence, reef accretion, and its gradual northwesterly drift way from the East Pacific Rise over the past 50-80 million years. Although scientists since Darwin (1842) have been pondering seamount, island, and atoll formation in the Pacific since the mid-1800s, the specifics of how Baker Island was formed have not been specifically investigated although this was reviewed (Joyce Miller in Maragos et al. 2008a). The specifics likely follow the general sequence first postulated by Darwin.

The dominant theory of atoll formation states that islands form in deep tropical oceans as a result of underwater volcanoes that grow to the surface to form high volcanic islands, giving coral polyps a foundation to grow upon and form reefs fringing the island. In time, the volcano becomes dormant, and its mass pushes down on the earth's crust causing it and its island to subside and shrink in size, while its fringing reefs continue to grow upward and maintain proximity to the sea surface. Coral reefs, originally fringing the edges of a large island, become a barrier reef around larger islands outlining the contour of the original coastline, with a lagoon occupying the space vacated by the shrinking island. Eventually, further subsidence causes the island to disappear completely from the lagoon leaving behind an atoll. However, for small islands such as Baker, lagoons may not have formed at latter stages, and continued subsidence has left only a small low reef island in its wake. Based upon deep drilling through the atolls in the Marshall Islands in the 1940s and 1950s, it is believed that these processes encompassed more than 50-70 million years and up to several thousand feet of reef growth equal to the degree of subsidence over that time span. In addition, it is hypothesized that changes in sea level associated with the end of the last ice age and the deposition of highly permeable coralline limestone (calcium carbonate) derived from the remains of marine organisms likely contributed to the carbonate platform that characterizes the contemporary geologic structure of Baker Island.

The western (leeward) shoreline of the island is sandy, while all other sides are covered with coral rubble. There is no pronounced beach crest or central basin (dried up lagoon) typically found on some larger low-lying reef islands. A small borrow pit with an interior island is located near the eastern shore. Soils of low-lying atolls in the Pacific frequently consist of accumulations organic matter, guano, pumice or other transported material on top of a calcareous sand or limestone substratum (Morrison 1990). The soil of Baker Island is composed of coral fragments and light brown coral sand with a low percentage of organic matter.

Hutchinson (1950) concluded that phosphates accumulate preferentially on islands, such as Howland, Baker and Jarvis Islands, that are situated in climatic dry belts used by large populations of seabirds. Deposits of phosphate-rich soils have formed over time from guano deposited on the island by fish-eating seabirds. Mild acids formed from the decomposition of organic matter carry the guano downward in the soil to limestone soil layers were acids are neutralized and calcium phosphate accumulated from the chemical changes. In addition, when guano-beds are exposed to rain their soluble constituents are removed and the insoluble matter is left behind. The soluble phosphates washed out of the guano may also become fixed to the coral sand and limestone by the process described above. The calcium phosphate rocks and soil occur among the sedimentary strata and were the principal sources of phosphate rock targeted for commercial fertilizer and military use during the guano mining period between 1861 and 1891 (see Chapter 3.15). Even after the guano mining era, the soil profile still contained heavy guano deposits (Christophersen 1927).

Hydrology

No information is available on the subsurface hydrology of Baker Island. However, its small size and prevailing arid rainfall conditions would not likely result in the formation of a drinkable groundwater lens. During staff visits to Baker, potable water is carried in containers to the island for short visits, and could be produced on-site via reverse osmosis technology for prolonged visits, just as it is now produced for permanent field stations at other remote Pacific island NWRs.

Air and Water Quality

Due to the lack of human presence, oceanic and air quality are expected to be good and lacking in pollutants. Vapors from abandoned spilled fuel storage drums left behind during the World War II era are likely to be confined to the immediate vicinity of the drums and have probably all volatized. However, polychlorinated biphenyls (PCBs) and other contaminants may have entered the groundwater or nearshore environment. The acoustic environment at Baker is completely natural without any anthropogenic noise except during periodic visits. On the island, dominant natural sounds include the wind, calls of seabird and shorebirds, and seawater lapping on the shoreline with wave action crashing further offshore on the outer reef margin. Underwater the dominant sounds are wave action and surge striking the reef slopes and the sounds of thousands of feeding and moving invertebrates and fish.

Environmental Contaminants

Debris from past human occupation is scattered throughout the island and in offshore waters. Most of this debris is left from the U.S. military and Coast Guard occupation of the island from 1942-46. The most noticeable remnant remaining from the military is the 150-foot wide, 5,400-foot long airstrip. At the northeast section, apparently the main camp area, are the remains of several buildings and heavy equipment. Five wooden antenna poles about 40 feet in height remain standing in the camp. Several crashed airplanes and large equipment such as bulldozers are scattered around the island. Numerous bulldozer excavations containing the remnants of metal, fuel, and water drums are scattered about the north central portion and northern edge of the island. The Navy reported the loss of 11 landing craft in the surf during World War II (WWII).

Thousands of fuel storage drums, cylinders of pressurized gases, piles of old batteries, cans of waste materials, paints, kerosene, oils, grease, and unidentified substances were left behind by the U.S. military and Coast Guard after occupation during the WWII era. In 1987, the ACOE, sponsored by funds from the Defense Environmental Restoration Program, organized an expedition to Howland and Baker to dispose of the fuel by burning it on-site while in the drums (ACOE 1987). However, ACOE efforts did not completely consume the fuel, and the burning left toxic residues in many of the drums and surrounding soils (Lee Ann Woodward, pers. comm. with Helene Takemoto). Another large source of contamination is rusting steel and iron from various machine parts and drums.

Baker is slowly being evaluated by U.S. Environmental Protection Agency (EPA) (EPA ID HI6143690075) for inclusion on the National Priority List (NPL) as directed by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 U.S.C. § 9601 et seq.). The evaluation is due to the large amounts of fuel, debris, and dumps left behind by the military and the Coast Guard when they abandoned the island. While the Service is responsible for monitoring and reporting in a timely fashion, the EPA has allowed an extended evaluation period due to the remoteness of the site. A brief summary of activities relevant to this action follows.

Beginning in 1978, the Service and Coast Guard visited the island and reported several large ditches containing "hundreds" of corroded and leaking 55-gallon drums. Open, upright drums were reported to be fatal traps for red-footed boobies that fell in while roosting on the drum rims. An estimated 25% of the upright drums were reported to contain bird remains. By 1984, the Service filed a "Notification of Hazardous Waste Site" form with EPA. Another joint Service and Coast Guard expedition in 1986 identified 2,758 55-gallon drums of diesel fuel, kerosene, motor oil, and unidentified liquids, and hundreds of smaller containers of powders, grease, paint, and unidentified substances. Most of the drums and other containers had rusted through and spilled their contents, however, 640 55-gallon drums were found to be intact with their original contents (USCG 1986).

Again in 1986 Service and ACOE personnel mounted an expedition resulting in burning, in situ, approximately one-third of the wastes identified in previous expeditions. No sampling or cleanup of the remaining ash was done following the waste/fuel burn (ACOE 1987).

In 1988, EPA published the "Federal Agency Hazardous Waste Compliance Docket" in the Federal Register listing Baker as a potential, uncontrolled, "federal facility" hazardous waste site requiring Preliminary Assessment (PA) and Site Investigation (SI) reports within 18 months of being placed on the docket. The EPA submitted a letter to the Service in 1991 requesting the PA and SI reports be completed for Baker. The Service conducted a SI in 1992 to further map and characterize trenches and drums identified from previous investigations. Samples were also collected to satisfy Service reporting requirements to EPA under the provisions of Section 107 of CERCLA. However, no report was filed with EPA. Further investigations by the Service contractor, Foster Wheeler Environmental Corporation (Foster Wheeler 1998), were deemed by EPA and the Service to be inconclusive.

Terrestrial Vegetation and Habitats

Baker Island is vegetated with grasses, herbaceous plants, and shrubs. Only strand species able to survive long periods of drought and irregular opportunities to reproduce during the infrequent wet years of the ENSO persist there. By 1924 when Christophersen (1927) did the first thorough survey of Baker Island's vegetation, there had already been approximately a century of visits by Europeans and guano mining. Despite this traffic and the potential for introductions, Christophersen found 16 species, consisting of 8 native species (*Digitaria pacifica, Eragrostis whitneyi*, *Lepturus repens, Fimbristylus cymosa, Boerhavia* sp., *Portulaca lutea, Tribulus cistoides,* and *Triumfetta procumbens*) and 8 that had probably been accidentally introduced.

Since then some species have been lost and new wave-carried adventives have resulted in a modern day total of only 16 species (see Appendix B). Flint and Woodside found 16 species in 1993. It is likely that seeds of additional species are regularly washing up on the beach and then dying back as conditions become too dry or high surf washes the plant away. Table B-3, Appendix B, lists all the plant species of Baker Island, collections or first observations.

Terrestrial Wildlife

Seabirds, shorebirds, lizards, vegetation, insects, crabs, and alien rats, house mice, and cats have been observed and studied at Baker Island during the current century.

Seabirds and Land Mammals

There are no native land mammals at Baker Island. Numerically dominant vertebrates are seabirds and migratory shorebirds. Earliest ornithological surveys at Baker Island took place long after the introduction of the rat (*Rattus norvegicus*) so the composition of the avian community prior to human contact can only be surmised by looking at other islands in the Phoenix Archipelago that did not suffer the invasion of rats. The rats were present in the 1930s when the Panala'au colonists arrived but they were exterminated some time after 1937 when the colonists introduced cats (Clapp and Sibley 1965). House mice (*Mus musculus*) were not recorded by the Whippoorwill Expedition in 1924 but were mentioned by Rodman in 1935. They persist today and their population size fluctuates with rainfall levels. Cats were introduced in 1937 or 1938 by colonists to control the rats. Additional cats may have been brought during the military occupation. The scientists of the Pacific Ocean Biological Survey Program eradicated most of the cats in 1964 and the last sighting was in 1965. Dogs (*Canis lupus familiaris*) were used to guard the LORAN station, but were removed at the termination of operation (USCG 1946).

The findings of the ornithologist on the Whippoorwill Expedition of 1924 are the only ornithological records prior to 1963, when scientists from the Smithsonian Institution visited eight times between 1963 and 1965. Table B-4 in Appendix B lists species and estimates of numbers for seabird species on all visits since 1973. Munro (1924) found eight species of seabirds breeding in 1924. Cats were introduced during 1935-1942 and the numbers and kinds of seabirds breeding at Baker decreased to four species by 1963 (Sibley and Clapp 1965). After the cats were removed in 1965, the bird populations rebounded, and now 11 species breed there. The three most numerous breeding species at Baker are the lesser frigatebird (*Fregata ariel*), brown noddy *(Anous stolidus*), and sooty tern (*Onychoprion fuscatus*). Table B-4 also indicates the breeding seabird species at Baker.

Several species of concern exist or have the potential to exist on Baker. The Phoenix petrel (*Pterodroma alba*) is considered a bird of National Conservation Concern by the Service and is listed by the International Union for the Conservation of Nature (IUCN) as Vulnerable. The Polynesian storm-petrel (*Nesofregetta fuliginosa*) and blue-gray noddy (*Procelsterna cerulea*) are Birds of Conservation Concern at the regional level (USFWS 2005). Both the Phoenix petrel and the Polynesian storm-petrel probably occurred at Baker Island prior to the introduction of rats.

Shorebirds

Species occurrence and counts of the nine migratory shorebird species recorded from Baker Island are displayed in Table B-4, Appendix B. The four most common migrants wintering at Baker are ruddy turnstone (*Arenaria interpres*), Pacific golden plover (*Pluvialis fulva*), bristle-thighed curlew (*Numenius tahitiensis*), and wandering tattler (*Heteroscelus incanus*). Of all shorebirds reported from Baker, the ruddy turnstone, bar-tailed godwit, sanderling, bristle-thighed curlew and the Pacific golden plover are considered species of High Concern in the national conservation priority scheme for shorebirds (Engilis and Naughton 2004). These islands provide crucial wintering habitat and may also serve as rest-stops for arctic-breeding shorebirds going to winter farther south in the Pacific islands. In addition, the bristle-thighed curlew and Pacific golden plover are recognized in the Birds of Conservation Concern, BCR 68 (USFWS 2002). These islands provide crucial wintering habitat and may serve as rest-stops for arctic-breeding shorebirds wintering farther south in the Pacific islands.

Reptiles

Only two species of terrestrial reptiles have been reported from Baker Island, the snake-eyed skink (*Cryptoblepharus poecilopleurus*) and the mourning gecko (*Leipidodactylus lugubris*). The skink was first reported by Hague in 1862, and the gecko by Bryan in 1935 (cited in Clapp and Sibley 1965). Both species were seen by Flint and Woodside (1993). The green sea turtle (*Chelonia mydas*) and the hawksbill turtle (*Eretmochelys imbricata*) have been observed foraging offshore at Baker.

Terrestrial Invertebrates

Baker Island is home to a large number of the land crab *Coenobita perlata*. Their large biomass plays a dominant role in terrestrial food webs on the island where they consume a wide variety of organic matter of all types. Other terrestrial arthropods and mollusks are very poorly known. The entomologist Edward L. Caum visited Baker Island in 1924 and a number of other naturalists collected insects on subsequent trips but there are no published accounts or lists. Recent observations and collections during visits by Service biologists include house flies, small ants, moths and millers, butterflies, spiders, and an earthworm.

Marine Habitats, Fish, and Wildlife

Previous surveys

Five sets of recent surveys from 2000-2006 have been accomplished in cooperation with the NOAA Pacific Islands Fisheries Science Center (PIFSC) and their research vessels (*Townsend Cromwell, Oscar Elton Sette,* and *Hi'ialakai*), primarily through the sponsorship of the Center's

Coral Reef Ecosystem Division (CRED). General results of these surveys have been published in NOAA sponsored State of the Reefs Reports (Turgeon et al. 2002, Brainard et al. 2005, and Miller et al. 2008). Additionally two other reports on Baker and the remaining U.S. Phoenix and Line Islands were published in the first of a series of books on the coral reefs of the world (Maragos et al. 2008a, b). The field surveys since 2000, are of several types including oceanographic data collection, towed diver surveys, rapid ecological assessments (REA) at stationary sites, and collections of marine animals and plants for identification and description in the lab. The Service, with assistance from CRED established three permanently marked transects to document trends in corals and some macro-invertebrates over time since 2000. Despite these intense efforts, several important habitats at Baker have not been adequately surveyed, especially below depths of 65 feet. The NOAA collected high resolution bathymetry of Baker from Multi-Beam™ surveys in 2006 and published the maps (Miller et al. 2008; Miller in Maragos et al. 2008a), and substantial oceanographic data have been collected since 2000 (Gove in Maragos et al. 2008a; R. Brainard, pers. comm.). Remotely operated vehicles (ROVs) have been launched to collect video- and camera-based data at depths greater than 65 feet.

Before 1998, Baker had not been surveyed for corals. Specimens of corals were collected at Baker by Service biologist John Schmerfeld in 1998 and 28 species were identified (Schmerfeld and Maragos, unpubl.). NOAA and the Service sponsored field studies at Baker in 2000, 2001, 2002, 2004, 2006, and early 2008. Studies through 2002 focused on the collection of biodiversity information and the relative abundance of each coral species at the REA sites. During 2004 and 2006 coral surveys shifted to population censuses following the methodology described in Maragos and coworkers (2004). Maragos accomplished the censuses at eight sites in 2006 and the incidence of coral diseases were assessed at the same sites by Greta Aeby in 2004 and Bernardo Vargas in 2006. Coral population data has also been assessed at three permanently marked transect sites from 2000-2006. In 2006, a deeper (90 feet.) area off the historic western anchorage was examined for metallic debris, including anchors and chains that appear to be degrading corals and facilitating the spread of an invasive corallimorph, *Rhodactis howesii* at depth and further upslope.

Submergent Habitats

Baker's shallow marine benthic habitats consist of fringing reef crests, shallow back reefs, steep fore reefs, spurs-and-grooves, and small reef terraces. The last two habitats are restricted to the windward (east side) of the island. In addition, a shallow short channel was blasted through the narrow fringing reef during the pre-World War II era to facilitate small boat access between the shoreline and ocean. Pelagic habitats occur further offshore beyond the influence of upwelling and nearshore oceanographic processes. Nearshore habitats include distinct nutrient-rich upwelling zones off the west side of the island and oligotrophic (nutrient-poor) waters off the windward reefs. The PIFSC is researching the differences between these zones (Gove et al. 2006; Gove in Maragos et al. 2008.

Reef Life

The dominant reef life studied during the post-1997 expeditions includes benthic algae (Peter Vroom, Kim Paige pers. comm.) corals and anemones (John Schmerfeld, Jim Maragos, Greta Aeby and Jean Kenyon pers. comm.), other reef invertebrates (Scott Godwin, Dwayne Minton, and Robin Newbold pers. comm.), and reef fishes (Ed DeMartini, Bruce Mundy, Brian Zgliczynski, Brian Green, Richard Wass, Alan Friedlander, Stephanie Holzwarth, and others pers. comm.). Additionally extensive collections of reef fishes were accomplished by Fowler (1927), anon. (1950), Helfrich (1962), Wass (1966), Smithsonian Institution Pacific Ocean Biological Survey (SIPOBS), and others cited in Mundy et al (2002). At the time of this CCP, only data from coral (Table 3.1) and fish surveys (Appendix B) were available for review and compilation. The algae and non-coral invertebrate analyses are not complete enough to provide compilations.

Corals

A total of 91 species and 37 genera of corals and anemones have now been reported from Baker since surveys and collections through 2006, including 32 genera and 82 species of stony corals (Appendix B, Table B-1). One site off the eastern reef terrace demonstrated high coral cover of about 80% with the dominant staghorn coral *Acropora* monopolizing all substrates. An invasive anemone, tentatively identified as *Aptasia* sp. was abundant at most survey sites in 2004, but had totally disappeared by the time of the 2006 surveys. However, the invasive red corallimorph, *Rhodactis howesii,* is now increasing in abundance and expanding its distribution on the reefs at Baker. It appears to be stimulated by dissolved iron from metallic debris.

Coral population data at Baker in 2006 reveal characteristics similar to those reported for Howland in 2006. Coral frequencies (number of corals per square meter) at Baker in 2006 were substantially higher compared to 2004 frequencies at the same three sites in 2004. The largest corals at the same three Baker sites were comparable to 2004 levels, but there was nearly an order of magnitude increase in the numbers of corals for the four smallest size classes and total numbers of corals. The mean percent coral cover also increased at the three sites from 2004 levels averaging 49.8% to 2006 levels averaging 52.9% although the trends were not consistent at the individual site level (Maragos in Miller et al. 2008).

The staghorn and table corals of *Acropora* were common at all research sites, and other corals seemed healthy except at the western anchorage. The bubble-tip anemone (*Entacmaea quadricolor*) was observed for the first time in 2006, and the stone snake coral (*Herpolitha* spp.) was also observed at three REA sites for the first time.

The red invasive corallimorph showed dramatic increases off the west and south coast at historical boat landing and anchorage locations. Corroding iron from anchors and chains may be stimulating the growth of this species as observed at Palmyra Atoll adjacent to a shipwreck in 2005-2006, and also observed at the Howland landing site in 2006. The historic western anchorage site appears to be degraded, at both transect depths of 30 and 100 feet. It is the only site at either Howland or Baker that appeared “sick.” Wave action appeared to have fractured some corals, and *Rhodactis* is asserting its dominance, especially at depth. Non-coral substrates are dark and covered by cyanobacteria, also likely stimulated by dissolved iron from the numerous anchors and chains observed at all depths. Sediment samples were collected at the site for toxicological analyses, and photoquadrat data show a steady decline in corals over a 6-year period.

Nearshore Fish

There are approximately 247 species of reef fish known from Baker reefs (Mundy et al. 2002; Table B-2, Appendix B). This compares with 324 species from nearby Howland Island. Moreover, 10 families of fish reported at Howland Island have not been reported from Baker Island, and 6 minor families from Baker have not been reported from Howland Island. Of interest is the presence of several species of goby and scorpion fish families at Howland Island and the lack of these families at Baker Island. Possible explanations for these differences may be that sampling and survey intensities may be insufficient and different between the two islands, or that geographic isolation may result in differential recruitment rates between the two islands. As noted earlier, not all habitats at Howland have been surveyed to the same degree as those at Baker.

Reef fish populations at Baker appeared healthy and diverse with little indication of unauthorized harvest. However, Maragos, during 2000 surveys noted that there were many small sharks and no larger sharks at both Howland and Baker. In contrast, there were numerous small and some large sharks at both locales by 2004 and 2006. Because “shark finning” (the catching of sharks only to remove their fins for sale) is a growing concern in the Pacific and other oceans, it is possible that the pre-2000 harvest of sharks at Baker resulted in the absence of larger adult sharks in 2000 (Maragos et al. 2008b). Larger sharks and additional recruitment by 2004, and lack of subsequent shark fin harvest in the area may explain the more normal size distribution in sharks observed in 2004 and 2006.

The fact that the disparities for the coral genera did not track in the same direction as for the fish families (more coral genera at Baker vs. more fish families at Howland), reinforces the hypothesis of geographic isolation may lead to biodiversity heterogeneity based on chance and differential recruitment success. Geographic isolation would require both corals and reef fish to rely more on local recruitment vis-à-vis external recruitment. The latter would likely play a much larger role where reefs and islands are larger and closer together and result in similar biodiversity characteristics.

Marine Mammals

On most visits to Baker Island, a group of approximately 40 bottle-nosed dolphins (*Tursiops truncatus*) appears as the ship approaches the island. Formal quantitative surveys of marine mammal distribution and abundance have not been undertaken at the refuge.

Pelagic Wildlife

Oceanic pelagic fish including skipjack, yellowfin tuna, and blue marlin prefer warm surface layers, where the water is well mixed by surface winds and is relatively uniform in temperature and salinity. Other pelagic species, such as albacore, bigeye tuna, striped marlin, and swordfish, prefer cooler, more temperate waters, often meaning higher latitudes or greater depths. In fact, the largest proportion of the tuna catch in the Pacific Ocean originates from the warm pool, even though paradoxically this is a region of low primary productivity. Tuna movement to upwelling zones at the fringe of the warm pool may be key in resolving this apparent discrepancy between algal and tuna production. Preferred water temperature often varies with the size and maturity of pelagic fish, and adults usually have a wider temperature tolerance than subadults. Thus, during spawning, adults of many pelagic species usually move to warmer waters, the preferred habitat of their larval and juvenile stages.

Large-scale oceanographic events (such as El Niño) change the characteristics of water temperature and productivity across the Pacific, and these events have a significant effect on the habitat range and movements of pelagic species. Tuna are commonly most concentrated near islands and seamounts that create divergences and convergences, which concentrate forage species, and also near upwelling zones along ocean current boundaries and along gradients in temperature, oxygen, and salinity. Swordfish and numerous other pelagic species tend to concentrate along food-rich temperature fronts between cold upwelled water and warmer oceanic water masses (NMFS 2001). These frontal zones also function as migratory pathways across the Pacific for loggerhead turtles (Polovina et al. 2000). Loggerhead turtles are opportunistic omnivores that feed on floating prey such as the pelagic cnidarian, *Vellela vellela* (“by the wind sailor”) and the pelagic gastropod *Janthina* spp., both of which are likely to be concentrated by the weak downwelling associated with frontal zones (Polovina et al. 2000).

The estimated hundreds of thousands of seabirds breeding at national wildlife refuges in the Central Pacific Ocean are primarily pelagic feeders that obtain the fish and squid they consume by associating with schools of large predatory fish such as tuna and billfish (Fefer et al. 1984, Au and Pitman 1986). These fish—yellowfin tuna (*Thunnus albacares*), skipjack tuna (*Katsuwonus pelamis*), mahimahi (*Coryphaena hippurus*), wahoo (*Acanthocybium solandri*), rainbow runner (*Elagatis bipinnulatus*), broadbilled swordfish (*Xiphias gladius*), and blue marlin (*Makaira indica*)—are apex predators of a food web existing primarily in the epipelagic zone. While both the predatory fish and the birds are capable of foraging throughout their pelagic ranges (which encompass the tropical Pacific Ocean), the birds are most successful at feeding their young when they can find schools of predatory fish within easy commuting range of the breeding colonies (Ashmole 1963, Feare 1976, Flint 1991). Recently fledged birds, inexperienced in this complex and demanding style of foraging, rely on abundant and local food resources to survive while they learn to locate and capture prey. Some evidence from tagging studies done by Itano and Holland (2000) suggests both yellowfin and bigeye tuna aggregate around island reef ledges, seamounts, and fish aggregating devices and are caught at a higher rate here than in open water areas. Yellowfin tuna in Hawai‘i exhibit a summer island-related inshore-spawning run (Itano 2001).

Ashmole and Ashmole (1967) and Boehlert (1993) suggest that the circulation cells and wake eddies found downstream of oceanic islands may concentrate plankton and therefore enhance productivity near islands. Higher productivity, in turn, results in greater abundance of baitfish, thus allowing higher tuna populations locally. Johannes (1981) describes the daily migrations of skipjack tuna and yellowfin tuna to and from the waters near islands and banks. The presence of natural densities of these tunas within the foraging radius of seabird colonies enhances the ability of birds to provide adequate food for their offspring (Ashmole and Ashmole 1967; Au and Pitman 1986, Diamond 1978, Fefer et al. 1984.). Wake eddies also concentrate the larvae of many reef fishes and other reef organisms and serve to keep them close to reefs, enhancing survivorship of larvae and recruitment of juveniles and adults back to the reefs. For at least three of the seabird species breeding in the NWHI (brown noddies, white terns, and brown boobies), large proportions (33 to 56 percent) of their diets originate from the surrounding coral reef ecosystem, in other areas where their diet has been studied (Ashmole and Ashmole 1967; Harrison et al. 1983; King 1970; Diamond 1978).

Threatened and Endangered Species

Species listed under the Endangered Species Act documented to use Baker include the threatened green turtle (*Chelonia mydas*) and endangered hawksbill turtle (*Eretmochelys imbricata*), although little information is available on sea turtle populations at Baker. However, both species have been observed and photographed foraging in the shallow water near the island.

Invasive Species

Human activities at Baker Island have resulted in various non-native species being introduced including the house cat, the Norway rat, house mouse, various ant and cockroach species, and plants such as coconut palm, tropical almond, ilima, *Portulaca oleracea*, and milo. The cats were introduced in 1937 and finally eliminated in 1965. The rats were documented as early as 1854 and in many accounts were described as extremely abundant but they disappeared sometime after 1937 and before 1963 (Clapp and Sibley, 1965), probably due to a combination of predation by the cats and the efforts of the settlers at the time.

Wilderness Resources

Portions of Baker remain in a wilderness state in terms of its biota, seascape, and landscape. However, the collection of abandoned fuel drums, excavations and pits left behind from the guano mining era, the airfield constructed during WWII, and remains from a Coast Guard Long Range Navigation (LORAN) station degrade the wilderness values of the terrestrial portion of Baker. The wilderness values of the marine portion of Baker are influenced by the small section of the reef blasted for a boat passage during the guano-mining era, the potential for 11 loaded LCMs (Marine Landing Craft) lost by the military while landing on the island in the 1940s to be present in the nearshore waters, and abandoned anchors and chain near the western shoreline. However, the collective contribution of these detractions to the marine portion of Baker is minor compared to the otherwise overwhelming wilderness character of the surrounding reefs. Additional wilderness information and evaluation are covered in greater detail in Appendix F.

Archaeology and Paleontology

Polynesians visited Baker Island prior to its discovery by European navigators (Hague 1862). However, Emory (1925) reported that no traces of Polynesian remains were found on Baker.

Baker has many visible signs and debris of human occupation. Most of the remaining debris is left from the military and Coast Guard occupation of the island from 1942-46. However, there are many remnants of earlier inhabitants. There is a burial ground on the southern portion of the western edge that dates from the guano mining days. A second cemetery, probably dating from WWII, is located on the western ridge north of the lighthouse. The most noticeable remnant remaining from the military is the airstrip 150 feet wide and 5,400 feet long. At the northeast section, apparently the main camp area, there are the remains of several buildings and pieces of heavy equipment. Five wooden antenna poles about 40 feet in height remain standing in the camp. Several crashed airplanes and large equipment such as bulldozers are scattered around the island. Numerous bulldozer excavations containing the remnants of metal, fuel, and water drums are scattered about the north central portion and northern edge of the island.

An archaeological reconnaissance survey performed on September 18-20, 1987, and consisting of only surface reconnaissance and limited subsurface testing performed as part of an ACOE Defense Environmental Restoration project to inventory and burn fuel in abandoned WWII fuel drums on Baker and Howland Islands (ACOE 1987). The archaeological reconnaissance was conducted prior to the drum collection and burning to avoid possible damage to cultural resources (Shun 1987). This archaeological reconnaissance at Baker in 1987 (Shun 1987) resulted in the identification of 20 surface sites, all less than 200 years old. These include a lighthouse, the remains of the Meyerton settlement, a guano miner’s stone structure, a cemetery, mounds, trenches, and runway matting.

Environmental conditions on Baker are inhospitable to lengthy human occupation. The lack of a constant supply of fresh water is the primary limiting factor for habitation by humans. It is conceivable that early prehistoric people could have used Baker Island as a stopping, resting, or gathering place during their voyages across the Pacific Ocean, including capture of nesting sea turtles kept alive for extended food supply during long ocean voyages. However, it is doubtful that voyagers would have willingly settled on this island. Landings in any vessel would have been difficult, although access gained by small canoe is possible. Due to its remoteness and lack of a sustainable freshwater supply, it is likely that Baker played a minimal role, if any, in the colonizing efforts of prehistoric people across the Pacific.

No records were found of paleontological surveys, although paleontological resources could exist in the form of fossilized coral or algae and other invertebrates. The chances of prehistoric indigenous terrestrial mammals inhabiting Baker are non-existent due to the geological forces that formed the island, and its remoteness and dry climate.

Recent Cultural History

The occupation and use of Baker after post-European contact, approximately AD 1800, can be divided into five distinctive time periods or eras based upon alternating periods of occupation, use, and abandonment. The eras are categorized as whaling, guano mining, colonizing, military, and post military.

Whaling Era: circa AD 1800-1870

Baker has also borne the names New Nantucket and Phoebe. The island was frequently visited by whaling vessels that used the island as a mail drop-off and provisioning station. While the first sighting of the island is unknown, the first name recorded for the island was New Nantucket. This name was given by either Captain Elisha Folger, of Nantucket, who visited the island in the whaler *Equator* in 1818, or by Captain Obed Starbuck on the ship *Loper* in 1825. Finally, in 1832, Michael Baker of New Bedford, Massachusetts gave the name 'Baker' to the island.

Guano Mining Era: 1850-1891

On February 5, 1857, Alfred G. Benson and Charles H. Judd on board the Hawaiian schooner *Liholiho* officially claimed the island under the "Guano Act" of 1856 for the American Guano Company (Bryan 1974). Guano mining on Baker Island was delayed because the ships sent to investigate the guano resources would not land at the island due to severe surf conditions (Clapp and Sibley 1965). While mining on Baker commenced in 1858 by the American Guano Company, formal recognition of their rights to the island did not occur until 1861 due to a mining rights dispute with the United States Guano Company. Mining on Baker Island peaked in the 1860s and 1870s. An estimated 200,000 to 240,000 tons of guano was removed from the island (Clapp and Sibley 1965). Evidence of this era of exploitation still remains as a large basin from mining excavation and mounds of low-grade guano mark the island landscape.

After 17 years of guano mining, Baker Island appears to have been uninhabited. Visits or very brief stopovers no doubt occurred during the interim. The Whippoorwill Expedition sponsored by Bishop Museum paid one such visit in September 1924. This scientific team spent only 1 day on Baker Island.

Colonizing Era: 1935-1942

The establishment of trans-Pacific air routes; territorial ownership disputes over several islands in the Pacific between the United States and the United Kingdom in the early 1900s, and the threat of a second world war led to colonizing efforts by the United States on several Pacific islands including Baker Island. Colonizing efforts began in March 1935. Several military personnel and graduates of Kamehameha Schools, Hawaii established a colony on Baker Island (Brown et al. 2002) termed the *Hui Panalā'au* (Bryan 1974; Kikiloi and Tengan 2002). After initial establishment, the colonists were comprised of Kamehameha graduates and were supplied with enough food, water and other necessities to sustain them "for a period of from six weeks to several months" (Bryan 1974). Water and bulk food were supplied from Hawaii. During this colonizing era, at least 26 trips were made to Baker Island by various Coast Guard cutters.

The colonists erected Meyerton as their place of permanent settlement, with structures for water, food storage, radio equipment, and walls around the main settlement being constructed. Attempts to grow trees, flowers, and vegetables were made, but the conditions were unfavorable for cultivated crops. During this era, a beacon was constructed from the stone slabs of the guano mining houses (Bryan 1974).

Military Era: 1942-1944

The colony on Baker Island continued undisturbed except for routine Coast Guard visits until December 10, 1941. A Japanese submarine surfaced offshore and fired about 30 rounds into the colonists' installations. A second round of 15 shells was fired later in the day. The shelling destroyed all the buildings except the rain shed and beacon. On December 28, a Japanese plane bombed and machine-gunned the island. The colonists were not injured by these raids and were removed by the destroyer *Helm* on January 31, 1942.

On July 30, 1943, engineer troops of the 7^{th} Army Air Force (AAF) were landed on Baker with equipment and supplies to construct an airstrip to defend the central Pacific islands. In the landing of materials for construction of the base, 11 out of 23 LCMs were damaged or lost in the surf (Morison 1951). The main portion of the base was constructed by October 1943, including the runway, 5,750 feet long and 150 feet wide, covered in a metal Marston mat and a 50-foot wide taxi-way made of rolled coral. Approximately 2,000-3,000 men were stationed on Baker Island during peak operations. The base participated in the Tarawa-Makin operation from November through December of 1943, providing extensive use of the airfield by B-24s. Military operations ceased thereafter and the island was evacuated in March 1944 (Bryan 1974).

On February 5, 1944, the Coast Guard authorized the construction of the Phoenix LORAN station on Baker Island. Construction began in June 1944, and required 12,000 cubic yards of coral to level off the selected area. Seven Quonset huts left by the AAF were placed on cribbed sleds and hauled about a mile to the station location on the north shore. Sufficient fuel was delivered to the site for the operation of a water distillation unit for over a year. This was one of the first LORAN stations where sentry dogs were used (USCG 1946). Due to high winds, treacherous surf, and torrential rains, landing materials at Baker took 2 weeks. Equipment was aided ashore by lines attached from the LCM to a tractor on shore that would haul the boat onto the beach (Willoughby 1980). The Coast Guard administered the island and LORAN station until it was abandoned in May 1946 (Clapp and Sibley 1965).

Post War Era: 1944 to present

No attempt was made to re-colonize Baker Island after the departure of the Coast Guard, although the Department of the Interior thought of doing so. In 1948, the United States decided that the claim to Baker Island could be effectively maintained by annual Coast Guard visits. Most visits to Baker Island usually occurred in the first four months of the year with the ships' crews completing repairs to the day beacon and taking photographs to establish their presence on the island (Shun 1987).

In March 1963, and for the following 2 years, Smithsonian Institution employees made a number of visits to Baker Island as part of the SIPOBS (Sibley et al. 1965). During this period of investigation by the Smithsonian, a reconnaissance team of the U.S. Atomic Energy Commission (AEC) visited the island. This group arrived on Baker Island on October 18, 1963, conducted their survey for the following 3 days and departed. In addition, a survey by AEC was made of topographical, geological, and oceanographic features of the island (USAEC 1963).

In recent years, sporadic visits have occurred in the form of Coast Guard and NOAA patrols and scientific expeditions. The island and its territorial seas were transferred to the Service in 1974 from the Office of Insular Affairs. This area is now managed as a unit of the System. Refuge staff members continue to participate in scientific expeditions, typically aboard NOAA vessels and occurring, on average, once every 2 years since 2000.

Socio-economics

Historical Developments

Since whaling days, Baker Island has been used for a variety of commercial enterprises. During the whaling era, it appears that Baker Island served as a port-in-a-storm and possible gathering site for provisions which included harvesting seabirds, sea turtles, and their eggs. Fishing for tuna and other species may have occurred as well. The guano-mining era provided the world with a nutrient-rich fertilizer. Baker and other central Pacific islands were exploited for their deep guano deposits.

After the guano mining period, Baker Island was retained by the U.S. Government to aid in transportation and commerce during the mid-1930s. A colony was established on Baker Island to assert U.S. possession by placing four to five men on Baker Island from 1935 to 1942 (Bryan 1974, Brown et al. 2002). Baker Island was used as an U.S. Army airfield from 1943-44. The Coast Guard constructed and staffed a LORAN station from 1944-46. After 1946, there was no further military use of the island, but Coast Guard vessels performed annual patrols to protect U.S. economic interests in the central Pacific.

In modern times, a proposal to use the island for military/atomic testing was developed in 1963 (USAEC 1963), but the proposal did not materialize for Baker, it was implemented on Johnston Island instead. In 1974, Baker Island and its territorial sea was transferred to the Service as a unit of the System to preserve and restore ecosystem values, focusing on nesting seabird populations

During the past decade, the government of Kiribati requested permission to allow their fishing fleets within Baker Island’s 200-mile Exclusive Economic Zone (EEZ). The Department of the Interior relayed their concerns about this request to the appropriate offices of the Bureau of East Asian and Pacific Affairs in the Department of State. As a result, the Department of State informed the Government of Kiribati that the U.S. Government would decline that request. There are no current economic uses of Baker, and the island remains unpopulated.

Land Use

Baker has been uninhabited since the World War II era and will remain so except for occupation during periodic field camps. As such, the future "land use" for Baker will likely include designation of a preferred field camp site that will not conflict with important wildlife functions, habitat restoration, cultural sites, or wilderness values or be in a contaminated area. Site planning will also identify corridors for small boat access, footpaths for regular island patrols, study sites, areas designated for solar power and potable water production generation, waste and trash disposal areas, work areas, and other needs.

Public Access

Baker is closed to public access. There has never been, nor are there plans to formally open the refuge to recreational activities by publishing public notice in the Federal Register. However, limited public access of Baker has been authorized in the past. Refuge access is managed through the issuance of a Special Use Permit (SUP) when the activity is deemed compatible and appropriate with the purposes of refuge establishment.

Commercial Fishing

There has been essentially no recorded Hawaii-based longline fishing activity within the Howland and Baker Islands U.S. EEZs (0-200 nmi) from 1991-2007 (Hamm and Dowdell, 2008). There has also been no commercial purse seine fishing between 0-12 nmi around Howland and Baker Islands from 1998 to 2007 (NMFS SWFSC 2008). Over the years, foreign commercial fishing vessels may have targeted uninhabited Baker for unauthorized and illegal fishing because of the lack of on-site surveillance and enforcement capacity. The economic pressure to pursue this option would likely increase in the future as commercial fishing stocks in Asia and the Pacific become more heavily fished and depleted. Baker is habitat to many commercially valuable fishery species including sharks, lobsters, groupers, giant clams, tuna, wahoo, swordfish, deepwater snappers, bumphead parrotfish, humphead wrasses, various aquarium fish, pearl oysters, sea cucumbers, and other species. The no-take mandate and establishment of the refuge predated the applicability of the Magnuson-Stevens Fishery Conservation and Management Act of 1996 as amended (16 USC 1361 et seq.) to Baker. The deep slope area outside the refuge is likely too small to support commercial bottomfish harvest especially in light of the long commuting distances between Baker and the home ports of the fishing vessels.

APPENDICES

Appendix A

Glossary of Terms and Acronyms

ACHP. President's Advisory Council on Historic Preservation.

Alien species. Non-native species intentionally or accidentally introduced into refuge habitats.

Atoll. A tropical reef formation, with a shallow water lagoon, surrounding perimeter reef, and reef islet(s).

Baker. Used alone in this report, it refers to the Baker Island National Wildlife Refuge.

CCP. Comprehensive Conservation Plan.

CCP/EA. A document that combines a Comprehensive Conservation Plan and an Environmental Assessment.

CFR. Code of Federal Regulations. A comprehensive directory of all Federal regulations.

CITES. Convention on the International Trade in Endangered Species of Wild Fauna and Flora.

Comprehensive Conservation Plan. A document that describes the desired future conditions of the refuge, and provides long-range guidance and management direction for the refuge manager to accomplish the purposes of the refuge, contribute to the mission of the System, and to meet other relevant mandates (Service Manual 602 FW 1.5).

CPWHP. Central Pacific World Heritage Project.

CRED. The Coral Reef Ecosystem Division of NOAA's Pacific Islands Fisheries Science Center.

DLNR. Hawaii Department of Land and Natural Resources.

DMA. Defense Mapping Agency.

EEZ. Exclusive Economic Zone.

EIS. Environmental Impact Statement. NEPA documentation that assesses the impacts of major Federal actions significantly affecting the quality of the human environment.

Environmental Assessment. A concise public National Environmental Policy Act compliance document that briefly discusses the purpose and need for an action and action alternatives, and provides sufficient analysis of impacts and evidence to determine whether an environmental impact statement or finding of no significant impact needs to be prepared (40 CFR 1508.9).

ENSO. El Niño Southern Oscillation; a periodic ocean warming anomaly in the tropics.

EUC. Equatorial Undercurrent; a subsurface ocean current flowing east at the Equator.

Federal Register (FR). Official bulletin publicizing notices of Federal actions.

FMPS. Fishery Management Plans for commercial fisheries in Federal waters.

FONSI. Finding of No Significant Impact; a federal agency notice and preliminary decision that its proposed action would not require preparation of an EIS.

GIS. Geographic information system; a database integrating tabular and geographic data.

GPS. Global Positioning System; satellite-based for accurate geographic/site positioning.

Howland. Used alone in this report, it refers to the Howland Island National Wildlife Refuge.

Hydrophone. Underwater microphone or listening device.

Improvement Act. The National Wildlife Refuge System Improvement Act of 1997 amendment to the National Wildlife Refuge System Administration Act of 1966.

Insular Area. The current generic term used to refer to a United States possession, territory, Territory, freely associated state, or commonwealth under United States sovereignty.

Invasive Species. Either an alien or native species that spreads, or achieves dominance quickly, resulting in undesirable effects on native species and their habitats

ITCZ. Inter-tropical Convergence Zone; approximately along 5º N Latitude where the northeast and southeast trade winds collide, rise, and create a zone of heavy rainfall and low winds; also known as the doldrums.

IUCN. International Union for the Conservation of Nature.

Jarvis. Used alone in this report, it refers to the Jarvis Island National Wildlife Refuge.

LEIS. Legislative Environmental Impact Statement. See EIS.

MBTA. Migratory Bird Treaty Act.

Mesoscale Eddy. A circular flow of water near an island or reef, roughly 10 to 100 nm in diameter caused by the wake of currents passing a reef or island.

µ L. Micro liter, or one-millionth of a liter.

NEC. North Equatorial Current, west-flowing oceanic surface current between 5-30ºN Latitude driven by the northeast trade winds.

NECC. North Equatorial Countercurrent; east-flowing oceanic surface current under the ITCZ.

NEPA. National Environmental Policy Act; establishes procedures requiring all Federal agencies to assess the environmental consequences of their actions.

NMI. Nautical mile; the equivalent of 1.15 statute (land) mile, 6,000 ft., or one minute of Longitude at the Equator.

NMFS. The National Marine Fisheries Service of NOAA.

NOAA. National Oceanic and Atmospheric Administration.

NPS. National Park Service.

NWR. National Wildlife Refuge.

NWRS. National Wildlife Refuge System.

Oligotrophic. Waters having low levels of the mineral nutrients required by green plants. At Howland, this refers to the transparent zone of nutrient-poor shallow tropical waters, bounded by a thermocline serving as a barrier against exchange with deeper nutrient-rich waters.

Phenology. The study of periodic biological phenomena, such as breeding, flowering, and migrations, especially as related to climate.

Preferred Alternative. This is the alternative determined [by the decision maker] to best achieve the refuge purpose(s), vision, and goals; contributes to the Refuge System mission, addresses the issues; and is consistent with principles of sound fish and wildlife management.

Proposed Action. Preferred Alternative among several evaluated to comply with NEPA.

Quadrat. A rigid frame used by ecologists to facilitate unit area estimates of the size and density of surface-dwelling plants and animals; **Photo-quadrat.** A photograph of the area inside the quadrat to allow office data analysis after field staff visits.

PIFSC. NOAA's Pacific Islands Fisheries Science Center.

REA. Rapid ecological assessments.

Reef Island. Low tropical islet resting on a coral reef and consisting of reef rock and sand.

RONS. Refuge Operating Needs System; Service program for NWR operating funds.

ROV. Remotely operated vehicle; mobile un-manned device for collecting deep-sea data.

SAMMS. Service Asset Maintenance Management System; Service program to provide funds to maintain refuge property.

SEC. South Equatorial Current; westward-flowing ocean current driven by the southeast trade winds between Latitudes 5º N and 30º S.

Secretary. The Secretary of the Interior.

Service. Used alone in this report, it refers to the U.S. Fish and Wildlife Service.

SIPOBS. Smithsonian Institution Pacific Ocean Biological Survey.

SUP. Special Use Permit; written Service approval and conditions for conducting an activity on a refuge.

System. Used alone in this report, it refers to the National Wildlife Refuge System.

Thermocline. In oceans, it is a depth zone of rapid density and temperature change serving as a barrier between mixing of shallow warmer surface and deeper subsurface waters.

Transect. A linear scientific field survey sampling design or area to facilitate repeatability, standard units of measurement, and future site relocation and resurvey.

UNESCO. United Nations Educational, Scientific and Cultural Organization.

USCG. United States Coast Guard.

U.S. Possession. Equivalent to *U.S. territory*. It is no longer current colloquial usage.

U.S. Territory. An incorporated United States insular area, of which only two currently exists in the Pacific Ocean (Guam American Samoa), in which the United States Congress has applied the full body of the United States Constitution.

U.S. territory. A United States insular area in which the United States Congress has determined that only selected parts of the United States Constitution apply.

WESPAC. Western Pacific Regional Fisheries Management Council.

WSA. Wilderness Study Area.

World Heritage Property. A protected and inscribed natural and/or cultural site with "outstanding universal value" and meeting one or more of the eligibility criteria of the International Convention on World Heritage.

Appendix B

Species Lists

Table B-1: FAMILIES, *genera*, common names, and number of species/genus for corals and other cnidarians reported from Baker Island NWR 1998-2006. After Maragos (2000-2003, 2004, 2006), and Maragos & Schmerfeld (1998).

Scientific Name	Common Name	Number of Species
MILLEPORIDAE		
Millepora	fire coral	1
POCILLOPORIDAE		
Pocillopora	antler coral and cauliflower corals	3
ACROPORIDAE		
Acropora	table and staghorn corals	23
Astreopora	crater coral	1
Montipora	rice and plate corals	10
PORITIDAE		
Porites annae	lobe corals	5
AGARICIIDAE		
Gardineroseris	honeycomb coral	1
Leptoseris	deep encrusting coral	1
Pachyseris	combed plate coral	1
Pavona	star and corrugated corals	4
FUNGIIDAE		
Cycloseris	small mushroom coral	1
Fungia	mushroom coral	4
Halomitra	giant basket coral	1
Herpolitha	stone snake coral	1
Sandalolitha	oval mushroom coral	1
MUSSIDAE		
Acanthastrea	spiny encrusting coral	1
Lobophyllia	spiny lobe coral	1
Symphyllia	spiny brain coral	1
MERULINIDAE		
Hydnophora	pedestal coral	1
FAVIIDAE		
Cyphastrea sp.	small walled brain coral	1
Diploastrea	star brain coral	1
Echinopora	encrusting brain coral	1
Favia	circular brain corals	3
Favites	honeycomb brain coral	2
Leptastrea bewickensis	incrusting brain coral	2
Montastrea	large walled brain corals	2

Scientific Name	Common Name	Number of Species
Platygyra	true brain corals	2
DENDROPHYLLIIDAE		
Cladopsammia	slender yellow tube coral	1
Tubastraea	common tube coral	1
Turbinaria	cabbage coral	1
Rhizopsammia	rhizome tube corals	1
DISCOSOMATIDAE		
Rhodactis	false corals	1
SIDERASTREIDAE		
Coscinaraea	sandpaper corals	2
Psammocora	granulated corals	4
ACTINARIA		
Aptasia	stalked anemone	1
Entacmaea	bubble-tip anemone	1
Heteractis	Anemone	1
ZOANTHIDEA		
Palythoa tuberculosa	rubber coral	1

Table B-2: Fish species and genera collected from or observed at Baker Island from 1927-2002. Collected or compiled by Mundy et al. (2002).

Scientific Name	Common Name
CARCHARHINIDAE	**Requiem Sharks**
Carcharhinus amblyrhynchos (Bleeker 1856)	grey reef shark
Carcharhinus melanopterus (Quoy &Gaimard 1824)	reef black-tip shark
HEMIGALEIDAE	**Weasel Sharks, White-tip Reef Sharks**
Triaenodon obesus (Rüppell 1837)	white-tip reef shark
SPHYRNIDAE	**Hammerhead Sharks**
Sphyrna mokarran (Rüppell 1837)	great hammerhead shark
Sphyrna sp.	unidentified *Sphyrna* species
DASYATIDAE	**Sand Rays**
Taeniura meyeni (Müller & Henle 1841)	giant sand ray
MYLIOBATIDAE	**Eagle Rays**
Manta sp.	unidentified *Manta* species
MURAENIDAE	**Moray Eels**
Echidna nebulosa (Ahl 1789)	snowflake moray
Gymnomuraena zebra (Shaw *in* Shaw & Nodder 1797)	zebra moray
Gymnothorax breedini (McCosker & Randall 1977)	Breeden’s moray
Gymnothorax flavimarginatus (Rüppell 1830)	yellow-margined moray

Scientific Name	Common Name
Gymnothorax rueppelliae (McClelland 1844)	yellow-headed moray
Gymnothorax sp.	unidentified *Gymnothorax* species.
Uropterygius marmoratus	marbled snake moray
Uropterygius micropterus	tide pool snake moray
Uropterygius sp.	unidentified *Uropterygius* species
MUGILIDAE	**Mullets**
Chaenomugil leuciscus	acute-jawed mullet
Crenimugil crenilabrus	fringelip mullet
Valamugil engeli	Engel's mullet
HOLOCENTRIDAE	**Squirrelfishes and Soldierfishes**
Myripristis berndti (Jordan & Evermann 1903)	bigscale soldierfish
Neoniphon opercularis	blackfin squirrelfish
Sargocentron caudimaculatum (Rüppell 1838)	tailspot squirrelfish
Sargocentrum punctatissimum	speckled squirrelfish
Sargocentrum tiere (Cuvier in Cuvier & Valenciennes 1829)	blue-lined squirrelfish
Pseudanthias cooperi	red-bar fairy basslet
Pseudanthias pascalus	fairy basslet
Pseudanthias pleurotaenia	fairy basslet
CARACANTHIDAE	**Orbicular Velvetfishes**
Caracanthus maculates (Gray 1831)	spotted coral croucher
SERRANIDAE	**Sea Basses, Fairy Basslets & Groupers**
Aethaloperca rogaa	redmouth grouper
Cephalopholis argus (Bloch & Schneider 1801)	peacock grouper
Cephalopholis miniatatus (Forsskål 1775)	coral grouper
Cephalopholis urodeta (Forster *in* Bloch & Schneider 1801)	flagtail grouper
Epinephelus fasciatus (Forsskål 1775)	black-tipped grouper
Epinephelus hexagonatus (Forster in Bloch & Schneider 1801)	hexagon grouper
Epinephelus howlandi (Günther 1873)	Howland Island grouper
Epinephelus macrospilos (Bleeker 1855)	black-spotted grouper
Epinephelus melanostigmus (Schultz in Schultz et al. 1953)	blackspot honeycomb grouper
Epinephelus merra (Bloch 1793)	honeycomb grouper
Epinephelus spilotoceps (Schultz in Schultz et al. 1953)	four-saddle grouper
Gracila albomarginata (Fowler & Bean 1930)	white-margined grouper
Luzonichthys whitleyi (Smith 1955)	Whitley's slender basslet

Scientific Name	Common Name
Pseudanthias bartlettorum (Randall & Lubbock 1981)	Bartlett's fairy basslet
Pseudanthias bartlettorum var. "red spot" (Randall & Lubbock 1981)	Bartlett's "red spot" basslet
Pseudanthias cooperi	red-bar fairy basslet
Pseudanthias olivaceus (Randall & McCosker 1982)	fairy basslet
Pseudanthias pascalus	fairy basslet
Pseudanthias pleurotaenia	fairy basslet
Pseudantias sp.	unidentified *Pseudantias* sp.
Variola louti (Forsskål 1775)	lyretail grouper
BELONIDAE	**Needlefishes**
Platybelone argulus platyura	keeled needlefish
Tylosurus crocodilus (Peron & Lesueur in Lesueur 1821)	crocodile needlefish
EXOCOETIDAE	**Flying Fish**
Exocoetidae sp.	unidentified flyingfish species
HEMIRAMPHIDAE	**Halfbeaks**
Hemiramphidae sp.	unidentified halfbeak species
APOGONIDAE	**Cardinalfishes**
Apogon angustatus (Smith & Radcliffe in Radcliffe 1911)	broad-striped cardinalfish
Apogon apogonides (Bleeker 1856)	cardinalfish
Apogon taeniophorus (Regan 1908)	cardinalfish
ECHENEIDAE	**Remoras**
Remora remora	remora
CARANGIDAE	**Jacks and Trevallys**
Carangoides ferdau (Forsskål 1775)	bar jack
Carangoides orthogrammus (Jordan & Gilbert 1882)	yellow-spotted trevally
Caranx ignobilis (Forsskål 1775)	giant trevally
Caranx lugubris (Poey 1860)	black jack
Carnax melampygus (Cuvier in Cuvier & Valenciennes 1833)	bluefin trevally
Caranx sexfasciatus (Quoy & Gaimard 1825)	bigeye trevally
Elegatis bipinnulata (Quoy & Gaimar 1825)	rainbow runner
Trachinotus baillonii	pompano
LUTJANIDAE	**Snappers**
Aphareus furca (Lacepède 1801)	blue small-tooth jobfish
Aphareus rutilans	jobfish
Aprion virescens	jobfish, uku
Lutjanus bohar (Forsskål 1775)	twinspot snapper, redspot snapper
Lutjanus fulvus	flametail snapper

Scientific Name	Common Name
(Forster *in* Bloch & Schneider, 1801)	
Lutjanus gibbus (Forsskål 1775)	humpback snapper
Lutjanus monostigma (Cuvier in Cuvier & Valenciennes 1828)	one-spot snapper
Macolor niger	black snapper
Pristipomoides filamentosus	snapper
CAESIONIDAE	**Fusiliers**
Caesio teres (Seale 1906)	yellow-back fusilier
Pterocaesio tile	bluestreak fusilier
LETHRINIDAE	**Emperors**
Gnathodentex aureolineatus (Lacepède 1802)	yellowspot emperor
Monotaxis grandoculis (Forsskål 1775)	bigeye emperor
Lethrinus sp.	unidentified emperor species
MULLIDAE	**Goatfishes**
Mulloides mimicus (Randall & Guézé 1980)	mimic goatfish
Mulloides vanicolensis	yellowfin goatfish
Parupeneus bifasciatus (Lacepède 1801)	two-barred goatfish
Parupeneus multifasciatus	multibarred goatfish
PEMPHERIDAE	**Sweepers**
Pempheris oualensis (Cuvier in Cuvier & Valenciennes 1831)	bronze sweeper
KYPHOSIDAE	**Rudderfishes & Sea Chubs**
Kyphosus cinerascens (Forsskål 1775)	highfin rudderfish, snubnose rudderfish
Kyphosus vaigiensis (Quoy & Gaimard 1825)	lowfin rudderfish, brassy chub
Sectator ocyurus	rudderfish
CHAETODONTIDAE	**Butterflyfishes**
Chaetodon auriga (Forsskål 1775)	threadfin butterflyfish
Chaetodon citrinellus	speckled butterflyfish
Chaetodon lineolatus (Cuvier (ex Quoy & Gaimard) in Cuvier & Valenciennes 1831)	lined butterflyfish
Chaetodon lunula (Lacépède 1802)	racoon butterflyfish
Chaetodon meyeri (Bloch & Schneider 1801)	Meyer's butterflyfish
Chaedodon ornatissimus (Cuvier (ex Solander) in Cuvier & Valenciennes 1831)	ornate butterflyfish
Chaetodon quadrimaculatus (Gray 1831)	fourspot butterflyfish
Chaetodon reticulates	reticulated butterflyfish
Chaetodon semeion	dotted butterflyfish
Chaetodon trifascialis	chevroned butterflyfish
Chaetodon unimaculatus (Bloch 1787)	teardrop butterflyfish
Forcipiger flavissimus (Jordan & McGregor in Jordan & Evermann 1898)	long-nosed butterflyfish
POMACANTHIDAE	**Angelfishes**
Apolemichthys griffisi	Griffith's angelfish

Scientific Name	Common Name
(Carlson & Taylor 1981)	
Apolemichthys xanthopunctatus (Burgess 1973)	golden-spotted angelfish
Centropyge bicolor	Bicolor angelfish
Centropyge flavissima (Cuvier in Cuvier & Valenciennes 1831)	lemon-peel angelfish
Centropyge loricula (Günther 1874)	flame angelfish
Centropyge vrolikii	pearlscale angelfish
Pygoplites diacanthus	regal angelfish
POMACENTRIDAE	**Damselfishes**
Abudefduf sordidus (Forsskål 1775)	black-spot sergeant
Abudefduf vaigiensis	sergeant
Abudefduf species	unidentified sergeant species
Amblyglyphidodan aureus	golden damsel
Amphiprion chrysopterus	orange-fin Anemonefish
Chromis acares (Randall & Swerdloff 1973)	midget chromis
Chromis caudalis	blue axil chromis
Chromis margaritifer (Fowler 1946)	bicolor chromis
Chromis xanthura (Bleeker 1854)	black chromis
Chrysiptera brownriggi	Brownrugg's damoiselle
Chrysiptera glauca (Cuvier in Cuvier & Valenciennes 1830)	gray demoiselle
Dascyllus auripinnis	yellow-fin dascyllus
Lepidozygus tapeinosoma (Bleeker 1856)	fusilier damsel
Plectroglyphidodon phoenixensis (Schultz 1943)	Phoenix Islands damsel
Plectroglyphidodon dickii (Liénard 1839)	Dick's damsel
Plectroglyphidodon imparipennis (Vaillant & Sauvage 1875)	bright-eye damsel
Plectroglyphidodon johnstonianus (Fowler & Ball 1924)	Johnston Island damsel
Plectroglyphidodon lacrymatus	jewel damsel
Plectroglyphidodon leucozonus	white-band damsel
Stegastes albifasciolatus	white-bar gregory
Stegastes aureus (Fowler 1927)	golden gregory
Stegastes fasciolatus (Ogilby 1889)	Pacific gregory
Stegastes nigricans (Lacepède 1802)	dusky farmfish
Stegastes sp. or *Pomacentrus* sp.	unidentified damselfish species
KUHLIIDAE	**Flagtails**
Kuhlia sandvicensis (Steindachner 1876)	Hawaiian flagtail
CIRRHITIDAE	**Hawkfishes**
Cirrhitichthys oxycephalus (Bleeker 1855)	pixy hawkfish
Cirrhitops hubbardi	Hubbard's hawkfish

Scientific Name	Common Name
Neocirrhites armatus (Castelnau 1873)	flame hawkfish
Paracirrhites arcatus (Cuvier in Cuvier & Valenciennes 1829)	arc-eye hawkfish
Paracirrhites forsteri (Schneider in Bloch & Schneider 1801)	freckled hawkfish, blackside hawkfish
Paracirrhites hemistictus (Günther 1874)	whitespot hawkfish
Paracirrhites xanthus (Randall 1963)	yellow hawkfish
SPHYRAENIDAE	**Barracudas**
Sphyraena sp.	unidentified *Sphyraena* species
Sphyraena barracuda (Walbaum, 1792)	great barracuda
LABRIDAE	**Wrasses**
Anampses caeruleopunctatus (Rüppell 1829)	blue-spotted wrasse
Anampses meleagrides (Valenciennes in Cuvier & Valenciennes 1840)	yellowtail wrasse
Bodianus axillaries (Bennett 1832)	axilspot hogfish
Bodianus prognathus (Lobel 1981)	hogfish
Cheilinus oxycephalus	snooty wrasse
Cheilinus trilobatus (Lacepède 1801)	tripletail wrasse
Cheilinus undulatus (Rüppell 1835)	humphead wrasse, Napoleonfish, Napoleon wrasse
Coris aygula (Lacepède 1801)	clown coris
Coris centralis (Randall 1999)	coris
Coris gaimard (Quoy & Gaimard 1824)	yellowtail coris
Dioroctacanthus xanthurus	wandering cleaner wrasse
Gomphosus varius (Lacepède 1801)	bird wrasse
Halichoeres ornatissinus (Garrett 1863)	ornate wrasse fish
Hemigymnus fasciatus (Bloch 1792)	barred thicklip wrasse
Labrichthys unilineatus	tubelip wrasse
Labroides bicolor (Fowler & Bean 1928)	bicolor cleaner wrasse
Labroides dimidiatus (Valenciennes in Cuvier & Valenciennes, 1839)	bluestreak cleaner wrasse
Labroides rubrolabiatus (Randall, 1958)	cleaner wrasse
Labropsis xanthonota (Randall, 1981)	wedge-tailed wrasse
Macropharyngodon meleagris (Valenciennes in Cuvier & Valenciennes 1839)	leopard wrasse
Novaculichtyhs taeniourus	dragon wrasse, rockmover wrasse
Oxycheilinus unifasciatus (Streets 1877)	wrasse
Pseudocheilinus hexataenia (Bleeker 1857)	sixline wrasse
Pseudocheilinus octotaenia (Jenkins 1901)	eightline wrasse
Pseudocheilinus tetrataenia (Schultz in Schultz et al. 1960)	fourline wrasse
Pseudocoris heteroptera (Bleeker 1857)	wrasse
Pseudodax mollucanus (Valenciennes in	wrasse

Scientific Name	Common Name
Cuvier & Valenciennes 1840)	
Stethojulis bandanensis (Bleeker 1851)	redshoulder wrasse
Thalassoma amblycephalum (Bleeker 1856)	twotone wrasse
Thalassoma Hardwicke	sixbar wrasse
Thalassoma lutescens (Lay & Bennett (ex Solander) 1839)	sunset wrasse
Thalassoma purpureum (Forsskål 1775)	surge wrasse
Thalassoma quinquevittatum (Lay & Bennett 1839)	fivestripe surge wrasse
Thalassoma trilobatum (Lacepède 1801)	Christmas wrasse
SCARIDAE	**Parrotfishes**
Calatomus carolinus (Valenciennes 1840)	bucktooth parrotfish, stareye parrotfish
Chlorurus frontalis (Valenciennes in Cuvier & Valenciennes 1840)	tan-faced parrotfish
Chlorurus microrhinus (Bleeker 1854)	parrotfish
Scarus niger	black parrotfish
Scarus frenatus (Lacepède 1802)	vermiculate parrotfish
Scarus oviceps (Valenciennes in Cuvier & Valenciennes 1840)	dark-capped parrotfish
Scarus rubroviolaceus (Bleeker 1847)	red and violet parrotfish, redlip parrotfish
Scarus tricolor (Bleeker 1847)	tricolor parrotfish
BLENNIIDAE	**Blennies**
Blenniella gibbifrons (Quoy & Gaimard 1824)	blenny
Cirripectes quagga (Fowler & Ball 1924)	squiggly blenny
Cirripectes sp.	unidentified *Cirripectes* species
Cirripectes variolosus (Valenciennes in Cuvier & Valenciennes 1836)	red-speckled blenny
Istiblennius edentulous (Schneider in Bloch & Schneider 1801)	rippled rockskipper
Meiacanthus atrodorsalis	poison-fang blenny
Plagiotremus laudandus	poison-fang blenny mimic
Plagiotremus rhynorhynchus (Bleeker 1852)	blue-striped blenny
Plagiotremus tapeinosoma (Bleeker 1857)	piano blenny, scale-eating blenny
Rhabdoblennius snowi	Snow’s rockskipper
PTERELEOTRIDAE	**Dartfishes, Hovergobies, & Wormfishes**
Ptereleotris zebra	zebra dartfish
ACANTHURIDAE	**Surgeonfishes & Unicornfishes**
Acanthurus achilles (Shaw 1803)	Achilles tang
Acanthurus blochii (Valenciennes in Cuvier & Valenciennes 1835)	ringtail surgeonfish
Acanthurus guttatus (Forster in Bloch & Schneider 1801)	spotted surgeonfish

Scientific Name	Common Name
Acanthurus lineatus (Linnaeus 1758)	blue-banded surgeonfish
Acanthurus maculiceps	White-freckled surgeonfish
Acanthurus mata (Cuvier 1829)	elongate surgeonfish
Acanthurus nigricans (Linnaeus 1758)	whitecheek surgeonfish
Acanthurus nigricauda (Duncker & Mohr 1929)	epaulette surgeonfish
Acanthurus nigrofuscus (Forsskål 1775)	brown surgeonfish
Acanthurus nigroris (Valenciennes in Cuvier & Valenciennes 1835)	blue-lined surgeonfish
Acanthurus olivaceus (Bloch & Schneider (ex Forster) 1801)	orangeband surgeonfish
Acanthurus pyroferus	chocolate surgeonfish
Acanthurus rackliffei (*A. achilles* x *A. nigricans*)(Schultz 1943)	hybrid surgeonfish
Acanthurus thompsoni (Fowler 1923)	Thompson's surgeonfish
Acanthurus triostegus (Linnaeus 1758)	convict tang
Acanthurus xanthopterus (Valenciennes in Cuvier & Valenciennes 1835)	yellow-finned surgeonfish
Ctenochaetus cyanocheilus (Randall & Clements 2001)	surgeonfish
Ctenochaetus flavicaudis (Fowler 1938)	surgeonfish
Ctenochaetus hawaiiensis (Randall 1955)	chevron tang, black surgeonfish
Ctenochaetus marginatus (Valenciennes in Cuvier & Valenciennes 1835)	blue-spotted bristletooth
Ctenochaetus striatus (Quoy & Gaimard 1825)	striped bristletooth
Naso caesius	unicornfish
Naso hexacanthus (Bleeker 1855)	black-tongue unicornfish, sleek unicornfish
Naso lituratus (Forster in Bloch & Schneider 1801)	liturate surgeonfish
Naso unicornis	bluespine unicornfish
Naso vlamingii (Valenciennes in Cuvier & Valenciennes 1835)	bignose unicornfish
Paracanthurus hepatus	Palette surgeonfish, Hepatus tang
Zebrasoma rostratum (Günther 1873)	tang
Zebrasoma scopas (Cuvier 1829)	brown tang
Zebrasoma veliferum	sailfin tang
EPHIPPIDAE	**Batfishes**
Platax orbicularis	circular spadefish, batfish
ZANCLIDAE	**Moorish Idol**
Zanclus cornutus (Linnaeus 1758)	moorish idol
SCOMBRIDAE	**Tunas**

Scientific Name	Common Name
Euthynnus affinis (Cantor 1849)	kawakawa, bonito
Gymnosarda unicolor (Rüppell 1836)	dogtooth tuna
Scomber japonicus	Japanese mackerel, saba
BALISTIDAE	**Triggerfishes**
Balistapus undulatus (Park 1797)	orangestriped triggerfish
Balistoides viridescens (Bloch & Schneider 1801)	mustache triggerfish, titan triggerfish
Melichtys niger (Bloch 1786)	black triggerfish
Melichtys vidua (Richardson (ex Solander) 1845)	pinktail triggerfish
Odonus niger (Rüppell 1836)	redtooth triggerfish
Pseudobalistes flavimarginatus (Rüppell1829)	yellowmargin triggerfish
Rhinecanthus rectangulus (Bloch & Schneider 1801)	wedge picassofish, humunukunukuapua‘a
Sufflamen bursa (Bloch & Schneider 1801)	scythe triggerfish, boomerang triggerfish
Sufflamen chrysopterus (Bloch & Schneider 1801)	halfmoon triggerfish
Sufflamen frenatus	bridle triggerfish
Xanthichthys caeruleolineatus (Randall et al. 1978)	bluelined triggerfish
MONACANTHIDAE	**Filefishes & Leatherjackets**
Aluterus scriptus (Osbeck 1765)	scribbled filefish
Amanses scopas (Cuvier 1829)	broom filefish
Cantherhines dumerilii (Hollard 1854)	barred filefish
Cantherhines pardalis (Rüppell 1837)	wire-net filefish
Pervagor janthinosoma	blackbar filefish
OSTRACIIDAE	**Trunkfishes**
Ostracion meleagris meleagris (Shaw in Shaw & Nodder 1796)	spotted trunkfish
TETRAODONTIDAE	**Puffers**
Arothron meleagris (Lacepède (ex Commerson) 1798)	guineafowl puffer
Arothron nigropunctatus	blackspotted puffer
Canthigaster amboinensis (Bleeker 1865)	Ambon sharpnose puffer
Canthigaster solandri (Richardson (ex Solander) 1845)	spotted sharpnose puffer
DIODONTIDAE	**Porcupinefishes**
Diodon hystrix (Linnaeus 1758)	porcupinefish

Table B-3: Vegetation of Baker Island NWR. Compiled from unpublished Service trip reports and literature

Scientific Name	Common Name, (Hawaiian Name)	Source*	Observed by**
Cocos nucifera	coconut, niu	I	h
Cordia subcordata	cordia, kou	N	a,c,d,e
Terminalia catappa	tropical almond	I	b
Ipomoea macrantha		W	a,b
Ipomoea pes-caprae	beach morning glory	W	d,e
Fimbristylis cymosa	mauu akiaki	N	a,e
Euphorbia hirta	asthra weed	A	a,b,d,e
Phyllanthus amarus		A	a,d,e
Sophora tomentosa	yellow neclacepod	W	e
Scaevola taccada	naupaka	W	f
Cassytha filiformia		N	i
Barringtonia asiatica	Fish poison tree	W	i
Sida fallax	‘ilima	A	a,b,d,e
Thespesia populnea	milo	I	b
Abutilon indicum	abutilon	I	a,e
Boerhavia sp.	alena	N	a,b,c,d,e
Cenchrus echinatus	sandbur	A	e
Cynodon dactylon	Bermuda grass	A	e
Digitaria pacifica	Pacific crabgrass	N	d,e
Lepturus repens	Pacific island thintail	N	a,b,c,d,e
Eragrostis tenela	love grass		
Eragrostis whitneyi	love grass	N	a
Setaria verticillata	hooked bristle grass	A	e
Portulaca lutea	portulaca, ‘ihi	N	a,,b,d,e
Portulaca oleracea	portulaca, ‘ihi	A	a,,b,d,e
Suriana maritime	Bay cedar	W	f
Triumfetta procumbens		N	a,b,e
Vitex negundo	Five leaved chaste tree	I	e
Tribulus cistoides	puncturevine, nohu	N	a,b,c,d,e

*Source: N = native, I = introduced, A = accidentally introduced, W = wave carried

** Collectors and Observers:

a -Christophersen 1927
b - Bryan 1942
c - Sibley 1963
d - Marshall 1963
e - Long 1964
f - Rauzon & Woodside 1998
g - Depkin & Newton 1995
h - Rodman 1935
i - Forsell & Bauer 1988
j - Flint & Woodside 1993

Table B-4: Birds of Baker Island NWR. Numbers are counts of adult birds only and compiled from unpublished Service trip reports. Note: No bird species found on Baker are listed under to the Endangered Species Act.

Scientific Name	Common Name	Highest count since 1973	Birds of Conservation Concern Status[b]	National Shorebird Prioritization Category[a]	Regional Seabird Conservation Category[c]
Phaethon rubricauda	red-tailed tropicbird*	72			Moderate
Sula dactylatra	masked booby*	3,134			Moderate
Sula leucogaster	brown booby*	375			Moderate
Sula sula	red-footed booby*	714			Currently not at Risk
Fregata minor	great frigatebird*	900			Moderate
Fregata ariel	lesser frigatebird*	16,200	BCC 68		High Concern
Onychoprion lunatus	gray-backed tern*	2,000			Moderate
Onychoprion fuscatus	sooty tern*	1,600,000			Moderate
Anous stolidus	brown noddy*	3,600			Currently not at Risk
Procelsterna cerulea	blue-grey noddy*	26	BCC 68		High Concern
Gygis Alba	white tern*	38			Moderate
Pluvianlis dominica	Pacific golden-plover	512	BCC 68	High Concern	
Tringa incana	Wandering tattler	70		Moderate Concern	

Scientific Name	Common Name	Highest count since 1973	Birds of Conservation Concern Status[b]	National Shorebird Prioritization Category[a]	Regional Seabird Conservation Category[c]
Numenius tahitiensis	bristle-thighed curlew	26	BCC 68	High Concern	
Arenaria interpres	ruddy turnstone	391		High Concern	
Limosa lapponica	bar-tailed godwit	2		High Concern	
Calidris acuminata	sharp-tailed sandpiper	6		Not Listed	
Calidris melanotos	pectoral sandpiper	2		Low Concern	
Calidris alba	sanderling	4		High Concern	
Charadrius semipalmatus	Semipalmated Plover	2		Low Concern	
Larus atricilla	Laughing Gull	1			

*indicates documented breeding species on Baker.
[a]Species prioritization categories according to United States Shorebird Conservation Plan (Brown et al. 2000).
[b]Birds of Conservation Concern (BCC) status according to Birds of Conservation Concern 2002 (USFWS 2002).
[c]Conservation classification according to Seabird Conservation Plan, Pacific Region (Englis and Naughton 2004)

Appendix C

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Appendix D

Planning Team Members

The following individuals were instrumental in the development of this CCP.

Name	Position	Degree(s)	Years of Exp.
Charles Pelizza*	Planning Team Leader	BA, Enviro. Science MS, Biology	26
Don Palawski*	Refuge Manager	BS, Fisheries Biology MS, Entomology	31
Bob Dieli*	Outdoor Recreation Planner	BS, Environmental Education	29
Barbara Maxfield	External Affairs Chief	BA, Business Admin/Marketing	27
Barry Stieglitz	Project Leader	BS, Forestry and Wildlife MPA, Public Admin.	18
Michael Molina*	Environmental Review Coor.	BS, Biology MS, Marine Biology	30
Beth Flint*	Supervisory Wildlife Biologist	BS, Wildlife Biology PhD, Biology	21
LeeAnn Woodward*	Contaminant Biologist	BS, Biology MS, Ecology PhD, Ecology	30
Jim Maragos*	Coral Reef Biologist	BA, Zoology, PhD, Oceanography	38

* indicates planning team member

Appendix E

Quarantine Protocol

The following protocol was developed to maintain consistency in quarantine procedures for all NWRs in the Pacific. Thus, these provisions apply to all of the remote island national wildlife refuges. Some refuges, including Baker, may have additional restrictions and requirements.

Pacific Remote Islands National Wildlife Refuge Complex
Special Conditions and Rules for
Moving Between Islands and Atolls and
Packing for Field Camps

The islands and atolls of the Pacific Remote Islands National Wildlife Refuge Complex are special places providing habitat for many rare, endemic plants and animals. Many of these species are formally listed as federally Threatened or Endangered under the Endangered Species Act of 1973. Endemic plants and insects, and the predators they support, are especially vulnerable to the introduction of competing or consuming, non-native species. Such introductions may cause the extinction of island endemics, or even the destruction of entire island ecological communities. Notable local examples include: the introduction of rabbits to Laysan Island in 1902 which caused the extinction of numerous plant and insect species and 3 endemic landbird species; the introduction of rats to many Pacific Islands causing the elimination of many burrowing seabird colonies; the introduction of the annual grass, sandbur, to Laysan Island where it has out competed native bunch grass and eliminated nesting habitat for the Endangered Laysan finch; and the introduction and proliferation of numerous ant species throughout the Pacific Islands to the widespread detriment of endemic plant and insect species (refuge files).

Several of the islands within the Refuge Complex are especially pristine, and, as a result, are diverse in terms of rare and special declining native plants and animals. Nihoa Island has 13 potential candidate Endangered insect species, numerous Endangered plants, and 2 Endangered birds. Necker Island has Endangered plants and 7 endemic insects that are candidates for the Endangered Species List. Laysan Island has endangered plants, five potential candidate endangered insect species and the Endangered Laysan finch and Laysan duck. Other islands in the Refuge Complex such as Lisianski, Howland, Baker, and Jarvis and islets in Atolls such as Rose, Pearl and Hermes Reef and French Frigate Shoals are inhabited by a variety of endemic and/or endangered species and require special protection from invasive species.

Other Pacific Island such as Kure and the “high islands” (Oahu, Hawaii, Maui, Kauai, etc.) as well as, certain islands within Midway Atoll, Pearl and Hermes Reef and French Frigate Shoals have native plants and/or animals that are at high risk from introduction to the relatively pristine islands discussed above. Of special concerns are introductions of non-native snakes, rats, ants and a variety of other insect and plant species. Invasive plants of highest concern are *Verbesina encelioides, Cenchrus echinatus, and Setaria verticillata.*

The U.S. Fish and Wildlife Service is responsible for the management and protection of the fish, wildlife, plants, and their habitats associated with islands of the Pacific Remote Islands NWR Complex. No one is permitted to access any of the Refuge's islands without the express written permission of the Refuge Manager in the form of a Special Use Permit. Because of the above concerns, the following restrictions on the movement of personnel and materials to the islands of the Refuge Complex exist. Note: Kure Island and Midway Atoll are not part of this Refuge Complex.

With the exception of Tern Island, French Frigate Shoals, the following rules apply:

Clothing and Soft Gear:

- Any personnel landing boats at any island should have clean clothes and shoes, meaning that they are free of dirt and seeds.

- Any personnel going ashore at any island and moving inshore from the immediate area in which waves are breaking at the time of landing must have new footwear, new or island-specific clothes and new or island-specific soft gear that have been frozen (<4 C) for at least 48 hours.

- At the discretion of the local USFWS representative, personnel from a NOAA ship or any other vessel servicing the Refuge may be allowed on shore to visit predesignated areas for guided tours. All stipulations for clean and frozen clothes apply.

- Otherwise, any personnel entering any vegetated area, regardless of how sparse the vegetation, must have new footwear, new clothes and new soft gear all frozen for at least 48 hours.

Definitions:

- “new" means off the shelf and never used anywhere but the island in question.
- "clothing" is all apparel , shoes, socks, over and under garments.
- "soft gear" is all gear such as daypacks, fanny packs, camera bags, camera/binocular straps, microphone covers, nets, holding or weighing bags, bedding, tents, luggage, or any fabric or material capable of harboring seeds or insects.

Clothing or gear coming off Kure and Midway should never be moved to any of the other refuge islands.

During transit, clothing and gear coming off Kure and Midway must be carefully sequestered to avoid contamination of gear bound for other remote islands. Special care must be taken to avoid contaminating gear storage areas and quarters aboard transporting vessels with seeds or insects from these islands.

General Rules:

- Regardless of origin or destination, inspect and clean all equipment, supplies, immediately prior to any trip to the Refuge. Carefully clean all clothing, footwear and soft gear following use to minimize risk of cross contamination of materials between islands.

- Pack supplies in plastic buckets with fitted lids or other sealable metal or plastic containers so they can be thoroughly cleaned inside and out. **Cardboard is not permitted on islands.** Cardboard boxes disintegrate in a short time and harbor seeds, animals, etc., which cannot be easily found or removed. **Wood is not permitted unless sealed on all surfaces.**

  Wooden boxes can also harbor insects and seeds and, therefore, are only allowed if well constructed (tight fitting seams are required). All wood must be treated, and inside and outside surfaces must be painted or varnished to provide a smooth, cleanable finish that seals all holes.

- Freeze or tarp and fumigate then seal all equipment (clothes, books, tents) immediately prior to departure. Food and cooking items need not be fumigated but should be cleaned and frozen, if freezable. Cameras, binoculars, radios, and other electronic equipment must be thoroughly cleaned, including internal inspection whenever possible, but they do not need to be frozen or fumigated. Such equipment can only be packed in wooden crates if treated as in #2 above. Any containers must contain new, clean packing materials and be frozen or fumigated.

- At present, Tern Island is the singular exception to the above rule having less stringent rules due to the large number of previously established invasive species. Careful inspection of all materials and containers is still required. However, it is acceptable to use wooden and cardboard containers for transporting supplies to Tem Island. In addition, there is no requirement for freezing or fumigating items disembarked at Tem. Although requirements for Tem Island are more lax, the Refuge is still concerned about the possibilities of new introductions.

Additional Special Conditions for Restricted Access to Nihoa Island:

Nihoa is one of the most pristine locations in the Refuge Complex. It is also inhabited by the highest number of federally listed endangered species. It is a small rugged island with many inaccessible areas. Introduction of any invasive species could have immediate, disastrous effects to natural resources. It would be almost impossible to mount any kind of control or eradication program on this island should an invasive species become established. Because of these reasons, access to Nihoa is strictly limited and rules governing entry are more stringent.

- Access to Nihoa by permittees would only be allowed under the direct supervision of a Refuge representative. The person, who shall be appointed by the Refuge Manager, would work with permittees to assure careful adherence with all rules for inspection, handling, and preparation of equipment. The Refuge Representative would have the authority to control and limit access to various parts of the island to protect animals, plants (especially endangered species), and archaeological sites. The Refuge Representative would have the authority to revoke access to the island or order an immediate departure from the island if conditions for working on the island are not fully met or are violated in some way.

- All field equipment made out of fabric material or wood must be new and never previously used in the Northwestern or main Hawaiian Islands. Equipment previously purchased or made for use on Nihoa that has been carefully sealed and stored while away from Nihoa, and not used elsewhere, may also be brought onto the island. Rules for freezing and/or fumigating are as described for other sites in the Refuge (see above).

- Clothing and personal effects must be cleaned and thoroughly inspected. All footwear (shoes, slippers, socks, etc.) must be new, unused, or previously only used on Nihoa and carefully sealed and stored while off of the island.

Rules Regarding Food:

Fresh foods that are typically transported to island field camps (potatoes, onions, cabbage, apples, oranges, etc.) are not likely to become established and flourish on the Refuge Complex and are allowed. However, other food items such as tomatoes could easily become established. Soil can contain many seeds, eggs, larvae, etc., and cannot be transported to or among islands.

Other food species such as alfalfa, mustard and cress, commonly used for sprouted greens, could potentially become established and cannot be brought to the islands. Other species such as mung beans, soybeans, and radishes would not likely survive on the islands and can be used for fresh greens. A list of fresh foods and seeds that are prohibited is provided below. Permittees should contact the Refuge Manager for more information or for questions about items not included on this list.

Strictly Prohibited:

Tomatoes (any variety), ray sunflower seeds, alfalfa seeds, mustard seeds.

Bulk dried fruits are allowed but should be frozen solid for at least one day to kill any insects.

Appendix F

Wilderness Review

I. General Information on Wilderness Reviews

Wilderness review is the process used to determine whether or not to recommend lands or waters in the National Wildlife Refuge System (System) to the United States Congress for designation as wilderness. Planning policy for the System (602 FW 3) mandates conducting wilderness reviews every 15 years through the Comprehensive Conservation Planning (CCP) process.

The wilderness review process has three phases: inventory, study, and recommendation. After first identifying lands and waters that meet the minimum criteria for wilderness, the resulting wilderness study areas (WSA) are further evaluated to determine if they merit recommendation from the U.S. Fish and Wildlife Service (Service) to the Secretary of the Interior (Secretary) for inclusion in the National Wilderness Preservation System (NWPS). Areas recommended for designation are managed to maintain wilderness character in accordance with management goals, objectives, and strategies outlined in the Final CCP until Congress makes a decision or the CCP is amended to modify or remove the wilderness proposal. A brief discussion of wilderness inventory, study, and recommendation follows.

<u>Wilderness Inventory</u>
The wilderness inventory consists of identifying areas that minimally meet the requirements for of wilderness as defined in the Wilderness Act of 1964 (Wilderness Act). Wilderness is defined as an area which:

- Has at least 5 thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition, or be capable of restoration to wilderness character through appropriate management at the time of review, or be a roadless island;
- Generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable;
- Has outstanding opportunities for solitude or a primitive and unconfined type of recreation; and
- May also contain ecological, geological, or other features of scientific, educational, scenic, or historical value. These features and values, though desirable, are not necessary for an area to qualify as a wilderness.

<u>Wilderness Study</u>
During the study phase, lands and waters qualifying for wilderness as a result of the inventory are studied to analyze values (ecological, recreational, cultural, spiritual), resources (e.g., wildlife, water, vegetation, minerals, soils), and uses (habitat management, public use) within the area. The findings of the study help determine whether to recommend the area for designation as wilderness.

Wilderness Recommendation

Once a wilderness study determines that a WSA meets the requirements for inclusion in the NWPS, a wilderness study report that presents the results of the wilderness review, accompanied by a Legislative Environmental Impact Statement (LEIS), is prepared. The wilderness study report and LEIS that support wilderness designation are then transmitted through the Secretary of Interior to the President of United States, and ultimately to Congress for approval.

The following sections summarize the inventory and study phases of the wilderness review for Baker Island National Wildlife Refuge (Baker).

II. Wilderness Inventory

The wilderness inventory is a broad look at the planning area to identify WSAs. These WSAs are roadless areas within refuge boundaries, including submerged lands and their associated water column, that meet the minimum criteria for wilderness identified in Sect. 2(c) of the Wilderness Act. A WSA must meet the minimum size criteria (or be a roadless island), appear natural, and provide outstanding opportunities for solitude or primitive recreation. Other supplemental values are evaluated, but not required. In order to identify WSAs, Baker was divided into two inventory units based upon the differences between the terrestrial and marine ecological resources. Inventory Unit A is the 531-acre roadless island known as Baker Island, and Inventory Unit B is composed of the 31,378 combined acres of coral reefs, submergent lands and their associated water column lying within 3 nautical miles (nmi) from the shoreline at the mean high water mark of Baker Island. The inventory of roadless areas, submerged lands, and associated water column of Baker and application of the wilderness criteria is described in the following sections and summarized in Table F-1.

Evaluation of Size Criteria for Roadless Areas, Roadless Islands, and Submergent Lands and Associated Water Column

Identification of roadless areas, roadless islands, and submerged lands and associated water column, required gathering land status maps, land use and road inventory data, satellite imagery, aerial photographs, and personal observations of areas within refuge boundaries. "Roadless" refers to the absence of improved roads suitable and maintained for public travel by means of motorized vehicles primarily intended for highway use. Wilderness inventory units currently owned by the Service in fee title were evaluated. These units include Baker Island and the submergent lands and waters lying within 3 nmi of shore.

Inventory units meet the size criteria for a WSA if any one of the following standards applies.

- An area with over 5,000 contiguous acres. State and private lands are not included in making this acreage determination.
- A roadless island of any size. A roadless island is defined as an area surrounded by permanent waters or that is markedly distinguished from the surrounding lands by topographical or ecological features.
- An area of less than 5,000 contiguous Federal acres that is of sufficient size as to make practicable its preservation and use in an unimpaired condition, and of a size suitable for wilderness management.

- An area of less than 5,000 contiguous Federal acres that is contiguous with a designated wilderness, recommended wilderness, or area under wilderness review by another Federal wilderness managing agency such as the Forest Service, National Park Service, or Bureau of Land Management.

There are no roads on Baker Island, and the submerged lands and associated water column meet the minimum acreage criteria, thus both inventory units within the refuge boundary meet one or more of the size criteria for wilderness study areas. The physical features of these units are described in detail in the Draft Baker CCP/Environmental Assessment (CCP/EA), Chapter 3.

<u>Evaluation of the Naturalness Criteria</u>
A WSA must meet the naturalness criteria. Section 2(c) of the Wilderness Act defines wilderness as an area that "…generally appears to have been affected primarily by the forces of nature with the imprint of man's work substantially unnoticeable." The area must appear natural to the average visitor rather than "pristine." The presence of ecologically accurate, historic landscape conditions is not required. An area may include some man-made features and human impacts provided they are substantially unnoticeable in the unit as a whole. Human-caused hazards, such as the presence of unexploded ordnance from military activity, and the physical impacts of refuge management facilities and activities are also considered in the evaluation of the naturalness criteria. An area may not be considered unnatural in appearance solely on the basis of "sights and sounds" of human impacts and activities outside the boundary of the unit. The cumulative effects of these factors were considered in the evaluation of naturalness for each wilderness inventory unit.

In the wilderness inventory, specific man-made features and other human impacts need to be identified that affect the overall apparent naturalness of the tract. Based upon the Preferred Alternative contained in the Draft Baker CCP/EA, the following factors were primary considerations in evaluating the naturalness of the inventory units:

Man-made Features:
- abandoned metal airstrip;
- day beacon (aid to navigation);
- derelict airplanes (World War II (WWII) vintage);
- refuge boundary sign;
- marine debris, including 11 marine landing crafts (LCMs);
- abandoned rock building foundations;
- abandoned military machinery;
- five wooden poles (long range navigation (LORAN) and communications);
- trenches filled with rusting remains of hundreds of barrels;
- contamination from burning thousands of gallons of fuel and polychlorinated biphenyls (PCBs);
- electrical debris contaminated with PCBs;
- batteries, paint, other unidentified contaminants;
- unidentified large human-made mounds;
- abandoned military village;

- airplane revetments;
- un-located ammunition dump;
- two graveyards;
- cuts in berm to channel and runway approach;
- mining activity including small ponded area.

Management Activities:
- refuge boundary sign;
- field camp;
- generators;
- contaminant remediation activities;
- invasive species control;
- collect and stockpile marine debris;
- migratory bird surveys;
- marine surveys (including SCUBA); and
- boat transportation.

A 4 x 8 foot boundary sign announcing the name and ownership of the island is maintained on Baker. The sign is informational in nature, identifying the sanctuary status the island enjoys. The primary management intrusion to the naturalness of Baker is during the deployment and demobilization of field camps. Transportation from Honolulu, Hawaii across 1,690 nmi of open ocean to Baker is only safely and reliably possible with motorized ocean-going marine vessels. Once the marine transport vessel arrives at Baker, small boats with outboard motors are deployed to transport two biologists and their field camp gear to the island. Once on the island, biologists set up tents, sleeping gear, food, and other supplies. Walking surveys occur across the island to document bird species presence, potentially hand pull or hand spray invasive plant species, inventory cultural sites, and monitor contaminated areas. Marine surveys also occur. They are based from the marine vessel primarily using SCUBA. Field camps are planned to last for 2 days and typically occur once every two years. Occasional field camps with 5-8 individuals staying for up to 2 weeks have occurred in the past. During these extended field camps, diesel-powered generators have been used to operate communication equipment. All other mechanical equipment such as air compressors for SCUBA equipment remains on the marine transport vessel. Upon demobilization of the field camp, all equipment and debris are removed. An indirect human impact to the naturalness of Baker is the presence of marine debris that washes onto coral reefs and beaches. Attempts to remove and stockpile this debris for eventual removal occur during field camps. Otherwise, Baker is an isolated, uninhabited island in the middle of the Pacific Ocean for the vast majority of time.

The terrestrial tract does not meet the naturalness criteria. Considerable evidence of human activities and abuse of the island exists. The metal airstrip is plainly evident, as are derelict vehicles, airplanes, and buildings. Fuel and other liquid filled drums are in various stages of decay, most having released their contents and thereby contaminating the associated soils. At present, these man-made features act collectively for the terrestrial portion of Baker not meet the naturalness criteria. If at some point in the future funding becomes available to clean up the contamination and debris, the terrestrial portion would need to be reevaluated for the naturalness criteria.

The submerged tract meets the naturalness criteria. There is a small channel cut in the coral reef to aid navigation, and there are scattered sections of chain and anchor, but these do not detract from Baker's submerged lands meeting the naturalness criteria. Being over 60 years old, new coral growth along the channel has made it indistinguishable from adjoining coral reef areas. Although the U.S. Navy documented the loss of 11 LCMs in the nearshore waters, their presence has yet to be confirmed. Taken collectively, these impacts to naturalness in the marine environment are a minor component of the overall marine area.

<u>Evaluation of Outstanding Opportunities for Solitude or Primitive and Unconfined Recreation</u>
In addition to meeting the size and naturalness criteria, a WSA must provide outstanding opportunities for solitude or primitive recreation. The area does not have to possess outstanding opportunities for both solitude and primitive and unconfined recreation, and does not need to have outstanding opportunities on every acre. Further, an area does not have to be open to public use and access to qualify under these criteria. Congress has designated a number of wilderness areas in the NWPS that are closed to public access to protect ecological resource values.

Opportunities for solitude refer to the ability of a visitor to be alone and secluded from other visitors in the area. Primitive and unconfined recreation means non-motorized, dispersed outdoor recreation activities that do not require developed facilities or mechanical transport. These primitive recreation activities may provide opportunities to experience challenge and risk, self reliance, and adventure.

These two opportunity "elements" are not well defined by the Wilderness Act but in most cases can be expected to occur together. However, an outstanding opportunity for solitude may be present in an area offering only limited primitive recreation potential. Conversely, an area may be so attractive for recreation use that experiencing solitude is not an option.

The following factors and their cumulative effects were the primary considerations in evaluating the availability of outstanding opportunities for solitude or primitive unconfined recreation at Baker:

- island size, vegetation, and terrain;
- distance to habitation, whether mainland or an inhabited island;
- presence of day beacon or aid to navigation and associated structures; and
- view shed within and from refuge boundary.

Solitude is the overwhelming force that visitors experience on Baker. The island is separated by over 1,690 nautical miles from Hawaii, and approximately 1110 nmi from Kiritimati Island Atoll, the nearest inhabited island. Expanses of open ocean with no other landform are visible from every angle. The island itself, with the exception of a few historical features, is a mixture of short grass and shrubs, bare ground, and shoreline beaches and cobble. In the past, field camps have been temporary, with only 2 individuals spending 2 days every 2 years. However, the Preferred Alternative in the Draft Baker CCP/EA proposes to visit the refuge every year with the same number of individuals for the same duration. Underwater, coral reefs are pristine and the open-water depths are devoid of human presence.

Since establishment, Baker has been and will remain closed to general public access in order to protect the valuable seabird and marine resource values. Thus, there are no outdoor recreational opportunities.

Both Baker inventory units meet the solitude criteria, but do not meet the primitive unconfined recreation criteria.

<u>Evaluation of Supplemental Values</u>

Supplemental values are defined by the Wilderness Act as “ecological, geological, or other features of scientific, educational, scenic, or historic value.” Baker Island and its surrounding coral reefs and deep water areas compose a complete and functioning ecosystem. Isolated, predator-free islands are valuable and often required for successful seabird nesting. Nearshore waters, coral reefs, and associated currents combine and provide food resources for foraging seabirds and coral reef communities. The position and underwater gradient of Baker in deep ocean currents allows these currents to reach the surface, thereby increasing rates of productivity for plants, corals and vertebrate species. These rich ecological resources in a relatively pristine and unaltered environment provide unique opportunities for scientific study and environmental education. There are no known archaeological resources on Baker. Historically, Baker Island was important to early colonization efforts during the guano mining and WWII eras. Historical artifacts such as the day beacon, building ruins, and guano mining excavations are present but eroded and are distinguishable from the natural environment. One landmark, the Baker day beacon, contrasts vividly with the overall expansive vistas of open ocean and island habitats. These values are not required for wilderness but their presence compliments the requirements for wilderness designation. Please see Chapter 3 of the Draft CCP/EA for a more complete description of these supplemental values.

<u>Inventory Findings and Wilderness Study Areas</u>

Only the marine Inventory Unit B meets the minimum criteria for consideration as WSA (Figure F-1), and is identified as:

- WSA-A: Coral reefs, submergent lands, and associated water column of the Baker Island WSA.

Figure F-1. Wilderness Study Areas

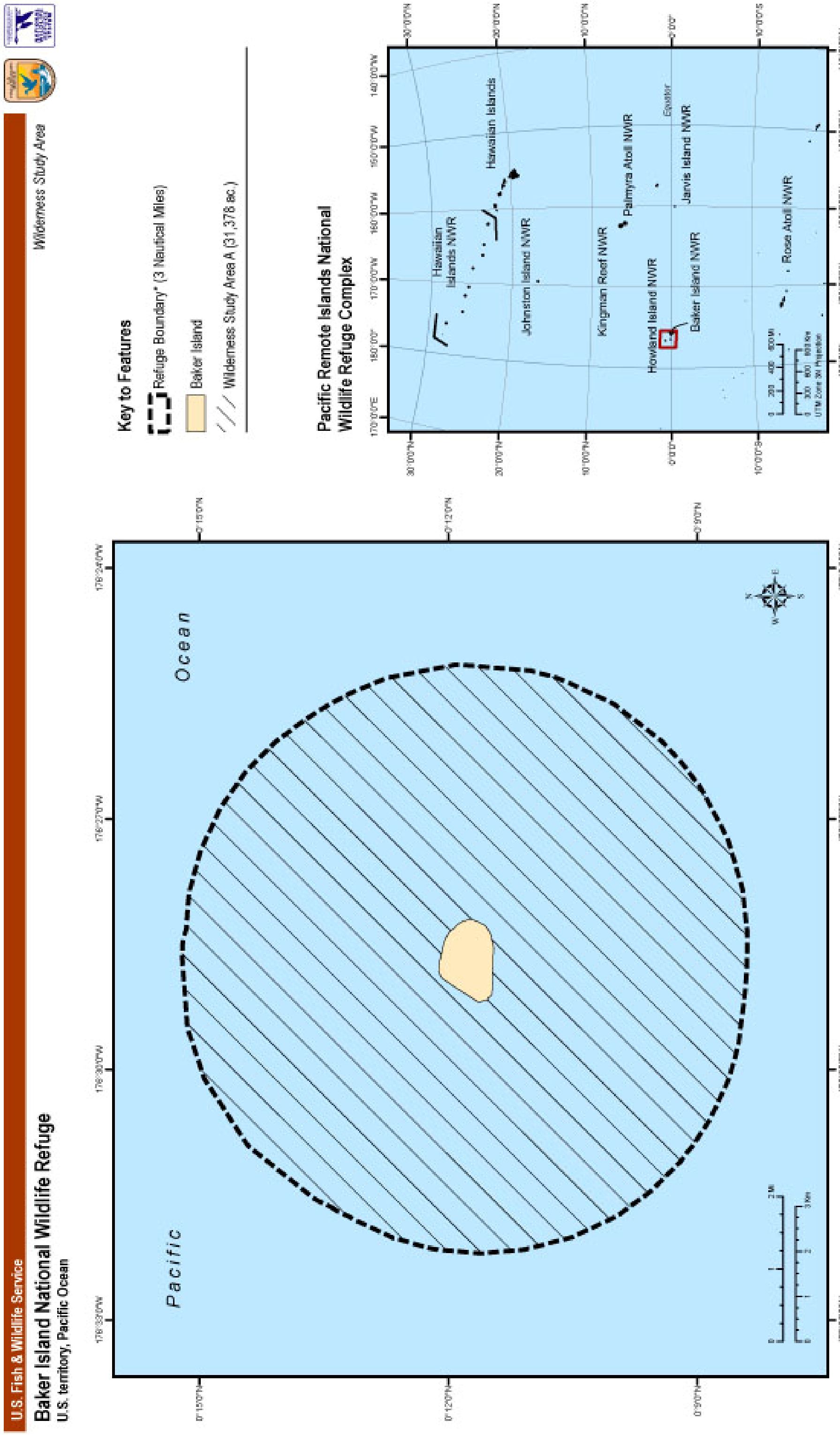

Table F-1 Wilderness Inventory Summary

	Inventory Unit A: Baker Island (531 acres)	**Inventory Unit B: Submerged lands and waters to 3 nmi (31,378 acres)**
Required Components		
(1) Has at least 5000 acres of land or is of sufficient size to make practicable its preservation and use in an unconfined condition, or is a roadless island.	Yes. Is a 531-acre roadless island.	Yes. Approximately 31,378 acres contained within the territorial sea from mean high tide to 3 nmi.
(2) Generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable.	No. The imprint of man's work is substantially noticeable.	Yes. Coral reefs and other underwater features untouched by humans.
(3a) Has outstanding opportunities for solitude.	Yes. Uninhabited island 1,690 nmi from Hawaii.	Yes. Isolation from habitation both on surface and below.
(3b) Has outstanding opportunities for a primitive and unconfined type of recreation.	No. Refuge is closed to all recreational activities.	No. Refuge is closed to all recreational activities.
Other Components		
(4) Contains ecological, geological, or other features of scientific, educational, scenic, or historical value.	Baker day beacon, guano mining, colonization ruins, WWII military ruins, and nesting seabirds.	Nearly pristine coral reefs and associated marine fish, mammals, and turtles abound.
Summary		
Parcel qualifies as a wilderness study area (meets criteria 1, 2 & 3a or 3b).	No	Yes

III. Wilderness Study

The WSA identified in the Wilderness Inventory was further evaluated to determine suitability for designation, management, and preservation as wilderness. Considerations in this evaluation included:

- quality of wilderness values; and,
- capability for management of refuge as wilderness (or manageability) and minimum requirements/tools analysis.

This information provides a basis to compare the impacts of a range of management alternatives and determine the most appropriate management direction for each WSA.

Evaluation of Wilderness Values
The following information considers the quality of the WSAs' mandatory and supplemental wilderness characteristics.

Size
WSA-A meets the minimum size criteria, being a 31,378-acre marine ecosystem.

Naturalness
WSA-A generally appears to have been affected primarily by the forces of nature, with the imprint of human uses and activities substantially unnoticeable. Except for the boat channel and potential presence of LCMs mentioned in the Wilderness Inventory, all submerged features were entirely created by the natural processes of volcanism; wind erosion; wave erosion; water erosion; geological subsidence; and reef growth and consolidation from coral, coralline algae, and giant clam calcification during the past 50 to 80 million years. Except the boat channel, no substantial features were constructed or modified by humans in the marine environment during the island's entire geological history. The impacts of past human presence (boat channel) are barely apparent. See Chapter 3 of the Draft Baker CCP/EA for a more detailed description of natural and cultural features. Management activities will temporarily disturb the naturalness of the area. Temporary field camps on adjacent Baker Island and marine research activities in the WSA will require boat access as the only safe, practical and reliable means of transportation.

Outstanding Opportunities for Solitude and Primitive Recreation
WSA-A offers outstanding opportunity for solitude. Solitude overwhelms the human spirit at Baker. The only noise on the island is from pounding surf, winds, buzzing insects, and the calls of birds. Underwater, all that is heard is one's own breath, the surf, and the sound of fish feeding on coral. The blue of the sky and sea and the brightness of the stark landscape saturate the visual character; and birds, winds, and surf saturate the acoustic character of the refuge. It is hard to image a more remote, isolated, and truly more wilderness experience in the entire equatorial Pacific than when standing on the island or diving on adjacent reefs.

There are no permanent improvements of any kind to accommodate visitors to Baker. The capacity to reach Baker without substantial investment, preplanning, and permission is considerable and further restricts the capability of individuals from reaching the island and intruding on the opportunity for solitude. The nearest humans live 330 nmi to the southeast where less than 100 Kiribati people inhabit Kanton Atoll where there is an airfield and dock. There are no other inhabitants elsewhere in the Phoenix Islands. These logistical constraints contribute to the maintenance of solitude.

Supplemental Values

WSA-A offers outstanding ecological values with features of scientific, educational, scenic interest, and historical value. Nearly pristine coral reefs, reef fish, giant clams, beaches, native terrestrial vegetation, unexplored deep slopes, localized upwelling currents, migratory shorebirds, and large populations and variety of seabirds are among the strong ecological values. The lack of current human impact provides a rare opportunity to study unaltered marine ecosystems, and the impact that global climate change may have on these systems. The sheer vastness of the ocean landscape, punctuated by a small dot of land, and the multitude of bird and marine life attracted to it, provide a sense of awe and spectacular beauty to the landscape.

Evaluation of Manageability and Minimum Requirements/Tools Analysis

Originally administered by the U.S. Department of Interior's Office of Territorial Affairs, the Secretary, on June 27, 1974, designated Baker Island and its territorial sea extending to the 3 nmi limit as a unit of the System (39 FR 27930). The Service administers all units of the System pursuant to the National Wildlife Refuge System Administration Act of 1966, as amended. The acquisition authority for establishing the refuge is found in the Fish and Wildlife Act of 1956 (16 U.S.C. 742f(b)(1)). It states the general purpose for establishing the refuge is "...for the development, advancement, management, conservation, and protection of fish and wildlife resources...", and "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services" (16 U.S.C. 742f (a)(4)). The specific purpose for establishing Baker is (USFWS 1973), "…the restoration and preservation of the complete ecosystem, terrestrial and marine. Priority must be given to allowing seabird nesting colonies to reestablish on Baker so eventually they would eventually reach the great numbers which were present there prior to human occupancy and abuse of the island during the past 125 years."

There are no valid existing private rights, including mineral rights, associated with this WSA.

Several management activities are required for the Service to meet responsibilities for managing Baker Island and its associated marine waters as a national wildlife refuge as specified in relevant legislation and policies. A complete description of management activities can be found in Chapter 2 of the Draft Baker CCP/EA. The following is a brief description of management activities as they relate to minimum requirement determinations of activities occurring within designated wilderness.

Section 4(c) of the Wilderness Act of 1964 lists several generally prohibited uses including no temporary roads, no use of motor vehicles, no motorized equipment or motorboats, no aircraft landings, no other forms of mechanical transport, and no structure or installation. However, Section 4(c) also states an exception to these general prohibitions: "…as necessary to meet minimum requirements for the administration of the area for the purpose of this Act…" Examples of actions that may satisfy this exception include recreational developments such as trails, bridges, and signs.

WSA-A on Baker can be managed to preserve its wilderness character in perpetuity, recognizing that using a "minimum requirements" approach would be required for all activities. Existing refuge management activities within the WSA is consistent with management direction in the Wilderness Act and current Service wilderness stewardship policy in the Refuge Manual (6 RM 8). These management activities include: motorized marine vessel transportation to and from Baker; small motorboat operations used in deployment and demobilization of field camp operations; survey and monitoring of marine habitat including the use of SCUBA equipment; and control of invasive species. None of the current or expected refuge management activities would permanently diminish the wilderness character of WSA-A. Additionally, there are no plans to construct permanent facilities or structures to accommodate these uses or activities.

Located in the central Pacific Ocean, transportation to Baker can only occur with the use of ocean-going marine vessels. The only practical and safe mode of vessel propulsion is gas or diesel powered engine. While it is possible to use sail power to navigate to the island, the reliability of mechanical engines provides a margin of safety to escape extreme weather hazards, or proceed on course and on time in the absence of wind. For the same reasons of safety and practicality, small motorized vessels are used to transport equipment and personnel from the transport vessel to the island to establish field camps and conduct biological survey and monitoring activities. Rough surf, shallow coral reefs, and strong winds preclude the use of non-motorized craft to safely navigate these hazards.

Monitoring of the marine ecosystem occurs from scientists based aboard the marine transportation vessel. Small motorboats often provide safe transportation to specific research sites near Baker. SCUBA equipment is often used to complete marine surveys and is the only safe and practical method of conducting underwater marine surveys.

In summary, safety, practicality, and effectiveness require the occasional use of management programs and associated tools (some of which are generally prohibited by the Wilderness Act) to pursue achievement of refuge purposes, goals and objectives. Current and proposed refuge management would be consistent with wilderness designation and management of both WSAs. Although occasionally diminished, none of the resource values identified above would be permanently impacted because of wilderness designation and the management described herein.

IV. Development of Alternatives

After evaluating the quality of wilderness values, manageability, minimum management requirements, the following alternatives were developed and analyzed for wilderness designation.

<u>Alternative A (No Action)</u>
Under this alternative, no WSAs would be recommended as suitable for wilderness designation. The refuge lands and waters would be managed as they have been in the past to accomplish refuge purposes in accordance with legal and policy guidance for the System.

<u>Alternative B</u>
WSA-A, which includes the submerged lands and associated water column would be immediately recommended for inclusion in the NWPS. Selection of this alternative would require the completion of an Legislative Environmental Impact Statement (LEIS).

<u>Alternative C (Preferred Alternative)</u>
WSA-A, which includes the submerged lands and associated water column of Baker would be recommended for inclusion in the NWPS. The wilderness study area would be managed to ensure that its wilderness character was not adversely impacted. However, the recommendation to include this area in the NWPS would be postponed until such time that CCPs and their associated wilderness inventories and studies for remote Pacific Island NWRs were completed. At such a time, a wilderness study report and associated LEIS that encompasses remote Pacific island refuges would be prepared. Alternative D is identified here as the Preferred Alternative for the Wilderness Review of Baker, and is a component of the Preferred Alternative in the Draft Baker CCP/EA.

<u>Alternatives considered but eliminated from detailed study</u>
Federal agencies are required by National Environmental Protection Act (NEPA) to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). It was determined that there was no benefit in analyzing partial wilderness alternatives. There are no feasible or practical boundary adjustments that would improve the manageability of this WSA.

Appendix G

Statement of Compliance

STATEMENT OF COMPLIANCE
for Implementation of the
Baker Island National Wildlife Refuge
Comprehensive Conservation Plan

The following executive orders and legislative acts have been reviewed as they apply to implementation of the Comprehensive Conservation Plan (CCP) for Baker Island NWR.

National Environmental Policy Act (1969) (42 U.S.C. 4321 et seq.). The CCP planning process has been conducted in accordance with National Environmental Policy Act implementing procedures, Department of Interior (Interior) and U.S. Fish and Wildlife Service (Service) procedures, and is performed in coordination with the affected public. Procedures used to reach this decision meet the requirements of the Act and its implementing regulations in 40 CFR Parts 1500-1508. These procedures include: the development of a range of alternatives for the Baker CCP; analysis of the likely effects of each alternative; and public involvement throughout the planning process.

The CCP management objectives and alternatives have been integrated into an environmental assessment (EA) document and process, including the release of a Draft CCP/EA for a 30-day public comment period. Public notices of availability of the Draft CCP/EA include a Federal Register notice, news releases to local media outlets, the Service's refuge planning website, and planning updates. Copies of the Draft CCP/EA and planning updates were distributed to an extensive mailing list. In addition, the Service met with staff from the Hawaii Department of Land and Natural Resources and the National Oceanic and Atmospheric Administration (NOAA). Revisions in the Final CCP are based on public comments received from the Draft CCP/EA. Comment letters and Service response to comments can be found as an Appendix in the final CCP.

National Historic Preservation Act (1966) (16 U.S. C.470 et seq.). This act requires Federal agencies to consult with the President's Advisory Council on Historic Preservation (ACHP), State or Territorial Historic Preservation Officers, and the National Park Service (NPS) for any proposed actions that may affect cultural resources eligible for the National Register of Historic Places. Consultation has occurred with the ACHP and NPS for their input. Consultation with a State Historic Preservation Officer is not required for this proposal because Baker Island NWR lies outside any state jurisdiction. No Territorial Historic Preservation Officer is assigned to Baker Island NWR. Rather territories/possessions lie in the jurisdiction of the ACHP.

The management of archaeological and cultural resources of Baker Island NWR complies with the regulations of Section 106 of the National Historic Preservation Act. No historic properties listed in or eligible for listing in the National Register of Historic Places have been identified on

Baker Island NWR. No historic properties are known to be affected by the proposed action based on the criteria of an effect or adverse effect as an undertaking defined in 36 CFR 800.9 and Service Manual 614 FW 2. Determining whether a particular action has a potential to affect cultural resources is an ongoing process that occurs as step-down and site-specific project plans are developed. Should historic properties be identified in the future, the Service will comply with the National Historic Preservation Act if any management actions have the potential to affect any these properties.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Secretarial Order 3127, and Section 211 of the Superfund Amendments and Reauthorization Act (SARA) of 1986 (10 U.S.C. 2701-2706, 2810-2811). Contamination resulting from military occupation is required to be mitigated as a Formerly Used Defense Site (FUDS). Any FUDS is part of the Defense Environmental Restoration Program (DERP), administered by the Army Corps of Engineers (ACOE). The ACOE is responsible for the identification, investigation, research and development, and cleanup of contamination from hazardous substances, and pollutants and contaminants; correction of environmental damage such as detection and disposal of unexploded ordnance; and demolition and removal of unsafe buildings and structures at former Department of Defense sites. In 1986, the ACOE maintain they have completed their responsibilities under DERP.

Executive Order 13175. Consultation and Coordination with Indian Tribal Governments. As required under Secretary of the Interior Order 3206 American Indian Tribal Rights, Federal-Tribal Responsibilities, and the Endangered Species Act, the refuge manager determined that there are no tribal governments associated with Baker Island NWR. Thus, there was no coordination with any American Indian tribe.

Executive Order 12372. Intergovernmental Review. Coordination and consultation with other affected Federal agencies has been completed through personal contact by Service planners, refuge managers, and supervisors. In addition, the refuge manager determined there are no local, state or tribal governments associated with Baker Island NWR.

Executive Order 12898. Federal Actions to Address Environmental Justice in Minority and Low-Income Populations. All Federal actions must address and identify, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations, low-income populations, and Indian Tribes in the United States. The CCP was evaluated and no adverse human health or environmental effects were identified for minority or low-income populations, Indian Tribes, or anyone else.

Migratory Bird Treaty Act (MBTA)(16 U.S.C. 703-712). Baker Island NWR is an important site for migratory shorebirds and nesting seabirds. Protecting nesting seabird habitat is the major purpose of the refuge, and is consistent with the provisions of MBTA. All of the proposed alternatives would be consistent with the refuge purpose and the MBTA in protecting of these birds, although the proposed action would afford more benefits. This planning effort is being coordinated with other offices of the Service and Interior that have responsibilities pertaining to the MBTA.

Executive Order 13186. Responsibilities of Federal Agencies to Protect Migratory Birds. This Order directs departments and agencies to take certain actions to further implement the Migratory Bird Treaty Act. A provision of the Order directs Federal agencies to consider the impacts of their activities, especially in reference to birds on the Fish and Wildlife Service's list of Birds of Conservation Concern (BCC). It also directs agencies to incorporate conservation recommendations and objectives found within the North American Waterbird Conservation Plan and bird conservation plans developed by Partners in Flight (PIF) into agency planning. Species selected as focal conservation targets in the CCP were identified from multiple sources including pertinent BCC lists, applicable Flyway Management Plans, and regional seabird and shorebird conservation plans. The effects of all alternatives on focal conservation targets were assessed during this planning process.

Endangered Species Act (ESA)(16 U.S.C. 1531-1544). The ESA provides for the conservation of threatened and endangered species of fish, wildlife, and plants by Federal action and by encouraging the establishment of state programs. It provides for the determination and listing of endangered and threatened species and the designation of critical habitats. Section 7 of the ESA requires refuge managers to perform consultation before initiating projects that affect or may affect endangered species.

Baker Island NWR provides feeding and potential nesting habitat for two listed species of endangered sea turtle: the endangered hawksbill turtle, *Eretmochelys imbricata* and the threatened green turtle *Chelonia mydas*. In accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et. Seq.), the Service, as a component of this CCP/EA, evaluated potential impacts to the two listed turtle species. It was determined that undertaking any action as part of any alternative in this CCP will have no affect on either of the two turtle species. Therefore, formal consultation with NOAA-National Marine Fisheries Service is not required and will not be initiated.

National Wildlife Administration Act of 1966, as amended by The National Wildlife Refuge System Improvement Act of 1997 (16 U.S.C. 668dd-668ee). The National Wildlife Refuge System Improvement Act requires the Service to develop and implement a comprehensive conservation plan for each refuge. These conservation plans identify and describe a refuge purpose; refuge vision and goals; fish, wildlife, and plant populations and related habitats; archaeological and cultural values of the refuge; issues that may affect populations and habitats of fish, wildlife, and plants; actions necessary to restore and improve biological diversity of the refuge; and opportunities for wildlife-dependent recreation.

Wilderness Preservation Act of 1964 (Wilderness Act). The Wilderness Act requires the Service to evaluate the suitability of Baker for wilderness designation (Appendix F) and has found that the marine wilderness inventory unit met wilderness study area criteria. Recommendation for portions of Baker to be included in the Wilderness Preservation System is deferred until such time that other remote Pacific island refuges are evaluated for wilderness designation and a combined proposal as part of a larger comprehensive Legislative Environmental Impact Statement is prepared.

Magnuson-Stevens Fisheries Management and Conservation Act (16 U.S.C. 1801-1882). This act provides the guidance for sustainable management of commercial fisheries in Federal waters by NOAA in consultation with Regional Fisheries Management Councils that develop fisheries management plans (FMPS) subject to NOAA approval, monitoring and implementation. The Western Pacific Regional Fisheries Management Council (WESPAC) and NOAA have implemented and approved several FMPS that apply to U.S. insular Pacific waters. The FMPS were all implemented after Baker Island NWR was established in 1974 and include plans for: 1) pelagic fish; 2) bottom fish including some reef species; 3) crustaceans including lobsters; 4) precious corals and; 5) coral reef ecosystem species. Commercial activities, including commercial fishing, are prohibited in surrounding marine water and benthic habitat out to the 3 nmi limit because Baker Island is established as a National Wildlife Refuge that is closed to public uses. Moreover, the Service retains jurisdiction and management for any fisheries within the Refuge. Available information indicates commercial fishing under the auspices of any of the FMPS is not and cannot be pursued within the 3 nmi boundary of the refuge. In addition, the Magnuson-Stevens Fisheries Management and Conservation Act jurisdiction is subject to other applicable laws and does not apply in Baker Island National Wildlife Refuge because this area is closed to public access and commercial fishing under the existing National Wildlife Refuge System Administration Act (16 U.S.C.668dd -6688ee).

Executive Order 13089, Coral Reef Protection (June 11, 1998). The purpose of this Executive order is "…to preserve and protect the biodiversity, health, heritage, and social and economic value of U.S. coral reef ecosystems and the marine environment…." It directs all Federal agencies to identify actions that may affect U.S. coral reefs; utilize their programs and authorities to protect and enhance coral reef ecosystems; and assure their actions would not degrade those ecosystems. Federal agencies whose actions affect U.S. coral reef ecosystems are further directed to implement measures needed to research, monitor, manage, and restore affected ecosystems, including, but not limited to, measures reducing impacts from pollution, sedimentation, and fishing. This Executive Order also initially established the U.S. Coral Reef Task Force, co-chaired by the Secretaries of the Interior and Commerce, through the Administrator of NOAA. The Task Force has oversight responsibility for implementation of policy and Federal agency responsibilities found in this order, and support activities under the U.S. Coral Reef Initiative. In addition, this order directs the Task Force to work cooperatively with State, territory, commonwealth, and local government partners to map, monitor, conserve, mitigate, and restore coral reef ecosystems.

The Proposed Action and other alternatives are fully consistent with the spirit and intent of the Executive order. Copies of the Draft CCP/EA would be provided to the Directorate of the Coral Reef Task Force for coordination.

Coral Reef Conservation Act and Executive Order 13158, Marine Protected Areas (16 U.S.C. 6401-6409)(May 26, 2000). These statutes collectively direct Federal agencies to coordinate among themselves and State and Territorial governments via the Coral Reef Task Force to protect and enhance coral reefs and avoid actions that degrade reefs, promote marine protected area development and reef restoration, and provide conservation grants and cooperative agreements (including States and institutions) to conduct research and development of existing and candidate marine protected areas located on coral reefs. The Coral Reef Conservation Act of

2000 is scheduled for reauthorization in 2007.

The Proposed Action and other alternatives are consistent with the spirit and intent of these policies. Baker Island NWR is one of only a few Federal no-take marine protected areas in the equatorial Pacific. Implementation of the Proposed Action would materially improve surveillance and enforcement and discourage unauthorized take of fish and wildlife within the refuge and improve the capacity of the Service to monitor fish and wildlife and manage their protection within the refuge.

Chief, Division of Planning and Visitor Services

9/16/08
Date

Appendix H

Plan Implementation and Costs

Introduction

Following public review and comment on the Draft Environmental Assessment (EA), public notification of the U.S. Fish and Wildlife Service's (Service) decision, and Comprehensive Conservation Plan (CCP) approval, refuge staff would begin to implement the CCP. This appendix describes the various partnerships, management plans, staffing and projects required to implement the plan over the next 15 years.

Staffing

The proportion of current staffing and proposed staffing within the Pacific Remote Islands National Wildlife Refuge (NWR) Complex dedicated to Baker are shown in the following tables. The proposed staffing indicates a 0.16 full-time-equivalent increase over current levels. This represents the difference in staffing needs from visiting Baker biannually to annually.

Current Staffing for Baker Island NWR

Staff	Employment Status and Proportion of Time[1]	Salary Rating
Project Leader	PFT (0.01 FTE)	GS 13
Supervisory Wildlife Biologist	PFT (0.07 FTE)	GS 12
Resource Contaminant Specialist	PFT (0.07 FTE)	GS 12
Coral Reef Biologist	PFT (0.07 FTE)	GS 12
Administrative Officer	PFT (0.01 FTE)	GS 9

[1] PFT = Permanent Full Time; FTE = Full Time Equivalent where 1.0 equals one staff year.

Proposed Staffing for Baker Island NWR

Staff	Employment Status and Proportion of Time[1]	Salary Rating
Project Leader	PFT (0.02 FTE)	GS 13
Supervisory Wildlife Biologist	PFT (0.14 FTE)	GS 12
Resource Contaminant Specialist	PFT (0.07 FTE)	GS 12
Coral Reef Biologist	PFT (0.14 FTE)	GS 12
Administrative Officer	PFT (0.02 FTE)	GS 9

[1] PFT = Permanent Full Time; FTE = Full Time Equivalent where 1.0 equals one staff year.

Funding

The following table describes the estimated annual cost to implement the CCP.

Field Camp Budget for Baker	Cost
Staff	$34,000 (0.3 FTE per year)
Supplies	$7,000
Remote Sensing equipment	N/A
Remote Sensing operations	N/A
Deep sea exploration	$25,000 per submersible vessel dive
Seabird recolonization initiative	$10,000
Vessel Charter	N/A
Vessel Purchase (one time cost)	N/A
Vessel operation	N/A
Adjusted annual personnel and operating costs	$76,000/yr

Projects

The table below contains projects developed as part of the Refuge Operating Needs System (RONS) and Service Asset Maintenance Management System (SAMMS). Brief project descriptions and their associated costs are provided. Funding of these projects would assist refuge staff in achieving the goals, objectives, and strategies of the CCP for Baker Island NWR.

Projects: RONS and SAMMS List

Project No.	Title and Description	Cost Estimate (Thousands)	Station Rank
97003	**Inventory and Monitor Terrestrial Resources:** Provide a wildlife biologist to inventory and monitor terrestrial plants, invertebrates and nesting seabirds. Remote Pacific islands provide the only secure habitat for nesting seabirds, sea turtles and marine life within thousands of square miles of ocean.	325.25	9
00001	**Eliminate Exotic Rodent Species on Remote Pacific Islands:** Provide biological technicians and transportation expenses to restore habitat for pelagic seabirds and terrestrial plant and animal species on Howland, Baker and Jarvis NWRs.	194.0	10
980002	**Eliminate Exotic Rodent Species on Remote Pacific Islands:** Provide Wildlife Refuge Specialist to supervise biological technicians and transportation expenses to restore habitat for pelagic seabirds and terrestrial plant and animal species on Howland, Baker, and Jarvis NWRs.	174.75	10
98002	**Develop Interpretative Program, Remote Island NWRs:** Develop a brochure for Baker, Howland and Jarvis Island NWRs and host 3 special outreach events every year in Hawaii.	77.875	999
00006	**Staff and Maintain a New Vessel to Accomplish Basic Refuge Operations:** This vessel will provide basic logistical support for 16 islands and remote field stations on 9 different national wildlife refuges across the Pacific Ocean. The vessel will be similar in size and capability to the M/V Tiglax at the Alaska Maritime NWR	204.8	3
00018	**Inventory and Monitor Coral Reef Resources:** Remote refuges contain some of the most valuable and spectacular marine and coralline resources in the National Wildlife Refuge System. Baker Island NWR is so remote that basic knowledge of marine resources is lacking. There is a need to perform biennial monitoring of the marine resources at this refuge.	137.0	4
98004	**Install Remote Surveillance System:** Acquire camera equipment and service contract with a satellite communications provider to detect incursion by unauthorized visitors, such as poachers and commercial fishing vessels to assist the Coast Guard and Refuge Law Enforcement Officers in investigating illegal activities within the Refuge.	241.2	14

Project No.	Title and Description	Cost Estimate (Thousands)	Station Rank
90100411	**Replace Broken, Rotten, and Vandalized Signs:** Replace degraded entrance signs to deter trespass and prevent introduction of invasive species.	190.0	6
02121744	**Rehabilitate Historic Day Beacon:** This beacon not only has historic significance, it is also used as a landmark by mariners. The beacon requires structural repairs and painting.	355.0	999
00018	**Establish Refuge Contaminants Abatement and Remediation Program** Environmental Toxicologist	183.75	2

Partnerships

Partnerships are a critical component of implementation of the Baker Island National Wildlife Refuge (Baker) CCP. Refuge staff would strengthen existing partnerships with the U.S. Coast Guard, the National Oceanic and Atmospheric Administration, and the University of Hawaii Undersea Research Laboratory to implement enhanced law enforcement coverage at this remote location and facilitate inventory and monitoring of marine resources. In addition, the refuge staff would seek to enhance its volunteer program. Volunteers are critically important in providing the logistical support in the Honolulu office and field support required to effectively manage and operate year-round field camps at remote locations.

Step-Down Management Plans

The CCP is one of several plans necessary for refuge management. The CCP provides guidance in the form of goals, objectives, and strategies for several refuge program areas but may lack some of the specifics need for implementation. Given the abbreviated and qualitative once-a-year management activities identified in the preferred alternative, step-down plans would not be developed for individual program areas after CCP completion. The Draft Seabird Monitoring Assessment for Hawaii and the Pacific islands (Citta and Reynolds 2006), U.S. Pacific Islands Regional Shorebird Conservation Plan (Engilis and Naughton 2004), Seabird Conservation Plan for the Pacific Region (USFWS 2005), and U.S. Coral Reef Task Force planning efforts would be applied to refuge operations described in the preferred alternative.

Appendix I

Consultation and Coordination

This section describes consultation and coordination efforts with the public, interested groups, and other agencies through the draft CCP/EA phase. Public involvement was sought throughout the planning process using meetings, newsletters, and other communication tools. All comments and responses to comments from the draft CCP may be found in Appendix K.

Planning Updates

The first Planning Update was mailed to 249 private individuals; nongovernmental organizations; local, state, Federal and international governments; and members of the media throughout the Pacific on October 12, 2005. The comment period identified in the Planning Update closed on November 14, 2005. This update announced the intent of the Service to produce a CCP for Baker Island, and invited comments on issues and concerns and interest in attending public meetings. A total of five responses were received.

A second planning update was mailed on May 17, 2006. This update announced the development of a list of alternatives and solicited comments on the draft alternatives. This update was mailed to 253 private individuals; non-governmental organizations; local, state, Federal and international governments; and members of the media throughout the Pacific.

A third Planning Update was mailed with the Draft Baker Island Comprehensive Conservation Plan and Environmental Assessment in September 2007. This Planning Update and the draft CCP/EA was distributed to about 190 individuals and organizations, and posted on Region 1's website. Nine review comments were received during the 45-day comment period.

Agency and Interest Group Consultation/Coordination

Members of the planning team met with NOAA staff and the Hawaii Department of Land and Natural Resources (DLNR) on May 31, 2005. Refuge staff also met with members of The Nature Conservancy on June 2, 2005. Both NOAA and DLNR informally indicated that they were interested in the process, wished to be kept informed of planning progress and would review the draft plan when it became available.

A second meeting between State, NOAA, and Service staff was held on May 19, 2006 to discuss issues of mutual interest, which included their potential involvement in the Service's CCP process. A follow-up formal request was sent to the agencies on June 7, 2006.

Baker Island is uninhabited and an unincorporated U.S. territory far removed and beyond the jurisdiction of any State, insular area, or foreign nation. Other parties involved in correspondence related to this document included multiple nongovernmental organizations, U.S. Environmental Protection Agency; National Park Service; U.S. Geological Survey; U.S. Department of Defense; President's Advisory Council on Historic Preservation; National

Oceanic and Atmospheric Administration (NOAA); Western Pacific Regional Fishery Management Council; Hawaii Department of Land and Natural Resources; Hawaii Office of Hawaiian Affairs; Governor of Hawaii; the Honorary Consulate-General of the Republic of Kiribati; and the United Nations Educational, Scientific and Cultural Organization (UNESCO).

Federal Register Notices

The Notice of Intent to prepare a CCP for these refuges was published in the Federal Register on September 14, 2005. Public involvement was sought throughout the planning process using meetings, newsletters, and other communication tools.

The Notice of Availability of the Draft Baker Island Comprehensive Conservation Plan and Environmental Assessment was published in the Federal Register on September 18, 2007.

Appendix J

Response to Comments

The Refuge received four letters and five emails in response to the Draft CCP/EA. Comments are summarized below by topic. The comment is either quoted directly or paraphrased based upon the comment received.

1. Wildlife Management

Comment: We encourage the Service to maintain its "wildlife first" philosophy and to prescribe the best and most thorough protection for plants and animals. (The Wilderness Society)

Service Response: By implementing the preferred alternative Baker Island NWR will continue to be managed as a wild, natural area. This management regime will contribute to the recovery, protection, and management efforts for all native species with special consideration for seabirds, migratory shorebirds, federally listed threatened and endangered species, and coral reef species.

Comment: We recommend that an effort to inventory, monitor, protect and enhance habitat for refuge species is outlined in the CCP. (The Wilderness Society)

Service Response: The CCP contains specific objectives and strategies to inventory, monitor, protect, and enhance native terrestrial habitats and marine communities that are representative of remote tropical Pacific Islands.

Comment: It is not clear what the scientific basis is for the statement linking seabird health to pelagic fisheries in the equatorial waters surrounding the three islands. NMFS requests the FWS to provide NMFS and the Western Pacific Regional Fisheries Management Council more information, including scientific support for that statement. (National Marine Fisheries Service)

Service Response: Information and scientific citations have been added to the plan to document the linkage between pelagic fish activity and its importance to seabird foraging activity.

Comment: The CCP should include a method to inventory the impact of human activities on species populations. (The Wilderness Society)

Service Response: Refuge management will be limited to monitoring terrestrial and marine plants and animals and removal of non-native species. The Refuges will also remain closed to public use to protect the extensive seabird nesting colonies, reduce the threat of introduction of invasive species, and conserve the pristine coral reef ecosystems. So the low level of human activities will have non-detectable impacts species populations.

Comment: The Final CCPs should include monitoring and enforcement provisions. (Marine Conservation Biology Institute)

Service Response: We agree. Goal 5 of the CCP has been expanded to include biological resource preservation. An objective and associated strategy has been added to encompass enforcement provisions to accomplish the preservation goal.

Comment: I highly recommend consultation with NMFS and our partners before any proposal for fisheries enforcement activities. (National Marine Fisheries Service)

Service Response: We agree with this recommendation and look forward to continuing the existing collaborative relationship that exists among our respective agency's law enforcement personnel.

Comment: We request that the Service analyze and disclose all wildlife and fisheries management and conservation plans in the CCP. (The Wilderness Society)

Service Response: Regional and Ecosystem Conservation Plans important for developing the CCP are summarized in Section 1.4.5 of the plan.

Comment: The CCP and preferred alternative B do not meet the mission of the National Wildlife Refuge System. (Center for Biological Diversity)

Service Response: We respectfully disagree. The goals and their respective strategies and activities in the CCP are designed to manage for "wildlife first" at Baker Island NWR and contributes to the System's national network of lands and waters administered for "the conservation, management and where appropriate, restoration of fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans."

Comment: Alternative D should be the preferred alternative. (Marine Conservation Biology Institute)

Service Response: While alternative D may be preferable from a conservation standpoint, it is not practical either logistically or financially to implement this management regime within the 15-year lifespan of this plan.

Comment: Hopefully more funds could make options 3 or 4 possible but at the very least option 2 is good. (K. Stender)

Service Response: We will use an adaptive management approach over the life of this plan. If additional funds unexpectedly become available, strategies and activities identified in alternatives C and D could be implemented.

Comment: I support Alternative B with the addition that management responsibilities should extend from the shoreline seaward to 100 fathoms to cover all coral associated with each island. These three islands should be no-take marine protected areas. (B. Carmen)

Service Response: We appreciate your support and the CCP does implement a no-take marine protected area management regime. In addition, the seaward boundary of the refuge is beyond the 100 fathom depth contour around the island. Therefore, all of the coral reefs at Baker Island are fully protected in accordance with the provisions of the National Wildlife Refuge System Administration Act of 1966, as amended.

Comment: The Final CCPs should include a more specific provision for reevaluation. (Marine Conservation Biology Institute)

Service Response: The Department of the Interior and the Service support the use of adaptive management to address uncertainty associated with implementing conservation activities. The "learning by doing" inherent in implementing activities in this CCP is central to re-evaluating the effectiveness of these activities and determining the need for management interventions to achieve the six goals identified in this plan.

2. Wilderness Review

Comment: We request that the Service analyze the wilderness resources in the CCP. (The Wilderness Society)

Service Response: The Service completed a Wilderness Review for Baker Island NWR and it is found in Appendix F of the CCP.

Comment: The CCP must also address management of both potential and designated wilderness lands in the CCP. (The Wilderness Society)

Service Response: The wilderness study area for Baker Island NWR identified in the CCP will be managed to ensure its wilderness character is not adversely impacted by implementing the management activities in the CCP.

Comment: The CCP should examine and outline a plan for off-road vehicle use. (The Wilderness Society)

Service Response: Off-road vehicle use has not been determined to be a compatible use on the refuge and is currently prohibited.

Comment: NMFS recommends that any wilderness-related management action requiring consideration and collaboration between our two agencies by fully described at the earliest opportunity.

Service Response: The Service will notify NMFS at such time that we decide to move forward in preparing a wilderness study report and associated Legislative Environmental Impact Statement for Baker Island NWR.

3. Climate Change

Comment: The Service should take a proactive approach and identify specific climate change concerns and formulate appropriate management strategies. (The Wilderness Society)

Service Response: We have included an objective in the CCP to increase understanding of impacts of global climate change by working with other agencies or institutions to conduct baseline global climate change investigations at this refuge.

Comment: The impacts of climate change were not adequately considered in the CCP. (Center for Biological Diversity)

Service Response: New information that recently emerged on this issue has been added to the CCP.

Comment: Looks like the refuges would be an ideal but remote location to study climate change on reefs as a control. (K. Stender)

Service Response: We agree.

3. Contaminants

Comment: The importance of removing contaminants from Baker Island NWR was not adequately considered in the CCP.

Service Response: An assessment of the environmental consequences associated with contamination at Baker Island NWR is presented in Section 4.4.1.

4. Commercial Fishing and Jurisdictional Issues

Comment: The treatment of commercial fishing and jurisdictional issues in these draft CCPs is incomplete. Each CCP should explain the processes and coordination necessary to achieve any management regime applicable to federal fisheries. (National Marine Fisheries Service)

Service Response: The "Refuge Establishment" section of the CCP has been revised to clearly indicate that the National Wildlife Refuge System Administration Act of 1966, as amended requires that the Service maintain sole and exclusive management authority over all national wildlife refuge areas. At Baker Island NWR, the refuge includes the island and the surrounding waters out to the 3-nautical mile boundary depicted in Figure 1.2. The CCP clearly indicates that the Refuge will remain closed to all public uses, including commercial fishing. The information in Appendix G pertaining to the Magnuson-Stevens Fisheries Management and Conservation Act has been revised to clearly identify the NMFS jurisdiction to regulate commercial fishing outside of the Refuge boundary and the requirement that this Act must conform to other applicable laws, including the National Wildlife Refuge System Administration Act of 1966, as amended.

Comment: NMFS would like a more detailed description of FWS activities to assist the Department of State in negotiating a U.S. position on managing commercial fishing in the U.S.

Exclusive Economic Zones adjacent to the Pacific Remote Insular Areas. (National Marine Fisheries Service)

Service Response: We have clarified language and provided more detail in the document that it was the Department of the Interior who notified the Department of State about a request from the Republic of Kiribati to conduct commercial fishing in the U.S. Exclusive Economic Zone surrounding Baker Island, Howland Island, and Jarvis Island.

Comment: We have no record of a personal communication between Kitty Simonds and Jim Maragos regarding informal consultation that WESPAC continues to honor Service jurisdiction and authorities within the 3nmi offshore boundary of the refuge. Please provide that to us for our records. (Western Pacific Regional Fisheries Management Council)

Service Response: Dr. Maragos continues to maintain such a discussion took place with Ms. Kitty Simonds although a "record of personal communication" was not prepared or filed. We removed this reference from the document and clarified the legal basis for the Fish and Wildlife Service's jurisdiction to mange the 3-nautical-mile territorial seas surrounding Baker Island in conjunction with the National Wildlife Refuge System Administration Act of 1966, as amended.

Comment: The Council's Coral Reef Fisheries Management Plan needs to be included in your list of FMPs so as to provide complete information to readers and decision-makers. (Western Pacific Regional Fisheries Management Council)

Service Response: In Appendix G, we have included the plan for coral reef species in the list of commercial fisheries plans developed in accordance with the Magnuson-Stevens Fisheries Conservation and Management Act.

Comment: The statement that "commercial fishing under the auspices of any of the FMPs is not being pursued outside the 3 nmi boundary of the refuge" is erroneous and needs to be corrected.

Service Response: This was a typographical error. The statement has been revised to read that "Available information indicates commercial fishing under the auspices of any of the FMPS is not and cannot be pursued within the 3 nmi boundary of the refuge."

Written Comments Received on the Draft CCP/EA

Comment	Signatory	Organization
Letter	William L. Robinson	National Marine Fisheries Service
Letter	Shaye Wolf	Center for Biological Diversity
Letter	Keiko Bonk	Marine Conservation Biology Institute
Letter	Maribeth Oakes	The Wilderness Society
Email		Western Pacific Regional Fishery Management Council
Email	Brent Carmen	
Email	pandora2@earthlink.net	
Email	Keoki Stender	
Email	b.s achau	