U.S. Fish & Wildlife Service

# Seabird Conservation Plan

*Pacific Region*

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# Regional Seabird Conservation Plan

**U.S. FISH AND WILDLIFE SERVICE**
**PACIFIC REGION**

**January 2005**

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# Executive Summary

The U.S. Fish and Wildlife Service (Service) Pacific Region, supports the most diverse group of seabirds in the United States and it is second only to Alaska in the total number of breeding seabirds. An estimated 14 million seabirds representing 60 species breed in this Region and millions more forage in the rich waters but do not breed. Two of the most diverse seabird assemblages in the U.S. are represented: the temperate species of the California Current System (California, Oregon, Washington) and the tropical/subtropical seabirds of Hawai`i and the other U.S. Pacific Islands.

## Purpose

The purpose of this Plan is to identify the Service's priorities for seabird management, monitoring, research, outreach, planning and coordination. It will serve as a guide to coordinate Service activities for seabird conservation at the Regional scale. The Plan includes: a review of seabird resources and habitats, a description of issues and threats, and a summary of current management, monitoring and outreach efforts. All species are prioritized by conservation concern at the regional scale and recommendations for conservation actions are identified and prioritized. In Part II of this Plan, brief profiles for each breeding species provide a summary of current information on population size, status, ecology, distribution, habitats, threats, and recommended conservation actions.

## Scope

The Pacific Region (Region), for the purposes of this plan, includes the coastal and offshore areas of California, Oregon, Washington, Hawai`i, and the U.S. Pacific Island commonwealths, territories, and possessions, including: Guam and the Commonwealth of the Northern Mariana Islands (CNMI); American Samoa; Johnston Atoll; Wake Atoll in the Marshall Archipelago; Palmyra Atoll, Kingman Reef and Jarvis Island in the Line Archipelago; Baker and Howland Islands in the Phoenix Archipelago; and Midway Atoll in the Hawaiian Archipelago.

Sixty species of seabirds representing three Orders and ten Families, nest in the Region including: three albatrosses, six petrels, four shearwaters, seven storm-petrels, three cormorants, one pelican, two frigatebirds, three boobies, two tropicbirds, five gulls, twelve terns, three noddies, one skimmer, one murre, one guillemot, three murrelets, two auklets and one puffin. Many of these populations are of global or national importance. In addition to the breeding seabirds, millions of non-breeding birds migrate to, or through, the area.

## Threats

The most serious threats to seabirds in the Region involve invasive (non-native) species, interactions with fisheries, oil and other pollution, habitat loss and degradation, disturbance, and global climate change. Invasive species, especially introduced predators have had devastating effects on seabirds worldwide, especially at island colonies. Introduced plants, herbivores, and insects have caused drastic habitat changes, often to the detriment of breeding seabirds. Thousands of birds have been killed each year in interactions with fishing gear, especially longline and gillnet fisheries. Although regulatory actions have been taken in recent years that have reduced this mortality, much work still needs to be done to identify and further minimize or eliminate these impacts. The indirect effects of fishing activities, such as bright lights near seabird colonies or overfishing of fish stocks, have not been as well documented but are also of concern. The negative impacts of large oil spills have long been recognized but smaller spills occur regularly and potentially cause even greater mortality. Contaminants such as organochlorines and heavy metals caused major seabird declines historically and are still present in the environment, affecting seabirds both at sea and at the colonies. Plastics and other marine debris are ingested or entangle foraging seabirds, causing injury and death. Global climate change could significantly effect seabird prey resources, and rising sea levels associated with global warming could be disastrous for seabird nesting habitat, especially on low islands and atolls. Habitat loss and degradation and human disturbance have resulted in population declines at the local and range-wide scales. The incidence of obstructions such as powerlines, communication towers, and wind generation facilities in areas used by seabirds is increasing. As the human population continues to grow and more people reside near the coasts, conflicts will continue to increase.

# Current USFWS Program

Within the U.S., the Service is the principal federal agency responsible for the protection and management of migratory birds. Within the Service, different divisions have defined, but often overlapping responsibilities concerning the conservation of seabirds: Migratory Bird Management; Ecological Services (including Endangered Species, Environmental Contaminants, and Habitat Conservation branches); Law Enforcement; and the National Wildlife Refuge System.

To date, Service activities have focused primarily on the protection and restoration of seabird nesting habitats. The largest seabird colonies in the Region are located on National Wildlife Refuge System lands, and numerically over 80% of the seabirds nest on these lands. Conservation activities include the control and eradication of introduced predators and other invasive species, broad scale monitoring and inventory of breeding populations, threat abatement, and specific responsibilities associated with endangered species management, oil spills and contaminant issues.

# Recommended Service Priorities, Pacific Region

Based on the review of seabird and habitat resources and threats the following priorities for seabird conservation have been identified.

## Habitat Management

- Maintain, protect and enhance habitats (breeding, roosting, foraging, migrating and wintering) to meet seabird needs. Identify important habitats and provide protection (*e.g.*, through acquisition, easement, regulation, or special designations) for areas not adequately protected.
- Restore lost or degraded seabird habitats through activities such as eradicating invasive plant species, restoring native vegetation, removing hazards, and restoring or simulating natural ecological function.

## Threat Management

The goals of Service activities with respect to threat management include identification and prioritization of threats, actions to remove or minimize the impacts, investigations to document the effects of threats on seabirds, and research to minimize impacts. Monitoring is an important component of threat management. Coordination with a wide range of federal, state, industry, and conservation partners is key to effectively addressing threats.

- ***Invasive Species.*** Eradicate or control introduced predators and other invasive species that have negative impacts on seabird populations. Support national and international efforts to prevent the introduction of invasive species to important seabird areas and to eradicate/control these species. Support research to develop new technologies to control invasive plants and animals.

- ***Fisheries Interactions.*** Identify problems and minimize the negative impacts of fisheries interactions. Work with partners to identify problematic fisheries and develop observer programs. Provide technical assistance and support in the development of new gear, fishing techniques, or mitigative measures to reduce and eventually eliminate seabird bycatch.

- ***Oil Spills.*** Respond to oil spills and work with other response agencies to minimize the impacts of spills to seabirds and other wildlife. Provide technical information on seabird distribution and abundance to increase the effectiveness of spill response efforts and increase Service participation in spill prevention and pre-spill planning activities.

- ***Contaminants.*** Identify contaminant problems and work with partners to ameliorate the effects and clean-up contaminated sites. Design and implement a seabird monitoring program to provide early warning of potential issues and support research into the source and effects of contaminants on seabirds.

## Inventory and Monitoring

- Design and implement a comprehensive seabird inventory and monitoring program. Work with USGS, seabird scientists, and other partners to develop a standardized system for data collection and analysis that is science based and statistically rigorous.

- Annually review and report the results of seabird monitoring and develop an interactive web interface with GIS mapping capabilities to disseminate the information to stakeholders and partners.

- Identify species with declining population trends, investigate causal relationships, and develop and implement actions to reverse the trend.

## Research

The Service will focus on research necessary to make informed conservation and management decisions. Priority will be given to seabirds listed as Birds of Conservation Concern and those listed under the Endangered Species Act.

- Support research directed at evaluating, ameliorating, or eliminating the effects of threats. For example, research to minimize the negative impacts of fisheries interactions or to devise methods to eradicate/control invasive species.

- Develop methods to monitor seabird population trends for those species where current methods are inadequate.

- Work with partners to investigate the interrelationships of seabirds and their environment: seabird foraging ecology; ecology of prey; response of seabirds and prey to large and small scale oceanographic and climatological cycles; etc.

## Outreach and Education

Educate the public about seabird ecology, threats, and conservation issues.

- Develop curriculums for schools; a seabird website with links to current monitoring and investigations; presentations for field offices and general distribution; interpretive displays, brochures, posters, and other outreach materials.

- Provide increased opportunities for the public to view and experience seabirds in the wild through viewing stations and remote cameras feeds.

- Provide technical assistance, outreach, and education to industry and other stakeholders and partners to resolve conflicts involving seabirds.

## Planning and Coordination

Seabirds are a shared resource that cross international, state, Tribal, and agency responsibility boundaries. Coordination with a wide variety of partners is essential to effective seabird conservation.

- Coordinate with other countries, U.S. Territorial and Commonwealth governments, Tribes, federal and state agencies, conservation and industry groups, and the public on the conservation and management of seabirds, at all scales.

- In partnership with others, develop and implement seabird components of regional waterbird plans under the North American Waterbird Conservation Plan and foster the development of international waterbird working groups to implement these plans.

- Participate in working groups, interagency teams, and other venues designed to further seabird conservation in the Region.

- Improve coordination with USGS and support increased involvement by USGS in seabird conservation through research and technical assistance on key issues. Improve coordination with NOAA-Fisheries on shared monitoring, management, and seabird conservation issues.

- Biannually update a seabird conservation strategic plan to focus Service efforts on priority management, monitoring, and research needs.

# Part I. Introduction

**VISION:**

***Restore and sustain healthy seabird populations and the natural systems on which they depend, through sound management, diverse partnerships, and science.***

U.S. Fish and Wildlife Service (Service or USFWS) is the federal agency with the primary responsibility for the management of migratory birds.[1] The Service's Pacific Region (Region) is vast, stretching across the north Pacific from the coasts of California, Oregon, and Washington in the east, to the Mariana Islands in the far western Pacific, and south of the equator to the islands of American Samoa (Figure 1). The Region supports the most diverse group of seabirds in the United States and it is second only to Alaska (Region 7) in the total number of breeding seabirds. An estimated 14 million seabirds representing 60 species breed in the Region and millions more winter or migrate through the area.

Two of the most diverse seabird assemblages in the U.S. are represented: the temperate species of the California Current System (California, Oregon, Washington) and the tropical/subtropical seabirds of Hawai`i and the other U.S. Pacific Islands (USPI). For four species, essentially the entire world population breeds in the Region. For 23 more species, the Region supports the entire U.S. population. Seven species/subspecies have small or declining populations and face significant threats that result in their inclusion on the national list of Birds of Conservation Concern (BCC).[2] Six more are listed under the Endangered Species Act (ESA) (see Appendix 3).

Within this vast expanse, significant numbers of breeding seabirds nest on 30 National Wildlife Refuges (NWR), owned and managed by the Service. This Regional Seabird Conservation Plan (Plan) will serve to guide and coordinate Service activities to conserve seabird populations and habitats in the Pacific Region and to foster conservation of seabirds at the ecoregion scale in coordination with our partners.

## Goals of USFWS Seabird Conservation Program in the Region

I. Maintain the current abundance, diversity, and distribution of healthy populations of breeding seabirds in the Pacific Region. Enhance the abundance and distribution of declining, depleted, or extirpated seabird species.

II. Maintain, protect, and enhance seabird habitats (breeding, roosting, foraging, migrating, and wintering) in sufficient quantity and quality to meet seabird needs.

III. Alleviate or eliminate threats and resolve management conflicts that negatively affect seabirds.

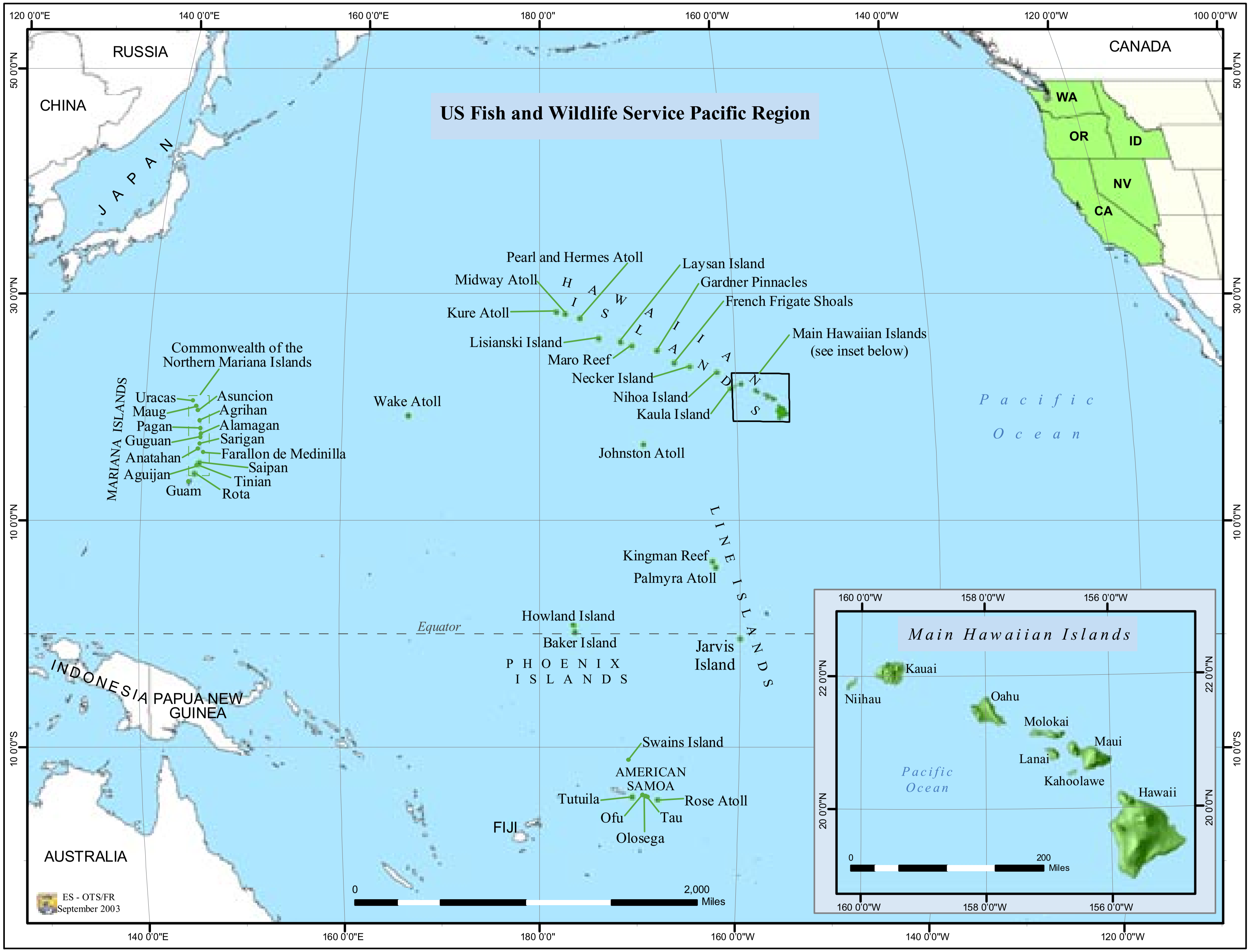
IV. Improve coordination and communication directed towards the conservation of seabirds at all scales: international, national, regional, and local.

V. Increase and improve opportunities for people to view, enjoy, and learn about seabirds of the Pacific Region.

[1] See Appendix 1: Treaties, Legislation, Policies, National and International Initiatives and Jurisdiction.

[2] USFWS 2002

**Figure 1. Map of U.S. Fish and Wildlife Service, Pacific Region.**



# Purpose and Objectives

The purpose of this Plan is to identify the Service's priorities for seabird management, monitoring, research, and outreach within the Region and to develop a comprehensive and coordinated regional strategy for seabird conservation. The seabirds covered in this Plan are a significant national and international resource. This Plan will serve as the foundation for developing cooperative seabird conservation efforts with agencies, academia, non-governmental organizations, and others at all scales from local to international. The objectives of this Plan are:

1. Present an overview of the seabird and habitat resources in the Region and a review of current Service seabird conservation activities.

2. Identify threats, issues and conservation concerns that jeopardize healthy seabird populations.

3. Establish Service priorities for seabird management, monitoring, research, outreach, and coordination to provide a foundation for program planning, budgeting, and implementation.

4. Promote internal, interagency, national and international coordination in seabird management and monitoring, and forge new and stronger ties with agency personnel, researchers and non-government organizations (NGOs) active in seabird conservation.

# Scope of the Plan

The Service's Pacific Region encompasses the six western states: Washington (WA), Oregon (OR), California (CA), Idaho, Nevada and Hawai`i (HI); and the U.S. island possessions, territories, and commonwealths in the central Pacific, including: Midway Atoll in the Hawaiian Archipelago; Johnston Atoll; Wake Atoll in the Marshall Archipelago; Guam and the Commonwealth of the Northern Mariana Islands (CNMI); Palmyra Atoll, Kingman Reef and Jarvis Island in the Line Archipelago; Baker and Howland Islands in the Phoenix Archipelago; and the islands of American Samoa (Appendix 2). Thus this plan encompasses migratory birds over a huge area, stretching across the north Pacific Ocean from California to the Mariana Islands and south of the equator to American Samoa - a distance of approximately 5,000 miles from east to west and 4,000 miles from north to south (Figure 1). Included are exposed coastlines, coastal bays, estuaries, coastal marshes, coral reefs, and offshore islands, rocks, and sea stacks of the three west coast states and the U.S. Pacific Islands (USPI).

The Plan includes species of the Orders Procellariiformes, Pelecaniformes and Charadriiformes (suborders Lari and Alcae) that breed on oceanic islands or along continental coastlines and exploit the marine and estuarine environments. Loons, grebes, sea ducks, and shorebirds are not included. The Plan also does not cover inland nesting "seabirds" such as White Pelicans[3] or Black Terns, nor does it include the inland breeding segments of wide-spread species such as Double-crested Cormorants.

Six species/subspecies are listed under ESA: Short-tailed Albatross, Hawaiian Petrel, Newell's Shearwater, California Brown Pelican, California Least Tern and Marbled Murrelet. The Service's Division of Endangered Species has primary responsibility for these species. ESA listed species are covered in this plan but readers are directed to the respective Recovery Plans[4] for a more in-depth discussion of the ecology, conservation, recovery goals, and priorities for these species. Short-tailed Albatross were listed in the U.S. in 2000 and a recovery plan is in development.

[3] Scientific names used in this plan are listed in Appendix 5

[4] USFWS 1980, USFWS 1983a, USFWS 1983b, USFWS 1997

# Seabird Overview

Sixty species of seabirds representing three Orders and ten Families, nest in the Region: three albatross,[5] six petrels, four shearwaters, seven storm-petrels, three cormorants, one pelican, two frigatebirds, three boobies, two tropicbirds, five gulls, twelve terns, three noddies, one skimmer, one murre, one guillemot, three murrelets, two auklets and one puffin (Table 1). Many of these populations are of global or national importance (Appendix 3). For example, the entire world populations of Hawaiian Petrels and Newell's Shearwaters, and over 95% of the world's Laysan and Black-footed Albatross nest in the Hawaiian archipelago. Most of the world's Ashy Storm-Petrels, Western Gulls, and Brandt's Cormorants nest along the U.S. west coast. For 27 species, this Region supports the entire U.S. population; this includes many of the central Pacific albatrosses, petrels, storm-petrels, shearwaters, frigatebirds and noddies. This group also includes Black Storm-Petrels, Elegant Terns and Xantus's Murrelets that nest in Mexico and California.

In addition to the breeding seabirds, millions of seabirds representing more than 100 different species migrate to or through the waters of this Region. The exact number of birds that utilize this area is unknown, even in the relatively well studied waters off California, Oregon and Washington. Estimates of 5.5 - 6 million birds off California and 1.8 million birds off Oregon and Washington, representing more than 100 species, were generated from at-sea surveys conducted during 1975-1990.[6] Surveys around the Hawaiian Islands during the summer and fall of 2002, documented 40 different species; 20 local breeders and 20 migrant species.[7] These visiting birds have wide biogeographic affinities including species that nest inland and move to the coast during the winter and birds that breed elsewhere in the north and south Pacific. Numerically the most abundant seabird off the California coast is the Sooty Shearwater, a southern hemisphere breeder that migrates to the north Pacific during the austral winter.[8] Several other southern hemisphere seabirds (*e.g.,* Short-tailed and Pink-footed Shearwaters) also migrate to or through this area. Northern nesting species such as Northern Fulmars and Black-legged Kittiwakes migrate south into the Region during the winter.

Seabirds are often grouped in relation to their basic foraging ecology: coastal, neritic or pelagic. Coastal seabirds rarely range far from land, foraging in marine, estuarine, freshwater, and sometimes even terrestrial habitats, and most return to land to roost at night. Pelicans, cormorants, and most temperate terns and gulls are considered coastal birds. Several of these species (*e.g.,* Double-crested Cormorants and California Gulls) have broad distributions that range far inland and segments of their populations may never encounter the ocean. Neritic species such as the alcids, usually occur over the continental shelf and typically remain at sea at night when not breeding. Pelagic species include the albatrosses, petrels, and many tropical terns that are strictly marine, ranging far out to sea and returning to land only to breed.

About 98% of all seabird species typically nest in colonies.[9] While individuals from many species might occasionally nest solitarily, the Marbled Murrelet is the only species in the Region that does so consistently. Small predator-free islands in the Region (*e.g.,* Laysan Is.) can support millions of breeding birds, representing 15 or more species.

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5 Short-tailed, Black-footed, and Laysan Albatross all nest at Midway Atoll. Short-tailed Albatross have laid eggs but there is no documentation that these eggs hatched. Accounts of chicks fledging in the 1950s/60s have not been substantiated.

6 Briggs *et al*. 1987a, Briggs *et al*. 1992

7 Ballance *et al*. 2004

8 Tyler *et al.* 1993

9 Furness and Monaghan 1987

**Table 1. Breeding Seabirds of the Coastal USFWS Pacific Region and Distribution by State.[1]**

| Scientific Name | Common Name | WA | OR | CA | HI | USPI |
|---|---|---|---|---|---|---|
| Order PROCELLARIIFORMES | | | | | | |
| Family DIOMEDEIDAE | | | | | | |
| *Phoebastria albatrus* | Short-tailed Albatross | | | | b | |
| *Phoebastria nigripes* | Black-footed Albatross | | | | B | B |
| *Phoebastria immutabilis* | Laysan Albatross | | | | B | B |
| Family PROCELLARIIDAE | | | | | | |
| *Pterodroma sandwichensis* | Hawaiian Petrel | | | | B | |
| *Pterodroma arminjoniana* | Herald Petrel | | | | | B |
| *Pterodroma rostrata* | Tahiti Petrel | | | | | B |
| *Pterodroma hypoleuca* | Bonin Petrel | | | | B | B |
| *Pterodroma alba* | Phoenix Petrel | | | | | Ex |
| *Bulweria bulwerii* | Bulwer's Petrel | | | | B | B |
| *Puffinus pacificus* | Wedge-tailed Shearwater | | | | B | B |
| *Puffinus nativitatis* | Christmas Shearwater | | | | B | B |
| *Puffinus auricularis newelli* | Newell's Shearwater | | | | B | |
| *Puffinus lherminieri* | Audubon's Shearwater | | | | | B |
| Family HYDROBATIDAE | | | | | | |
| *Oceanodroma furcata* | Fork-tailed Storm-Petrel | B | B | B | | |
| *Oceanodroma leucorhoa* | Leach's Storm-Petrel | B | B | B | | |
| *Oceanodroma homochroa* | Ashy Storm-Petrel | | | B | | |
| *Oceanodroma castro* | Band-rumped Storm-Petrel | | | | B | |
| *Oceanodroma melania* | Black Storm-Petrel | | | B | | |
| *Oceanodroma tristrami* | Tristram's Storm-Petrel | | | | B | |
| *Nesofregetta fuliginosa* | Polynesian Storm-Petrel | | | | | B |
| Order PELECANIFORMES | | | | | | |
| Suborder PHAETHONTES | | | | | | |
| Family PHAETHONTIDAE | | | | | | |
| *Phaethon lepturus* | White-tailed Tropicbird | | | | B | B |
| *Phaethon rubricauda* | Red-tailed Tropicbird | | | | B | B |
| Suborder PELECANI | | | | | | |
| Family SULIDAE | | | | | | |
| *Sula dactylatra* | Masked Booby | | | | B | B |
| *Sula leucogaster* | Brown Booby | | | | B | B |
| *Sula sula* | Red-footed Booby | | | | B | B |
| Family PELECANIDAE | | | | | | |
| *Pelecanus occidentalis* | Brown Pelican | | | B | | |

**Table 1. Breeding Seabirds of the USFWS Pacific Region and Distribution by State (continued).**

| Scientific Name | Common Name | WA | OR | CA | HI | USPI |
|---|---|---|---|---|---|---|
| Family PHALACROCORACIDAE | | | | | | |
| *Phalacrocorax auritus* | Double-crested Cormorant | B | B | B | | |
| *Phalacrocorax penicillatus* | Brandt's Cormorant | B | B | B | | |
| *Phalacrocorax pelagicus* | Pelagic Cormorant | B | B | B | | |
| Family FREGATIDAE | | | | | | |
| *Fregata minor* | Great Frigatebird | | | | B | B |
| *Fregata ariel* | Lesser Frigatebird | | | | | B |
| Order CHARADRIIFORMES | | | | | | |
| Suborder LARI | | | | | | |
| Family LARIDAE | | | | | | |
| *Larus delawarensis* | Ring-billed Gull | B | B | | | |
| *Larus californicus* | California Gull | | | B | | |
| *Larus occidentalis* | Western Gull | B | B | B | | |
| *Larus glaucescens* | Glaucous-winged Gull | B | B | | | |
| *Larus heermanni* | Heermann's Gull | | | B | | |
| *Sterna nilotica* | Gull-billed Tern | | | B | | |
| *Sterna caspia* | Caspian Tern | B | B | B | | |
| *Sterna maxima* | Royal Tern | | | B | | |
| *Sterna elegans* | Elegant Tern | | | B | | |
| *Sterna paradisaea* | Arctic Tern | B | | | | |
| *Sterna forsteri* | Forster's Tern | | | B | | |
| *Sterna albifrons* | Little Tern | | | | B | B |
| *Sterna antillarum* | Least Tern | | | B | | |
| *Sterna lunata* | Gray-backed Tern | | | | B | B |
| *Sterna anaethetus* | Bridled Tern | | | | | B? |
| *Sterna fuscata* | Sooty Tern | | | | B | B |
| *Anous stolidus* | Brown Noddy | | | | B | B |
| *Anous minutus* | Black Noddy | | | | B | B |
| *Procelsterna cerulea* | Blue-gray Noddy | | | | B | B |
| *Gygis alba* | White Tern | | | | B | B |
| *Rynchops niger* | Black Skimmer | | | B | | |
| Suborder ALCAE | | | | | | |
| Family ALCIDAE | | | | | | |
| *Uria aalge* | Common Murre | B | B | B | | |
| *Cepphus columba* | Pigeon Guillemot | B | B | B | | |
| *Brachyramphus marmoratus* | Marbled Murrelet | B | B | B | | |
| *Synthliboramphus hypoleucus* | Xantus's Murrelet | | | B | | |
| *Synthliboramphus antiquus* | Ancient Murrelet | B | | | | |
| *Ptychoramphus aleuticus* | Cassin's Auklet | B | B | B | | |
| *Cerorhinca monocerata* | Rhinoceros Auklet | B | B | B | | |
| *Fratercula cirrhata* | Tufted Puffin | B | B | B | | |

B = Breeding; b = unsuccessful breeding attempts; B? = breeding suspected; Ex = extirpated breeders
[1] Only the coastal portions of seabird breeding populations are represented.

Seabirds are long-lived, with delayed maturity, low fecundity and high adult survival.[10] They are almost invariably monogamous with relatively high rates of mate retention.[11] Clutch sizes typically are small, with most neritic and pelagic species laying only one large egg. Coastal seabirds tend to have larger clutch sizes, with temperate gulls and terns laying 2-3 eggs and cormorants averaging 3-4 eggs.[12] Both adults participate in incubation and the period of chick rearing can be quite extended compared to other birds (six weeks for Caspian Terns and six months for Laysan and Black-footed Albatross). Frigatebirds have the longest post-fledging parental care period of any species of bird with adults continuing to feed young up to a year after fledging.[13]

Seabirds spend most of their lives in the marine environment. Laysan Albatross young remain at sea for 3-4 years before returning to land to find a mate.[14] Sooty Tern chicks go to sea for 2-5 years before they return to the nesting islands, and they spend most of this time "on the wing", because they quickly become waterlogged if they sit on the water. In contrast, cormorants and Brown Pelicans have wettable feathers, and they return to land daily to roost and dry their plumage. Coastal species will often return to land several times a day during the breeding season to feed a chick or relieve a mate incubating an egg. More pelagic species can be gone for days or weeks. At the Farallon Islands, Brandt's Cormorants have a mean incubation shift of approximately 5 hours[15] while at Midway Atoll, male Laysan Albatrosses incubate the egg for an average of 22-23 days during their first shift.[16]

Seabirds obtain their food from the ocean and they forage on a variety of marine organisms. They employ a variety of methods to obtain food including diving (propelled by wings or feet), plunging, plunge-diving (plunging coupled with active underwater pursuit), aerial capture (*e.g.,* flyingfish), dipping, pattering, skimming, surface-seizing, scavenging, and piracy. Plunge diving, aerial pursuit, and surface feeding are more common in the clear waters of the tropics while diving is more common in the turbid and productive waters farther north. Most seabirds feed on small fish, squid and the larger zooplankton such as euphausiids, copepods, and amphipods.

Pacific seabirds are a shared international resource. Foraging seabirds can spend considerable time in international waters or the territorial waters of other Pacific Rim nations. Birds breeding on islands in the California Current System (CCS) (Figure 2) may migrate or disperse after the breeding season, north to Canadian waters or south to Mexico, Central or South America. Many USPI birds forage far beyond the 200 mile U.S. Exclusive Economic Zone (EEZ). The most numerous seabird off the west coast of North America is the Sooty Shearwater; a southern hemisphere breeder.

Pacific Region seabirds face a range of threats at sea and on the colonies. Invasive (non-native) species, fishery bycatch, disturbance, pollution, and loss of habitat are the most serious issues.

The 60 species of seabirds breeding in this Region were classified according to regional conservation concern using the ranking system of the North American Waterbird Conservation Plan. The ranking process considers population size and trends, extent of the breeding and non-breeding distribution, and threats during the breeding and non-breeding seasons. In the *Waterbird Conservation for the Amercias: North American Waterbird Conservation Plan*, seabirds were classified at the larger scale of North and Central America, Caribbean, and USPI, however, regional population trends and threats can vary greatly, especially for seabirds that breed in both the Pacific and the Carribean. In this plan, conservation scores were assessed at the regional scales of the CCS and USPI (Tables 2 and 3). A more detailed description of the scoring and ranking process is presented in Kushlan *et al.* (2002).

Almost half (47%) of the seabird species breeding in the Region fall into the two highest categories of conservation concern: "Highly Imperiled" and

[10] Weimerskirch 2002

[11] Furness and Monaghan 1987

[12] Johnsgard 1993

[13] Nelson 1976

[14] Rice and Kenyon 1962b

[15] Boekelheide *et al.* 1990

[16] Fisher 1971

**Figure 2, The West Coast of California, Oregon, and Washington with Key Features of Significance to Seabirds.**

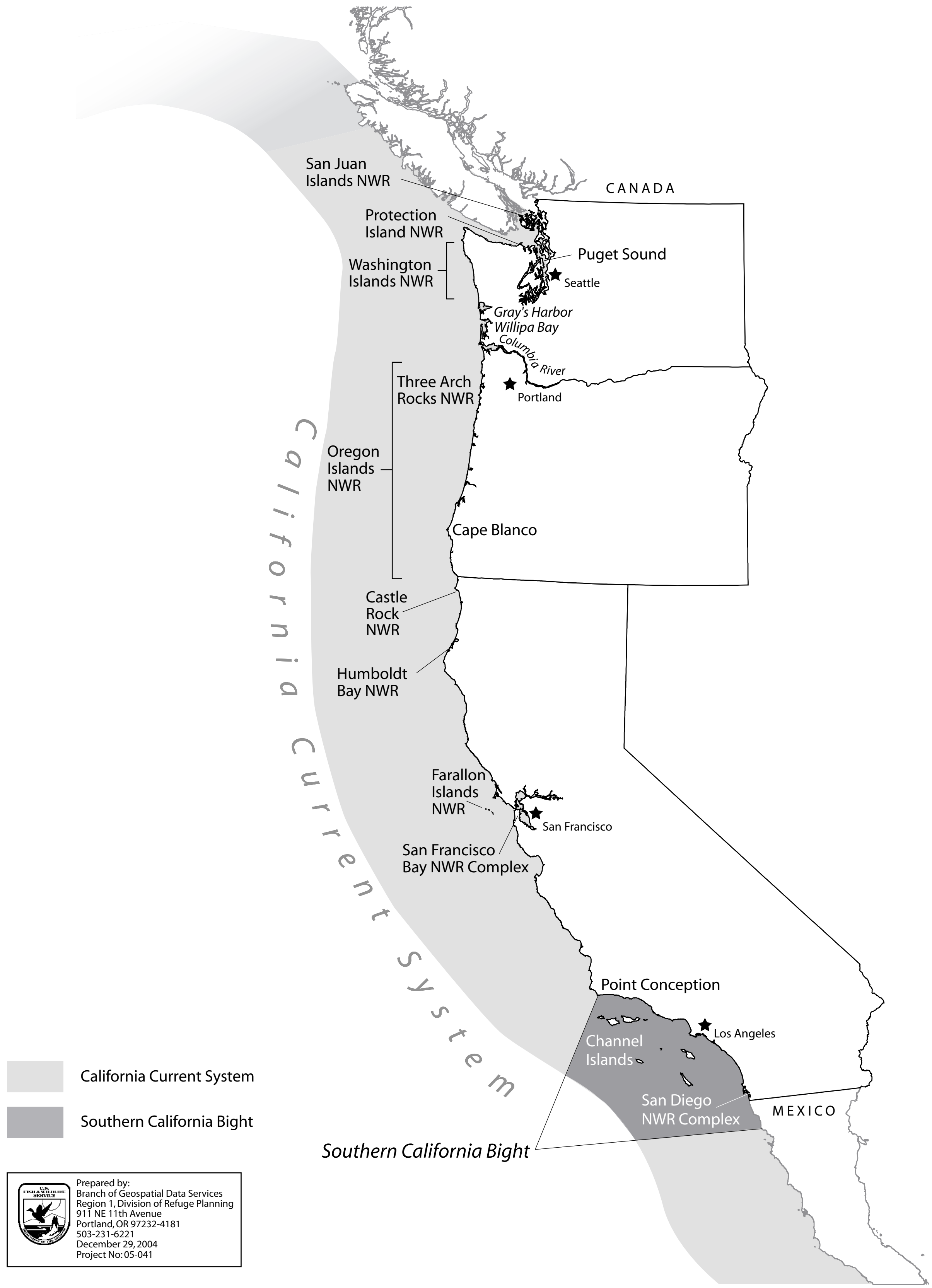

**Table 2. Conservation Classification for Breeding Seabirds of the California Current System.**

| English Name | ESA/BCC Status [a] | Regional Conservation Category [b] |
|---|---|---|
| Ashy Storm-Petrel | BCC | Highly Imperiled |
| Marbled Murrelet | T | Highly Imperiled |
| Black Storm-Petrel | | High Concern |
| California Brown Pelican | E | High Concern [c] |
| Pelagic Cormorant | | High Concern |
| Elegant Tern | BCC | High Concern [d] |
| Western Gull-billed Tern | BCC | High Concern |
| California Least Tern | E | High Concern |
| Black Skimmer | BCC | High Concern |
| Xantus's Murrelet | P/BCC | High Concern |
| Cassin's Auklet | BCC-32 | High Concern |
| Rhinoceros Auklet | | High Concern |
| Brandt's Cormorant | | Moderate |
| Heermann's Gull | | Moderate |
| Caspian Tern | BCC-5 | Moderate [d] |
| Forster's Tern | | Moderate |
| Common Murre | | Moderate |
| Pigeon Guillemot | | Moderate |
| Ancient Murrelet | | Moderate [e] |
| Tufted Puffin | | Moderate |
| Leach's Storm-Petrel | | Low |
| California Gull | | Low |
| Western Gull | | Low |
| Royal Tern | | Low [e] |
| Arctic Tern | | Low [e] |
| Fork-tailed Storm-Petrel | | Currently Not at Risk |
| Double-crested Cormorant | | Currently Not at Risk |
| Ring-billed Gull | | Currently Not at Risk |
| Glaucous-winged Gull | | Currently Not at Risk |

[a] Federal Endangered Species Act or Birds of Conservation Concern Status: E=Endangered, T=Threatened, C=Candidate, P=Petitioned, BCC= Bird of Conservation Concern at the National or Regional scale (USFWS 2002), BCC-# = Bird of Conservation Concern in the Bird Conservation Region (BCR) indicated.

[b] Seabirds were ranked according to the process outlined in the North American Waterbird Conservation Plan (Kushlan *et al.* 2002).

[c] Brown Pelicans rank as Moderate but are upgraded to High Concern because of endangered status in the Region.

[d] Species rank as Low or Moderate Concern but are Birds of Conservation Concern in the Region or BCR and their category is upgraded due to extreme concentration of the population at a few colonies.

[e] Species rank as High or Moderate Concern but are downgraded because of limited occurrence in the Region.

### Table 3. Conservation Classification for Breeding Seabirds of Hawai`i and U.S. Pacific Islands.

| English Name | ESA/BCC Status [a] | Regional Conservation Category [b] |
|---|---|---|
| Hawaiian Petrel | E | Highly Imperiled |
| Tahiti Petrel | BCC | Highly Imperiled |
| Phoenix Petrel | BCC | Highly Imperiled |
| Newell's Shearwater | T | Highly Imperiled |
| Band-rumped Storm-Petrel | C/BCC | Highly Imperiled |
| Polynesian Storm-Petrel | BCC | Highly Imperiled |
| Short-tailed Albatross | E | High Concern |
| Laysan Albatross | BCC-5,67,68 | High Concern |
| Black-Footed Albatross | BCC | High Concern |
| Herald Petrel | BCC-68 | High Concern |
| Christmas Shearwater | BCC-67,68 | High Concern |
| Audubon's Shearwater | | High Concern |
| Tristram's Storm-Petrel | BCC | High Concern [c] |
| Lesser Frigatebird | BCC-68 | High Concern |
| Blue-gray Noddy | BCC | High Concern |
| Bonin Petrel | | Moderate |
| Bulwer's Petrel | | Moderate |
| Red-tailed Tropicbird | | Moderate |
| Masked Booby | | Moderate |
| Brown Booby | | Moderate |
| Great Frigatebird | | Moderate |
| Little Tern | | Moderate [d] |
| Gray-backed Tern | | Moderate |
| Sooty Tern | | Moderate |
| Black Noddy | | Moderate |
| White Tern | | Moderate |
| Wedge-tailed Shearwater | | Low |
| White-tailed Tropicbird | | Low |
| Bridled Tern | | Low |
| Red-Footed Booby | | Currently not at Risk |
| Brown Noddy | | Currently not at Risk |

[a] Federal Endangered Species Act or Birds of Conservation Concern Status: E=Endangered, T=Threatened, C=Candidate, P=Petitioned, BCC= Birds of Conservation Concern at the National or Regional scale (USFWS 2002), BCC-# = Birds of Conservation Concern in the Bird Conservation Region (BCR) indicated.

[b] Seabirds were ranked according to the process outlined in the North American Waterbird Conservation Plan (Kushlan *et al.* 2002).

[c] Species rank as Low or Moderate but are Birds of Conservation Concern in the Region or BCR and their category is upgraded due to extreme concentration of the population at a few colonies.

[d] Species rank as High or Moderate but are downgraded because of limited occurrence in the Region.

“High Concern” (Table 4). Procellariiformes have the highest representation (75% of 20 species), including all of the albatrosses. Alcids are also heavily represented (62% of 8 species). There are more high priority seabirds in the USPI (15 species) than in the CCS (12 species). This reflects the concentration of breeding birds on a smaller number of islands, the devastating impacts of invasive species, habitat degradation associated with human habitation of islands, and the impacts of commercial fisheries. In the CCS, oil and other contaminants, habitat loss, and interactions with fisheries are the primary factors that resulted in high conservation rankings.

For most seabirds, population recovery is slow because of life history traits such as delayed maturity and low fecundity. Annual declines in populations are often difficult to detect, but can have long-term consequences if left unchecked. Careful and precise monitoring to detect trends, resources to investigate the causes of population changes, and active management to stay or reverse declining trends are fundamental to seabird conservation.

**Table 4. Summary by Family of Seabirds Breeding in USFWS Pacific Region that are Ranked High Concern or Highly Imperiled at the Regional Scale.**

| Family | Common Name | Number Breeding Species [a] | Number of Species Ranked High Conservation Concern [b] | % Ranked High Conservation Concern |
|---|---|---|---|---|
| Diomedeidae | albatrosses | 3 | 3 | 100% |
| Procellariidae | petrels and shearwaters | 10 | 7 | 70% |
| Hydrobatidae | storm-petrels | 7 | 5 | 71% |
| *subtotal* | *Procellariiformes* | *20* | *15* | *75%* |
| Phaethontidae | tropicbirds | 2 | 0 | - |
| Sulidae | boobies | 3 | 0 | - |
| Pelecanidae | pelicans | 1 | 1 | 100% |
| Phalacrocoracidae | cormorants | 3 | 1 | 33% |
| Fregatidae | frigatebirds | 2 | 1 | 50% |
| *subtotal* | *Pelecaniformes* | *11* | *3* | *27%* |
| Laridae | gulls, terns, skimmers | 21 | 5 | 24% |
| Alcidae | murres, murrelets, auklets, puffins | 8 | 5 | 62% |
| *subtotal* | *Charadriiformes* | *29* | *10* | *34%* |
| **TOTAL** | | **60** | **28** | **47%** |

[a] Includes extirpated breeders and unsuccessful breeders (*e.g.,* Short-tailed Albatross).

[b] Includes species regionally ranked 4: High Concern or 5: Highly Imperiled according to Colonial Waterbird scoring system (Kushlan *et al*. 2002).

# Seabird Habitats

Seabirds spend most of their life at sea feeding on fish, squid and other invertebrates, but return to land to breed. Terrestrial and ocean habitats in this Region are described in the following sections. Nesting and roosting habitats along the Washington, Oregon, and California coasts are quite distinct from those found on the tropical and subtropical Pacific Islands, so each of these broad geographic areas is summarized separately, after the general discussion below.

## Nesting and Roosting Habitat

Most seabirds nest directly on the ground, or underground in burrows and crevices, or on vegetation. Disturbance - and predator-free habitats are important determinants of successful breeding. More than 99% of the seabirds in the Region nest on islands. The intrinsic isolation of islands afford greater protection from disturbance and terrestrial predators. Historically, as human populations expanded, large islands were settled, often accompanied by the introduction of exotic plants and animals. Increased disturbance, habitat degradation, and predation associated with human habitation resulted in declines of seabird populations, range contractions, and colony extirpations. Today, relatively small islands[19] support the largest colonies and the majority of the breeding birds. Small islands are often uninhabited and free of mammalian predators such as rats, cats, dogs, foxes, racoons, and mongooses. The large, inhabited islands of the Region typically do not support correspondingly large seabird populations. However, these large islands do provide habitat for several species that nest nowhere else in the U.S., or in some cases the world (*e.g.,* Newell's Shearwaters and Hawaiian Petrels). Many of the seabird species restricted to these larger islands are listed or are candidates for listing under the ESA or BCC.[20]

Suitable nesting habitat is limited, but generally not a regulating mechanism for today's seabird populations. Seabirds nest in three strata: on the surface, underground, and above ground (Table 5). Each of these broad categories can be further divided. For example, storm-petrels nest under cover, but Black and Ashy Storm-Petrels typically nest in rocky crevices or among boulders, while Leach's and Tristram's Storm-Petrels typically excavate burrows in the soil. Surface nesters may prefer: 1) narrow ledges on steep cliffs (*e.g.,* Pelagic Cormorant), 2) broad ledges and flat tops of offshore islands (*e.g.,* Brandt's Cormorant and Common Murre), 3) the level surface of low, flat islands, either associated with vegetation (Laysan Albatross), or 4) barren areas generally devoid of vegetation (Black-footed Albatross and Caspian Tern). Many of the surface nesting species select nest sites associated with cover, such as under vegetation or man-made objects (*e.g.,* Christmas Shearwater and Xantus's Murrelet). Red-footed Boobies and frigatebirds prefer to nest on trees and shrubs, but will nest on the ground if vegetation is unavailable. Marbled Murrelets are the most specialized of the above-ground nesters, laying eggs on the branches of trees in old growth forests.

In the tropical Pacific, birds nest year-round and there is temporal segregation in the use of some breeding habitats. For example, Bonin Petrels and Wedge-tailed Shearwaters both nest in burrows, but the petrels breed in the winter/spring and the shearwaters in summer/fall. Late-fledging petrels are often forcibly ejected or killed by shearwaters returning to the burrows.

Roost sites are another essential habitat for many seabirds. Roosting allows birds to rest, preen and dry their plumage. Communal roosting may benefit social functions such as mate selection and facilitate finding prey. Many pelagic and neritic seabirds such

[19] Small islands are generally defined as <40ha (100ac) in the CCS area and <400ha (1,000ac) in the USPI.

[20] USFWS 2002

**Table 5. Spatial Segregation of Seabird Nesting Habitat.**

| | Above Ground | On Surface | | | Below Surface | |
|---|---|---|---|---|---|---|
| | **On Vegetation** | **Under Vegetation** | **With Vegetation** | **Without Vegetation** | **Burrows** | **Cavities/Crevices** |
| **Pacific Islands** | Red-footed Booby<br>Great Frigatebird<br>Lesser Frigatebird<br>Brown Noddy<br>Black Noddy<br>White Tern | Christmas Shearwater<br>Phoenix Petrel<br>Polynesian Storm-Petrel<br>Newell's Shearwater<br>Red-tailed Tropicbird | Laysan Albatross<br>Brown Booby<br>Red-footed Booby*<br>Sooty Tern<br>Blue-gray Noddy<br>Brown Noddy | Black-footed Albatross<br>Masked Booby<br>Gray-backed Tern<br>Little Tern<br>Black Noddy*<br>Brown Noddy*<br>White Tern | Hawaiian Petrel<br>Tahiti Petrel<br>Herald Petrel<br>Bonin Petrel<br>Wedge-tailed Shearwater<br>Polynesian Storm-Petrel<br>Tristram's Storm-Petrel | Hawaiian Petrel<br>Bulwer's Petrel<br>Christmas Shearwater*<br>Newell's Shearwater*<br>Tristram's Storm-Petrel*<br>Red-tailed Tropicbird* |
| **California Current System** | Brown Pelican<br>Double-crested Cormorant<br>Marbled Murrelet | Xantus's Murrelet | Brown Pelican<br>Double-crested Cormorant<br>Ring-billed Gull<br>California Gull<br>Western Gull<br>Glaucous-winged Gull<br>Gull-billed Tern<br>Forster's Tern | Double-crested Cormorant<br>Brandt's Cormorant<br>Pelagic Cormorant<br>Gull-billed Tern<br>Caspian Tern<br>Royal Tern<br>Elegant Tern<br>Arctic Tern<br>Forster's Tern*<br>Least Tern<br>Black Skimmer<br>Common Murre | Fork-tailed Storm-Petrel Leach's Storm-Petrel<br>Ancient Murrelet<br>Cassin's Auklet<br>Rhinoceros Auklet<br>Tufted Puffin | Fork-tailed Storm-Petrel<br>Leach's Storm-Petrel*<br>Ashy Storm-Petrel<br>Band-rumped Storm-Petrel<br>Black Storm-Petrel<br>Pigeon Guillemot<br>Xantus's Murrelet<br>Ancient Murrelet<br>Cassin's Auklet<br>Rhinoceros Auklet*<br>Tufted Puffin* |

as albatrosses, petrels, Sooty Terns, and several alcids, return to land only during the breeding season and they roost at the colonies. Seabirds that feed closer to shore, return to land regularly to roost, both during the breeding and non-breeding seasons. Gulls, terns, and cormorants return to land frequently and roost sites are located both at and away from colonies. The plumage of some seabirds, such as pelicans and cormorants, is not waterproof; therefore, roosting on dry land is necessary for drying feathers.[21]

## California Current System Terrestrial Habitats

The coastal and offshore areas of California, Oregon, and Washington provide a variety of roosting and nesting habitats, including islands, rocks, cliffs, headlands, beaches, estuaries, and man-made structures such as bridges, dikes, dredge spoil islands, jetties, navigation structures, and breakwaters. Loss and degradation of coastal habitat has been significant, especially of beaches and associated sand dunes, coastal marshes, and estuarine islands. The larger islands (*e.g.*, Channel Islands and San Juan Islands) have been significantly altered. Smaller offshore rocks and islands have also been affected, but due to their relative inaccessibility, they typically have not been degraded to the same degree as large islands or mainland and inshore habitats.

The mainland coast from Canada to Mexico stretches approximately 2,500 km,[22] or 11,600 km following coastal contours. If the thousands of offshore rocks and islands are included, the total tidal coastline is approximately 14,000 km. Estuaries provide important nesting and foraging habitat for cormorants, terns, and gulls. The largest estuaries are Puget Sound, WA; Columbia River Estuary, OR and WA; and San Francisco Bay, CA.

The largest colonies and the vast majority of breeding seabirds are found on small islands (<40 ha; <100ac). There are more than 15,000 small offshore rocks and islands strewn along this coast. Almost half of the seabirds in the CSS nest in Oregon, most within the Oregon Coast NWR Complex where the largest offshore island is <8ha (<20ac). The two largest colonies in California are at Farallon NWR (a complex of seven islands; the largest individual island is 26ha/65ac) and Castle Rock NWR in northern California (6ha/14ac). Small islands also support an impressive diversity of breeding species: the most species-rich seabird nesting island in the Region is Prince Island (16 ha/ 39 ac), off San Miguel Island in southern California.

Many of the larger islands (*e.g.,* Channel Islands, CA; San Juan Islands, WA; and other islands in Puget Sound, WA) support human habitation, some for thousands of years. Mammalian predators often occurred naturally and non-native predators and other invasive species were introduced. Habitats and ecology of larger islands were significantly altered by human activities: agricultural, residential, commercial, and military. Consequently, few of the large islands support large numbers of breeding seabirds and colonies are usually restricted to steep cliffs, sea caves, and other remote and relatively inaccessible areas. Smaller islets just off main islands often support larger numbers of breeding seabirds and greater species diversity.

Most of the islands utilized by seabirds are composed of rock, the result of tectonic or volcanic activity. Habitat features such as size, shape, height, composition, micro-habitat characteristics, distance from shore, distance to feeding areas, soil characteristics, and plant and animal communities determine seabird community structure and size. These rocky, offshore islands are the primary breeding habitat for the more pelagic seabirds (storm-petrels and alcids) and also Brown Pelicans, cormorants, and Western Gulls.

Included in the island category, but unique, are the low inshore islands and exposed sand bars of bays and estuaries. These islands form naturally when sediments fall out of suspension in the slower moving waters of an estuary. Much more dynamic in size and shape than the rocky, marine islands, these islands appear, disappear, and continually change shape in a naturally functioning ecosystem. Scoured by winter floods, they often have little or no vegetation and provide important nesting and roosting habitat for coastal species, especially

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21 Rijke 1970, Johnsgard 1993

22 Values for coastline length differ considerably between sources. For the purposes of this report (unless otherwise noted) we used the values provided by NOAA Medium Resolution Digital Vector Shoreline, created by the Strategic Environmental Assessments (SEA) Division of NOAA's Office of Ocean Resources Conservation and Assessment.

gulls, terns, and Double-crested Cormorants. Human activities that alter natural hydrology (*e.g.*, channelization, hydro-electric dams, and dredging) have significantly degraded estuarine nesting and roosting habitat. On the other hand, islands created or enhanced by deposition of dredge spoils now provide important habitat. The largest Caspian Tern and Double-crested Cormorant colonies in the west are located at East Sand Island in the Columbia River Estuary[23] - a natural island enhanced with dredge spoils. Many species that historically nested along the coast on beaches, sand dunes and estuarine islands now nest on artificial habitats such as dredge-spoil islands, dikes, and wetland fill sites. Several of these species are federally listed under ESA (*i.e.*, California Least Tern), or are BCC (*e.g.*, Gull-billed, Caspian and Elegant Terns), or are state threatened/endangered species. These artificial sites usually require ongoing management to maintain an early seral stage.

The relatively inaccessible cliffs and headlands along the mainland coast and larger islands are another important habitat for seabirds in the CCS. It is difficult for humans or predators to access these sites, so disturbance and predation are low. Cormorants, crevice nesting alcids, and storm-petrels utilize this habitat. In a few locations, Double-crested Cormorants have established coastal colonies in trees, but cliffs constitute the most important natural habitat for this species along the mainland coast. Sea caves, especially on the larger Channel Islands, appear to be less accessible to predators and Xantus's Murrelets and Ashy Storm-Petrels are often found nesting in this habitat.

Finally, mature forests of the Pacific Northwest and central California are the primary breeding habitat for Marbled Murrelets. Loss of habitat to timber harvest resulted in significant isolation and declines in murrelet populations which ultimately led to the listing of these segments of the Marbled Murrelet population as threatened under ESA.

## U.S. Pacific Islands Terrestrial Habitats

Spread over millions of square kilometers of ocean, the USPI comprise only 17,860 $km^2$ of dry land (Figure 1). The Hawaiian Islands account for more than 90% of this land area, and greater than 58% is attributable to the single island of Hawai`i ("Big Island").

The islands of the USPI can be classified into three types: high volcanic, low limestone, and raised limestone (see box). More than 99% of the land is located on the volcanic islands; however, most of the seabirds occur on the low, sandy islands or atolls that have remained uninhabited or nearly so. Human populations are concentrated on volcanic and raised limestone islands due to location, size, and water availability. The large inhabited islands have suffered the greatest habitat loss and degradation, although no Pacific island has escaped human alterations.

The low islands and atolls of the central, equatorial Pacific are extremely isolated and fall into two broad categories: forested and non-forested. Rose and Palmyra atolls, located south and north of the equator, respectively, receive large amounts of rainfall and are densely forested. Arboreal species such as Red-footed Boobies, Great Frigatebirds, and Black Noddies flourish in these habitats. The largest Black Noddy colony in the Central Pacific and one of the largest Red-footed Booby colonies

### Types of islands in the USPI

**Type I: Volcanic islands** rising from the seafloor, often to high elevations that intercept tropical moisture to create a variety of habitats including dense forests, *e.g.,* the main islands of Hawai`i and American Samoa (also referred to as "high islands" or "main islands").

**Type II: Low limestone/coralline islands** usually truncated volcanoes fringed with coral, forming isolated islands or atolls. These islands typically have limited habitat diversity, little fresh water, and several have lagoons, *e.g.,* the Northwestern Hawaiian Islands and U.S. possessions in the Line and Phoenix archipelagos.

**Type III: Raised limestone islands** ancient coral reefs pushed above sea level by tectonic movements. These islands generally consist of uplifted, flat terraces separated by steep cliffs. They support numerous caves and cliffs, *e.g.,* Guam and the southern Mariana Islands, CNMI.

[23] Wires and Cuthbert 2000, Shuford and Craig 2002

are located on Palmyra Atoll. Red-footed Boobies and Great Frigatebirds nest in high densities at Rose Atoll. The non-forested, tropical islands receive little rainfall and are vegetated with grasses, forbs, shrubs and some low-stature trees (*e.g.,* tree heliotrope). Surface nesting species predominate on these islands and some of the largest Sooty Tern colonies in the world are found at Howland, Baker, and Jarvis islands.

Farther north, the subtropical low islands and atolls of the Northwestern Hawaiian Islands (NWHI) are typified by bunchgrass, shrubs, and short trees. Surface and burrow nesting species abound. More than 95% of the world's populations of Laysan and Black-footed Albatrosses and a significant proportion of the world's Bonin Petrels nest here. Sooty Terns are the most numerous breeding species with annual breeding populations estimated at more than 2.5 million birds. In a natural state, none of the NWHI are forested, although Laysan and Nihoa historically supported small groves of native palms and Laysan had native coast sandalwood. Ironwood trees were introduced to Midway Atoll in the early 1900s and large tracts of Midway's Sand Island are densely forested. White Terns and Black Noddies nest year-round in these trees, constituting the largest colonies in Hawai`i.

The high "main" islands of the Hawaiian Islands and American Samoa have been greatly altered by human habitation beginning with the earliest Polynesians. At one time, these islands supported large and diverse populations of nesting seabirds. Today many of the seabirds nest on the smaller rocks and islets off the main islands that are relatively free from disturbance and predators. However, the main islands are still the primary nesting area for several species of petrels (Hawaiian, Tahiti, and Herald's), shearwaters (Audubon and Newell's) and Band-rumped Storm-Petrels, that do not nest on low islands. These species are now restricted to steep, densely forested mountain valleys or high elevations. All of these species are threatened by predators and habitat degradation. The Hawaiian Petrel, once the most abundant seabird on the main Hawaiian Islands, nested from sea level to the mountain tops, but is now endangered, with small colonies at high elevations.

The Mariana archipelago is situated at the northern end of Micronesia. The total land area is 1,119 $km^2$, with one island, Guam, accounting for approximately half (550 $km^2$) of the total land area. The southern six islands of Guam, Rota, Aguijan, Tinian, Saipan, and Farallon de Medinilla are raised limestone islands while the northern islands are volcanic. All of the raised limestone islands are inhabited, except Farallon de Medinilla which is used by the military as a bombing range. Like the main Hawaiian Islands, the southern Marianas have been extensively altered by humans and support a wide array of introduced predators. The northern islands receive little rainfall and are largely barren, but they do provide habitat for surface nesting species, especially Sooty Terns. Seabird populations in the archipelago are relatively small (~265,000 birds) but are significant for Micronesia. The largest islands, Guam, Rota, Saipan and Tinian are inhabited and support less than 4% of the breeding birds; most of these birds nest on Naftan Rock, an islet off Saipan. Except for a few Wedge-tailed Shearwaters, the islands are devoid of burrowing seabirds and surface nesting species predominate.

## Habitat Protection

With notable exceptions, most of the important seabird nesting habitat in the CCS and USPI, that remains today has some type of protected status. Many are managed by state or federal agencies as NWRs, National Parks (NPs), National Monuments, or state parks, reserves, and sanctuaries. Non-governmental organizations (NGOs) such as The Nature Conservancy (TNC) own lands and work with the Service (*e.g.*, at Palmyra Atoll) or the National Park Service (NPS) (*e.g*., at Santa Cruz Is., CA) to manage these areas. Most of the NWRs referenced in this Plan were created specifically to protect seabirds (*e.g.,* Three Arch Rocks, OR). Seabird conservation may or may not be the primary management objective for other federal, state or privately managed areas.

The National Wildlife Refuge System (NWRS) encompasses many important seabird colonies along the west coast. In Washington, all but two of the 600 or more islands, rocks, sea stacks, and reefs along the outer coast are encompassed by the Washington Island NWR Complex. The largest seabird colonies in Puget Sound and the Straits of Juan de Fuca are also NWRs. In Oregon, all of the 1400 marine rocks, reefs, and islands (except Chief's Island) are encompassed within the NWRS. In California, the two largest seabird colonies (Farallon Islands and Castle Rock, in northern California) are NWRs. The Bureau of Land Management (BLM) oversees the California Coastal National Monument which includes thousands of rocks and islands off California. NPS manages the Channel Islands NP, Point Reyes National Seashore, and Golden Gate National Recreation Area. State Parks, reserves, and sanctuaries encompass seabird colonies in all three states. Some of these state lands, such as Año Nuevo Is., CA, are managed for seabird and pinnipeds but often seabird conservation is not the primary goal of these areas. Habitat loss at southern California sandy beaches is high, and there is little protection. The land may be public domain (*e.g.*, public beaches) but human use and disturbance are high.

In the USPI, the largest seabird colonies and the vast majority of breeding seabirds nest on NWRs. The NPS manages large parks on the high islands of American Samoa and the Hawaiian Islands that support key seabird colonies. The NP of American Samoa includes two rainforest preserves on Ta`u and Tutuila where petrels and shearwaters nest. in the Hawaiian Islands, Haleakala, Hawai`i Volcanoes, and Kalaupapa NPs support endangered Hawaiian Petrels, Band-rumped Storm-Petrels and other seabirds. Kure Atoll and islets offshore of the main Hawaiian Islands are managed by the State of Hawai`i, Department of Land and Natural Resources as seabird sanctuaries. In the Mariana Islands, the three islands of Maug are managed as a Bird Reserve by the CNMI.

Conservation and management of seabirds is not a primary goal of the U.S. Department of Defense, however, due to land management practices and public access restrictions, they often support important seabird colonies, especially bases located in areas of heavy urban development (*e.g.,* southern California). Military bases have Integrated Natural Resource Management Plans and according to these plans engage in numerous activities to benefit seabirds. The Service works with the military and other federal, state, county, and city agencies and private citizens to protect and restore habitats important to seabirds.

National Marine Sanctuaries, Marine Protected Areas, and other state and federal designations provide for the management of water and other marine resources in and around seabird colonies and they can provide protection to seabirds by limiting human disturbance, maintaining ecosystem functions (*e.g.,* foraging opportunities), and minimizing negative seabird fisheries interactions. The role of marine protected areas in ocean management is growing and could be of great benefit to seabird conservation.

## Ocean Habitats and Seabirds At Sea

Seabirds derive their food from the sea and their distribution at sea is influenced by oceanographic and biological processes operating at various temporal and spatial scales. Understanding the fundamental processes affecting ocean habitats is important to the conservation of seabirds.

The ocean appears deceptively homogeneous, but in reality is composed of distinct, interacting habitats. The dominant circulation pattern of the North Pacific Ocean is the clockwise North Pacific Subtropical Gyre[24] (Figure 3). As the North Pacific and the Subarctic currents approach North America, the flow diverges with one branch flowing to the north while the other turns southeast, parallel to the coastline, forming the California Current. At the center of the gyre, the warm salty surface waters of the North Pacific Central Water are among the least productive of the ocean,[25] whereas the California Current System is known for its diverse and abundant marine communities. In general, highly productive coastal regions sustain greater overall seabird densities than less productive pelagic waters.[26] Greater numbers of diving seabirds are found in coastal areas along the west coast (*e.g.,* murres, auklets, puffins and cormorants); while areas of lower ocean productivity in the equatorial Pacific sustain less diverse and abundant seabird communities that feed by surface-picking and plunging.[27]

Ocean habitats are dynamic - changing in size, shape, magnitude and even location through time as water masses of varying temperature, salinity and/or velocity converge and diverge. Some habitats, such as the edges of major currents (*e.g.,* California and Equatorial currents), are relatively predictable and persistent, but others are unpredictable and ephemeral. Dynamic ocean habitats are also formed

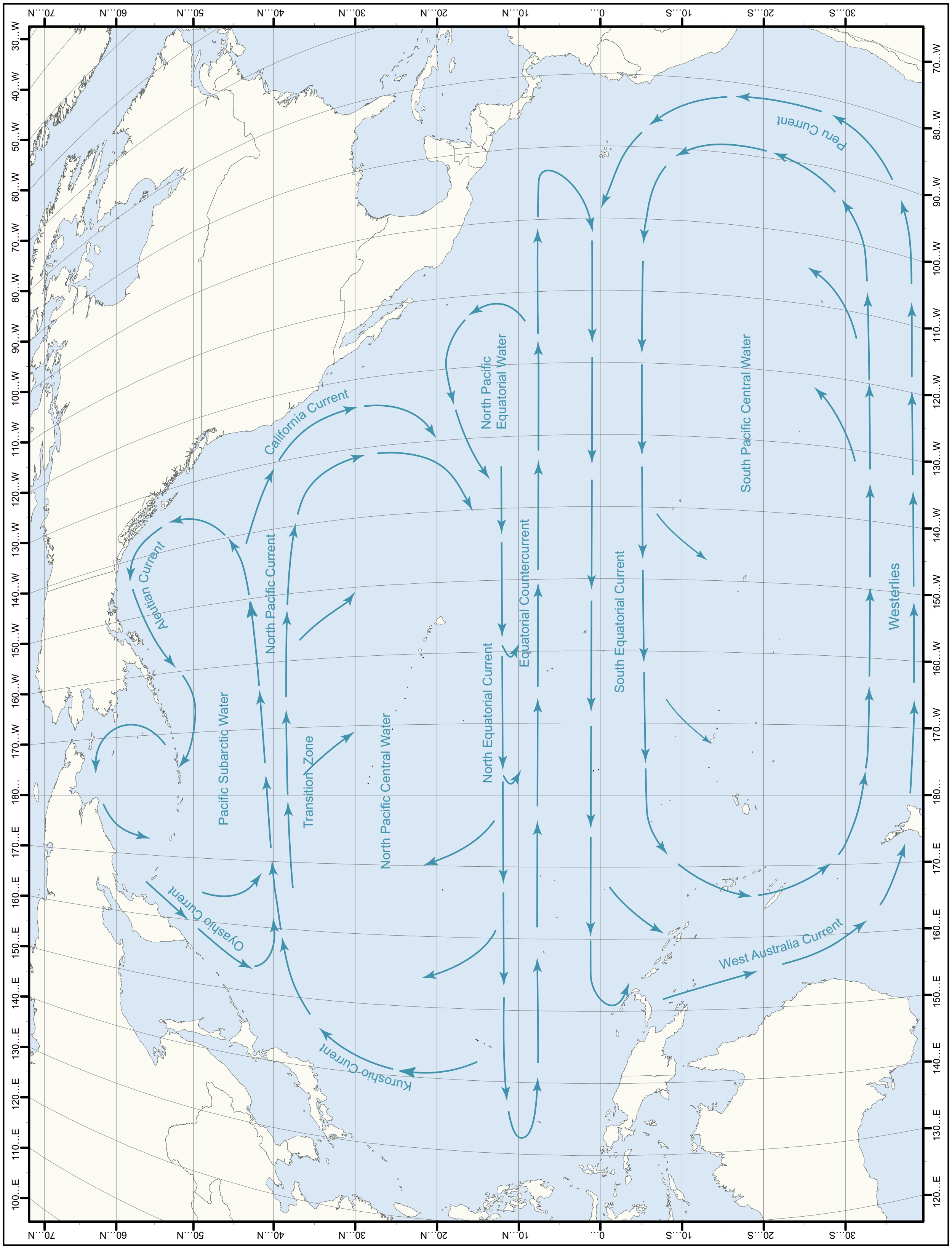
[24] Gyre: circular motion

[25] Seki and Polovina 2001

[26] Ashmole 1971, Briggs *et al.* 1987a, Ballance *et al.* 1997

[27] Ainley 1977, Ballance *et al.* 1997, Spear *et al.* 2001

Figure 3. Diagram of Major Currents of the North Pacific Ocean. (adapted from King et al. 1967)



when water interacts with static features such as an irregular coastline or topography of the ocean floor (*e.g.,* continental shelves or seamounts). Along the west coast, the continental shelf is relatively shallow (<100 m). At the continental shelf break and slope, water depth increases from about 100 m to 2000 m. Along the outer continental shelf, a front often appears due to the transition from colder, less saline coastal waters to the warmer and saltier offshore waters; this convergence results in concentration of prey and wind stress can lead to localized upwelling along the shelf break.

Shelf break/slope fronts and convergences, eddies, and upwellings are important habitats for seabirds due to physical processes that promote productivity and/or concentrate prey. Many species of alcids (*e.g.,* Common Murres, auklets) and shearwaters forage within the shelf break/slope convergences.[29] Moreover, the shelf break/slope habitat is a complex region interspersed with submarine canyons, tables, sills and seamounts. Upwelling can be enhanced by an order of magnitude in the vicinity of submarine canyons[30] and the increased abundance of seabirds foraging in the vicinity of seamounts and canyons is likely a result of processes that promote the aggregation of macro-zooplankton and fish.[31]

In the central Pacific Ocean, there is no continental shelf, but islands, seamounts and even shallow reefs create localized upwelling and convergence fronts throughout the region.[32] Shallow waters are limited in this open ocean/island ecosystem and seabirds in the tropics are much more pelagic than those in temperate areas.

***California Current System.*** The CCS is a complex and extremely productive system of currents, counter currents, undercurrents and other oceanographic processes such as upwelling, that supports millions of breeding and migrant seabirds. Surface flow along the coast (north of Pt. Conception) is generally northward during winter, but during the spring there is a dramatic reversal, or "spring transition", as the current shifts to predominantly southward.[33] Upwelling of cold, nutrient-rich waters along the coast is greatest in spring and summer, coincident with seabird breeding seasons. The irregular coastline, ocean floor topography and climate variability all contribute to spatial and temporal variability in the system (*e.g.,* changes in upwelling intensity, formation of eddies and jets).

Within the CCS, the greatest seabird concentrations occur over the continental shelf, with moderate productivity over the shelf break/slope, and lowest productivity in offshore waters >2000 m deep.[34] The high abundance of prey over the continental shelf attracts millions of seabirds that breed, winter, or migrate through this region annually.[35] Gulls, murres, auklets, and shearwaters are the most abundant seabirds in the CCS. The coastal avifauna is comprised of locally breeding species such as Common Murres, Brandt's Cormorants, and Cassin's Auklets, but Sooty Shearwaters (migrants from the southern hemisphere) are numerically dominant during most of each year. Seabird diversity and biomass are greatest during late spring and fall migration. Overall, seabird density and diversity are lower in the winter, when birds in offshore waters are mainly local breeders or visitors from northern and inland colonies (*e.g.,* kittiwakes, California and Herring Gulls). Beyond the shelf and slope region, *Pterodroma* petrels and Leach's Storm-Petrels are the numerically dominant species.

The Southern California Bight[36] is the recessed coastline between Pt. Conception, CA and Cabo Colnett, MX (Figure 2). The dramatic indentation of the coastline creates a large backwater eddy - a transition zone between warm equatorial waters and the cold subarctic waters of the California Current. This dynamic ecotone delineates the nesting ranges of many subarctic and subtropical marine bird species, *e.g.,* the southern extent of the nesting range for Pigeon Guillemots and Pelagic Cormorants and the northern extent for Black Storm-Petrels, Brown Pelicans, and

29 Oedekoven *et al.* 2001
30 Hickey and Royer 2001
31 Hunt 1991
32 Mann and Lazier 1996
33 Hickey and Royer 2001
34 Tyler *et al.* 1993
35 Ainley 1976, Briggs *et al.* 1987a, Tyler *et al.* 1993
36 A "bight" is defined as a bend in the coastline.

Xantus's Murrelets.[37] However, this region is also characterized by substantial seasonal, interannual and interdecadal variability in oceanographic conditions that may lead to changes in the seabird community structure. For example, there are relatively more subtropical taxa found in this region under warm ocean conditions (*e.g.,* Heerman's Gulls, Black-vented Shearwaters, and Black and Least Storm-Petrels) compared to cooler periods.[38]

***North Pacific Central Water, Transition Zone, and the Equatorial Pacific.*** The North Pacific central water is in the center of the subtropical gyre. Hawai`i is located in this region. Compared to the highly productive waters of the CCS, the warm, salty waters of this area are biologically impoverished. Most seabirds here are associated with schools of predatory fish (especially tunas) that drive prey to the surface making it available to seabirds.[39] Further south, the clear, warm waters of the tropics are also characterized by low productivity in the surface waters. Along the equator, however, the oceanographic system is more dynamic with Equatorial upwelling. Another feature is the Equatorial Front where surface waters between the South Equatorial Current and the North Equatorial Countercurrent converge.[40] Planktivorous seabirds such as storm-petrels concentrate in the area of the Equatorial Front, but piscivorous seabirds do not.[41] Here, as elsewhere in the tropical Pacific, the distribution of piscivorous seabirds is tied to the distribution of schooling tunas.

The transition zone between the North Pacific Central Water and the Pacific Subarctic Water is an area of enhanced productivity in the open ocean.[42] This broad region is characterized by a series of fronts where the cooler, nutrient rich subarctic water sinks below the warmer, more saline subtropical water.[43] These fronts support high concentrations of small squids, fishes and crustaceans during spring and summer, creating important feeding grounds for seabirds and other top marine predators.[44]

## Large Scale Ocean/Climate Processes

***El Niño, La Niña, the Southern Oscillation, and Currents.*** El Niño and La Niña are linked via changes in global pressure systems of the southwestern Pacific Ocean (Southern Oscillation). The connection of El Niño with the Southern Oscillation has led to the acronym, ENSO. Declines and increases in zooplankton, squid and fish populations that compose the food webs of most seabirds in the Pacific Ocean can be linked directly to physical oceanographic changes that occur during ENSO events. Under El Niño conditions (periodic, every 4-7 years, ocean warming), biological productivity in the upper water column declines markedly,[45] with consequent negative effects on survival and reproduction of seabirds.[46] The inverse of El Niño is La Niña (periodic, ocean cooling). During La Niña, enhanced upwelling has positive effects on food web development and seabird productivity and population dynamics.

ENSO has been linked to the population dynamics of seabirds[47] suggesting an important natural mechanism for understanding seabird population changes. Seabird responses can vary in relation to the intensity and timing of each El Niño.[48] Life history and demographic parameters affected by El Niño and La Niña include reproductive success, adult mortality, mortality of hatch-year birds, colony attendance, and breeding effort.[49] The El Niño of 1982-1983 dramatically focused attention on the effects of ENSO on biological communities

37 Hunt *et al.* 1980

38 Hyrenbach and Veit 2003

39 Au and Pitman 1986; Ballance and Pitman 1999

40 Barber 2001, Spear *et al.* 2001

41 Spear *et al.* 2001

42 Seki and Polovina 2001

43 Hyrenbach *et al.* 2002

44 Seki and Polovina 2001, Hyrenbach *et al.* 2002

45 Barber and Chavez 1986

46 Ainley *et al.* 1995, Chavez 1996

47 *e.g.,* Schreiber and Schreiber 1984

48 PRBO unpubl. data

49 Hodder and Graybill 1985, Bayer *et al.* 1991, Wilson 1991, Boekelheide and Ainley 1989, Nur and Sydeman 1999, Massey *et al.* 1992

worldwide.[50] Along the west coast, sea surface temperatures rose and mass mortality of many temperate region fish, marine birds and mammal species occurred.[51] Starvation is the likely cause of elevated mortality of young and adults, but direct evidence of this mechanism is often lacking. Researchers investigating tropical seabirds, have also documented decreases in breeding probabilities and reproductive success of seabirds during El Niño years, at specific colonies.[52]

In contrast, strong La Niña years may result in exceptional production which can sustain seabird populations for decades.[53] It is important to note that generalizations regarding the effects of ENSO on seabirds, especially in the tropical Pacific are based on data for specific species nesting at a few well studied colonies. More data from various species and locations throughout the central Pacific are needed to fully understand the effects.

***Pacific Decadal Oscillation.*** In addition to ENSO/ LNSO there are other natural cycles that occur on time scales of decades or centuries.[54] In the North Pacific, one of these "low frequency" marine climate shifts is called the Pacific Decadal Oscillation (PDO). The PDO is "an El Niño-like phenomenon operating on time scales of decades" comprised of a 50-60 year periodicity of "warm" and "cold" phases.[55]

Biological communities have responded to PDO-related ocean warming and cooling in the Pacific Ocean. For example, zooplankton biovolume in the Southern California Bight has declined significantly over the past 40 years.[56] In California and Hawai`i, some seabirds showed long-term declines in productivity while others did not after the PDO shifted from a cool to a warm phase in 1976-1977.[57] However, after a hypothesized shift back to a cool era in 1998-1999, colony data from the Farallon Islands clearly demonstrated an increase in productivity for six species of seabird.[58] In the central north Pacific, increases in ocean productivity following the 1977 shift correlated with increases in reproductive success of Red-tailed Tropicbirds and Red-footed Boobies in Hawai`i.[59]

An increased understanding of the fundamental processes affecting the ocean habitats and food webs of seabirds is key to effective management and sound conservation decisions for seabirds. The manner in which year-to-year and decade-to-decade (or possibly century- to-century), changes in ocean characteristics affect ocean habitats, foraging ecology and demographic processes will require great attention in the next decade. Functional relationships between seabird life history parameters, demographic traits, and environmental conditions have rarely been documented,[60] yet knowledge of such relationships is critical to understanding causes of seabird population fluctuations in relation to climate variability and change. The need to both interpret population change and enact appropriate conservation actions in relation to climate variability and change will likely expand in the future. For example, coupling of natural warming cycles of the PDO and El Niño with anthropogenic changes such as global warming could have devastating effects on seabirds. Developing an understanding of the relative effects of anthropogenic and natural factors on ocean warming at multiple temporal scales remains a serious conservation challenge.

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[50] reviewed by Glynn 1988

[51] Wooster and Fluharty 1985

[52] Schreiber and Schreiber 1989, Ainley *et al.* 1986, Polovina *et al.* 1994

[53] Nur and Sydeman 1999

[54] Aebischer *et al.* 1990

[55] Francis and Hare 1994, Mantua *et al.* 1997

[56] Roemmich and McGowan 1995, Hayward 1997

[57] Polovina *et al.* 1994, Sydeman *et al.* 2001

[58] Schwing *et al.* 2002

[59] Polovina *et al.* 1994

[60] reviewed by Hamer *et al.* 2002, Weimerskirch 2002

# Threats and Issues

Seabirds face a wide range of threats. Some of these have existed for centuries, while others have developed more recently. Habitat loss, fisheries conflicts, oil spills, introduced species, contaminants, and human disturbance have long been recognized as threats, but as human populations and marine resource exploitation have increased, new threats have emerged.

Because of their low fecundity, seabirds are extremely vulnerable to factors that reduce survival, which is typically high compared to other birds. Small decreases in adult survival can result in population declines and hamper recovery. As a result, factors that increase seabird mortality or limit production can seriously jeopardize seabird populations, especially if population levels are already low. It is important, therefore, that threats be identified early, seabird populations be monitored appropriately, and negative impacts be detected quickly, so that actions can be taken.

## Commercial and Recreational Fisheries

Fisheries target a diversity of sea life and use a variety of vessels and gear including: longlines, gillnets, trawls, purse seines, pots, throw and dip nets, hook and line, and harpoons. Seabirds are killed or injured when they are hooked or entangled in fishing gear. This occurs in all oceans and almost all fisheries and gear types; however, only particular fisheries pose a serious threat to certain species of seabirds. Gillnets and longlines kill the greatest number of seabirds in this Region.

Fishery observer programs are crucial for documenting seabird mortality and injury, but few exist, and there is little quantitative or qualitative information regarding seabird bycatch for most of the fisheries in the north Pacific. Seabird mortality has been documented in 10 of 84 fisheries that occur in this Region (Table 6), affecting a minimum of 20 species of seabirds.[61] Currently, observer programs monitor 8 of these 84 fisheries that operate from CCS and USPI ports, and only 4 of these programs are mandatory. Additionally, seabird bycatch occurs in many fisheries that operate in international waters and the Exclusive Economic Zones (EEZs) of other North Pacific nations, although there is little documentation for most areas.[62] Many seabirds are migratory and do not remain within U.S. waters, thereby necessitating international cooperation in resolving seabird-fishery conflicts.

It is more difficult to substantiate and quantify the indirect effects of fisheries, such as overfishing that could result in reduced abundance or availability of prey, or increased disturbance to seabirds on colonies or at foraging areas, or introduction of debris or contaminants into the marine environment. Not all fishery effects are negative, for example offal discarded from fishing vessels may enhance seabird feeding opportunities,[63] unfortunately, this also attracts seabirds to vessels and can lead to hooking or entanglement.[64] In the North Sea, fisheries targeting predatory fish resulted in more forage fish available to seabirds.[65]

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[61] A database of U.S. fisheries that operate in the Region was compiled from NMFS and state sources (database available upon request). This database identified fisheries with documented seabird bycatch and those with high potential for problems.

[62] Melvin and Robertson 2000

[63] Camphuysen *et al.* 1995

[64] Wahl and Heinemann 1979, Moreno *et al.* 1996

[65] Furness 1982c

## Table 6. Current U.S. Fisheries with Documented, or High Potential for, Seabird Bycatch in USFWS Pacific Region.

| Fishery Name | Target Catch | Mgmt. Agency[1] | Seabird Species[2] | Notes |
|---|---|---|---|---|
| CA angel shark/halibut set gillnet | main target is halibut but few angel shark also taken | CDFG, NMFS | alcids, cormorants, loons, grebes COMU, BRAC, PECO, DCCO | Thousands of murres were killed annually in the 1980s, contributing to declines in the central California murre population. Recent regulations have closed areas of highest bycatch. |
| CA other species, large mesh, set and drift gillnet | white seabass and yellowtail | CDFG, NMFS | cormorants | |
| CA tuna with surface drift net | tuna | NMFS | | Emerging fishery with high potential for bycatch of seabirds. Demersal seabass nets are being used at surface. Out of Morro Bay. During summer 2002-2003 NMFS observers noted zero seabird interactions. |
| WA Puget Sound Region salmon drift gillnet | salmon | WDFW, NMFS | COMU, RHAU, PIGU, MAMU | Research identified mitigation measures to reduce bycatch. WA state fishery bycatch greatly reduced when regulations requiring mitigation measures were enacted; Tribal fisheries continue with no mitigation regulations. |
| CA/OR thresher shark/ swordfish drift gillnet | thresher shark, swordfish | CDFG, ODFW NMFS | NOFU | Well observed fishery with very low rates of seabird bycatch. |
| HI pelagic longline | tuna, billfish, oceanic sharks, swordfish | HDAR, NMFS | BFAL, LAAL | High albatross mortality associated with this fishery; mortality decreased while swordfish fishing was banned in 2001-2004. |
| U.S. West Coast pelagic longline | Highly migratory species (HMS) -swordfish, tuna | NMFS | BFAL, LAAL | Fishery expanded in 2001 as HI fishers moved to CA with increased restrictions on the HI fishery (see HI pelagic longline). Preliminary observer results indicate high rate of BFAL bycatch until shallow setting that targeted swordfish was prohibited in 2004 & part of the fishery shifted back to HI with the lift of the swordfish ban . |
| WA, OR, CA groundfish trawl | groundfish (hake, flatfish, sablefish, lingcod, rockfish) | WDFW, ODFW, CDFG, NMFS | BFAL | Preliminary results indicate seabird bycatch as birds hit the gear. |
| WA, OR, CA, HI commercial passenger fishing vessel | various species | WDFW, ODFW, CDFG, NMFS, HDAR | BRPE, LETE, MAMU, CORM, RFBO, MABO, BRBO | Most entanglement of pelicans and boobies is in the hook-and-line troll fishery. |
| Recreational hook and line | various species | WDFW, ODFW, CDFG, NMFS, HDAR | BRPE | Most entanglement is of pelicans. |

[1] Agencies: NMFS=National Marine Fisheries Service; CDFG=California Dept. of Fish & Game; ODFW=Oregon Dept. of Fish & Wildlife; WDFW=Washington Dept. of Fish & Wildlife; HDAR=Hawai`i Div. of Aquatic Resources.

[2] BFAL=Black-footed Albatross; BRAC=Brandt's Cormorant; BRBO = Brown Booby; BRPE=Brown Pelican; COMU=Common Murre; CORM=cormorant; DCCO=Double-crested Cormorant; LAAL=Laysan Albatross; LETE=Least Tern; MABO=Masked Booby; MAMU=Marbled Murrelet; NOFU=Northern Fulmar; PECO=Pelagic Cormorant; PIGU=Pigeon Guillemot; RFBO=Red-footed Booby; RHAU=Rhinoceros Auklet.

## Direct Effects

***Set and Drift Gillnets.*** Millions of seabirds of various species have been killed by set and drift gillnets. It is estimated that more than 500,000 seabirds, primarily shearwaters, were killed by the North Pacific high seas drift gillnet fishery in a single year, 1990[66], and this fishery operated for over a decade. Large numbers of Black-footed and Laysan Albatrosses were taken in the Japanese salmon and squid drift gillnet fishery, with almost 10,000 killed during 1990 in the squid driftnet fishery alone.[67] The North Pacific high seas drift gillnet fishery was internationally banned in 1992, in part, because of the high numbers of seabirds killed.[68]

Most of the seabirds that are killed in coastal gillnet fisheries are diving seabirds, in particular alcids, although cormorants are also commonly caught.[69] It is estimated that at least 70,000 Common Murres died in set gillnets targeting halibut off central California between 1979 and 1987.[70] Large population declines at central California murre colonies during the 1980s were attributed primarily to gillnet mortality, with El Niño effects and oil spills as contributing factors. Common Murre populations continued to suffer high gillnet mortality in the 1990s (1,000 - 3,000 killed annually), even though most of the fishery was closed in 1987 and 1989 (a small fishery remained in Monterey and Morro bays). This chronic mortality may have limited population growth for the murre colonies closest to the fishing area.[71] A recent law, changing the area and depth closures, is expected to essentially eliminate seabird bycatch in central California gillnet fisheries. There are unobserved set gillnet fisheries that operate in southern California. Common Murres and Rhinoceros Auklets constituted the greatest portion of the bycatch mortality in coastal drift gillnet salmon fisheries in Puget Sound, WA, although Pigeon Guillemots and Marbled Murrelets, were also killed.[72] Thompson *et al.* (1998) estimated over 2,700 murres and 1,000 Rhinoceros Auklets were killed in 1994 alone in just a portion of the sockeye salmon fishery. Mortality of Rhinoceros Auklets in gillnets is suspected to be an important factor in population declines at Protection Island NWR colonies.[73] The coastal salmon gillnet fishery in the border waters has three governing entities: Canada, the state of Washington, and the Tribes. Each entity enforces different regulations underscoring the need for local, national, and international coordination. Seabird bycatch was reduced by up to 75% in the Puget Sound sockeye salmon gillnet fisheries by regulating the use of visible mesh panels and eliminating dawn fishing.[74] Local Tribes, however, did not adopt similar regulations, resulting in continued bycatch.

The thresher shark/swordfish drift gillnet fishery off California documented bycatch of fulmars, but the incidence and numbers of dead seabirds are very small (42 birds over a 10 year period).[75]

***Pelagic and Demersal Longlines.***[76] Longline fisheries world-wide pose a serious threat to many seabird populations and affect between 40-60 species of seabirds, predominantly Procellariiformes,[77] and particularly surface-feeding albatrosses. Birds are caught both during setting and retrieval of gear, with the highest mortality during setting.

Pelagic longlining, which targets mainly tuna and swordfish, kills thousands of seabirds annually.[78] This type of fishing increased after high seas drift

[66] DeGange *et al.* 1993, Ogi *et al.* 1993

[67] Jones and DeGange 1988, Ogi *et al.* 1993, Yatsu *et al.* 1993

[68] Northridge 1991, DeGange *et al.* 1993, Johnson *et al.* 1993

[69] Julian and Beeson 1998, Melvin *et al.* 1999

[70] Takekawa *et al.* 1990

[71] Forney *et al.* 2001, Julian and Beeson 1998

[72] Melvin *et al.* 1999

[73] U. Wilson, USFWS, Washington Maritime NWR, pers. comm., 2003

[74] Melvin *et al.* 1999

[75] Julian and Beeson 1998

[76] Pelagic longlines fish in the water column versus demersal longlines that fish at or near the sea floor.

[77] Brothers *et al.* 1999

[78] Brothers *et al.* 1999, Cousins *et al.* 2000

gillnetting was banned in 1992, coupled with a growing demand for tuna, swordfish, and shark products. Longlining, both domestic and foreign, currently comprises the highest effort for industrial fisheries in the Pacific. The U.S. North Pacific longline fleet accounted for 16% of the total hooks set between 1991-1997.[79] Other countries that have large North Pacific longline operations include Japan, Taiwan and Korea, none of which carries observers.[80] Cousins *et al.* (2000) estimated 13,000 albatrosses were killed annually in the swordfish and 23,000 in the tuna fisheries in the North Pacific. The relatively small (<200 vessels) pelagic longline fishery based in Hawai`i killed an estimated 1,000-3,000 each, Laysan and Black-footed Albatrosses annually between 1994-1998.[81]

Mitigation measures to reduce the bycatch of albatross[82] have been identified through research, and these measures are now required on Hawai`i-based longline vessels. Most of the albatross mortality occurred in the swordfish fishery, which was closed by court order in 2001 to protect sea turtles. In response, many Hawai`i-based fishers shifted their operations to California, where regulations were less restrictive. An observer program documented relatively high rates of Black-footed Albatross mortality and, to a lesser degree, Laysan Albatross mortality in this fishery.[83] For several years, use of mitigation measures was voluntary and area closures defined by the Hawai`i court order did not apply to California fishers, even though there was considerable overlap in fishing areas. Area closures and mandatory use of mitigation measures, similar to those for Hawai`i fishers, became effective in April/May 2004, for California fishers. The swordfish fishery out of Hawai`i is expected to reopen in 2004 with new gear regulations designed to limit the bycatch of sea turtles.

Beginning in 1995, pelagic longline fishing replaced most of the troll-based fishery in American Samoa, and unlike Hawai`i, longline permits for the CNMI, Guam, and American Samoa fisheries are not limited.[84] In addition, fish landed in these ports by foreign fishers can be shipped, duty-free, to other U.S. ports. It is currently unknown what effects these practices are having on seabirds. It is probable that these fisheries will continue to increase in the future.

Seabirds are also killed in demersal longline fisheries. An estimated 10,000-27,000 seabirds were hooked each year in Alaska longline fisheries, mostly (75%) fulmars and gulls.[85] Although Alaska is outside the scope of this Plan, it is mentioned here because albatross, especially Laysan Albatross, that breed in Hawai`i are killed in these fisheries. As a result of high seabird bycatch, regulations were adopted in 1997 and 2004 to reduce bycatch in the Alaska fisheries.[86] Paired tori lines[87] were found to be an effective deterrent, reducing seabird bycatch by 71-96%.[88]

A demersal longline fishery for groundfish and halibut operates off the west coast of Washington, Oregon, and California. In the fall of 2001, an observer program was initiated on the groundfish portion of this fishery and preliminary data indicate interactions with Black-footed Albatross, but no take has been documented to date.[89]

***Other Direct Effects.*** Lost and discarded fishing gear such as gillnets can “ghost fish” for years, traveling long distances and killing large numbers of seabirds before the nets sink, wash ashore, or eventually degrade. Monofilament line also poses a threat if seabirds ingest the line or become entangled. When birds take bait from recreational hook-and-line fisheries, anglers sometimes cut

[79] URS 2001

[80] Cousins *et al.* 2000

[81] Cousins *et al.* 2000

[82] McNamara *et al.* 1999

[83] Peterson *et al.* 2003

[84] URS 2001

[85] Melvin *et al.* 2001

[86] Melvin and Parrish 2001

[87] Tori lines are streamers attached to a line designed to trail behind the boat as it deploys and retrieves the gear. These streamers form a moving “fence” that acts as a deterrent to keep the birds away from the hooks.

[88] Melvin *et al.* 2001

[89] Nordeen, NOAA Fisheries, pers. comm., 2003

the line, leaving the hook in the bird with trailing monofilament line which eventually entangles the bird. If not treated, this type of interaction/injury often results in death. Off the California coast, Brown Pelicans are one of the primary species affected, although currently no data exist to quantify the magnitude of the problem.

### Indirect Effects

There is growing concern about bright lights used by squid fishers near the Farallons and Channel Islands, CA. Some experts believe that lights were a factor in Brown Pelican nest abandonment and low reproductive success at Anacapa Island in 1999.[90] Lights may also affect nocturnal species such as Xantus's Murrelet and Ashy Storm-Petrel. The bright lights disorient birds as they fly to and from the islands, attract birds to the boats or gear, cause birds to alter their behavior, or render these nocturnal seabirds more vulnerable to predation by gulls or owls.[91] This is especially true during inclement weather. The colonies affected by these fishing operations include some of the largest seabird colonies along the west coast (*e.g.,* Farallon Islands), and affect ESA and BCC listed seabirds (*e.g.,* Ashy Storm-Petrels, Brown Pelicans, and Xantus's Murrelets at Anacapa and Santa Barbara Islands). Even far out to sea, seabirds become disoriented by the bright lights on ships and injure themselves when they collide with the ship.

Reduction of seabird prey abundance by commercial fisheries and the effects on seabird populations are difficult to assess. In some ecosystems, it has been estimated that seabirds consume up to 30% of the annual pelagic production of fish,[92] placing them in direct competition with fisheries. Even where it is documented that seabirds are affected by a reduction in prey, it is difficult to prove a causal relationship to fishery harvest.[93] Seabirds can be affected by a direct depletion of their food when seabirds and fisheries target the same species and age classes. Similarly, if fisheries target reproductive fish, reduced spawning biomass may reduce the availability of juvenile fish for seabirds. However, spawning biomass and recruitment are not always correlated in fish populations. The seabird species that are most vulnerable to these types of indirect effects are those that have a restricted foraging range or those with specialized feeding methods or diet.[94] In the tropics, most seabirds feed in association with predatory fish, primarily tuna, that drive prey to the surface; overfishing of predatory fish stocks could potentially affect seabirds by reducing the availability of these patchily-distributed prey resources.

There are several emerging and evolving fisheries that have potential to adversely affect seabirds. The anchovy fishery off the west coast currently occurs at a small scale, but there is interest in developing it further. A potential krill fishery is also of particular concern. In 2001, a ten-year moratorium was imposed on this fishery. Both of these fisheries have the potential to negatively affect seabirds by disrupting the marine food web and decreasing seabird prey stocks.

## Introduced/Non-native Species

The majority of all bird extinctions since 1800 have been caused, either entirely or partially, by introduced species.[95] Referred to as non-native, invasive, introduced, exotic, or alien species, these animal and plant introductions have resulted in disastrous consequences for seabird populations worldwide and they continue to pose one of the greatest threats to seabirds. Roughly 90% of all extinctions during the last two centuries have been on islands. Most seabirds breed on islands where they evolved in the absence of ground predators; consequently, seabirds are extremely vulnerable to introduced predators. Introduced plants and herbivores have substantially altered and degraded the composition and quality of seabird nesting habitats. The effects of introduced invertebrates, other than mosquitoes, have not been well studied, but the impacts of mosquitoes alone, as vectors of disease, are significant, especially in Hawai`i.

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[90] Frank Gress, California Institute of Environmental Studies, pers. comm., 2003

[91] Anderson *et al.* 2001

[92] Furness 1982a, Furness 1982b

[93] Rindorf *et al.* 2000, Furness 1990

[94] Furness 1982a

[95] BirdLife 2000

## Predators

Introduced predators have repeatedly been identified as the foremost threat to seabird populations on islands, causing population declines, extirpation of species or colonies, and in rare instances extinction (*e.g.,* Guadalupe Storm-Petrel). Small, ground-nesting petrels, shearwaters, and terns are the species most frequently affected.[96] In this Region, rats and feral cats have had the greatest effects.[97] They are responsible for colony extirpations and range-wide population declines of numerous species.[98]

Rodents have become established on approximately 82% of the world's islands.[99] Virtually all large Pacific Islands have at least one species of introduced rodent and often several species are present. Black rats, Norway rats, and Pacific rats eat birds and eggs and are the most destructive. Even on islands with native predators (*e.g.,* Channel Island deer mice) introduced rats have caused seabird population declines (*e.g.,* Xantus's Murrelet declines at Anacapa Is.).[100] House mice prey on the eggs and potentially the chicks of smaller seabirds, especially storm-petrels, but population-level effects are poorly understood and not well documented. At the Farallon Islands, CA, it is hypothesized that house mice sustain migrant Burrowing Owls on the island through the winter and early spring (when they would normally migrate through) affording them access to Ashy Storm-Petrels that return to the islands in April.[101] Introduced rats have been eliminated from all but a few NWR islands but they remain a serious problem on the larger, inhabited islands of both the USPI and CCS (Appendix 6).

Feral cats prey upon adults and eggs and they can kill larger seabirds than those typically taken by rats[102] (although rats have been documented killing adult albatross[103]). At Jarvis Island, cats killed an estimated 24,000 seabirds each year and all but four breeding seabird species were extirpated before the cats were finally eradicated.[104] Cats have been eradicated from all NWR islands in the Region and from many of the smaller NP islands, but they are still present on all of the main islands of Hawai`i, American Samoa, Guam and the Marianas, and many of the larger islands off California and in Puget Sound, WA (Appendix 6). In Hawai`i, cats are found from sea level up to 10,000 feet on Mauna Loa, where they feed on Hawaiian Petrels, limiting the population of this endangered petrel.[105]

Dogs were first introduced to the USPI by Polynesians and again with European colonization. Today, they are found on almost all inhabited islands. Feral and uncontrolled domestic dogs threatened the existence of the albatross colony at Kilauea Point NWR, HI until fences were erected. Red foxes were introduced to California for fox hunting and fox farming; they prey on terns and gulls including endangered California Least Terns.[106] In Oregon, red foxes recently invaded several offshore rocks within Oregon Islands NWR which were accessible at low tide. Foxes destroyed all seabird eggs and chicks on these islands in 2002, resulting in total colony failure for Western Gulls, Brandt's and Double-crested Cormorants, Common Murres and Tufted Puffins; only Pigeon Guillemots and Pelagic Cormorants nesting in crevices and on steep cliffs successfully reproduced.[107]

Indian mongoose were introduced to all of the main Hawaiian islands except Ni`ihau, Kaua`i, and Kaho`olawe, and they have been implicated in the near extinction of Hawaiian Petrels and Newell's Shearwaters.[108] The last stronghold of Newell's Shearwaters is on the steep mountainsides

[96] Moors and Atkinson 1984

[97] Moors *et al.* 1992

[98] Drost and Lewis 1995, McChesney and Tershy 1998, Rauzon 1983

[99] Atkinson 1985

[100] McChesney and Tershy 1998; McChesney *et al.* 2000

[101] Mills *et al.* 2002

[102] Smith *et al.*2002; Nogales *et al.* 2004

[103] Kepler 1967

[104] Rauzon 1983

[105] Simons and Hodges 1998

[106] Minsky 1980

[107] Roy Lowe, USFWS, pers. comm., 2004

[108] Munro 1960, Berger 1972

of Kaua`i[109] and there is concern that this will be jeopardized if mongoose become established on this island.

Pigs were widely introduced throughout the Pacific, first by Polynesians and then by Europeans.[110] Feral pig populations are present on most of the main islands of the USPI. They trample burrows and eat chicks and eggs. Destruction of vegetation by pigs results in erosion that degrades island forests and promotes mosquito breeding habitat, thus facilitating the spread of mosquito-borne avian diseases. Feral pigs are also present on several of the Channel Islands, CA.

Along the mainland coast, seabirds evolved with avian predators such as owls, eagles, falcons, gulls and corvids. However, populations of these native predators, especially gulls and corvids, have increased near urban centers and can have negative impacts on breeding seabird populations, especially the coastal terns in southern California. In the USPI native avian predators are rare (frigatebirds, Hawaiian Hawk, Pueo, and night herons) and the population-level impacts of introduced avian predators are not known. Barn Owls have naturally dispersed over much of the Pacific, but they were introduced to Hawai`i. Barn Owls take seabird adults and fledglings.[111] Introduced Cattle Egrets eat seabird eggs and chicks, and compete with Red-footed Boobies for nesting habitat on Lehua Island.[112] Common Mynas are widespread in the main islands of American Samoa and Hawai`i, and Midway Atoll. They were documented as an important predator of Wedge-tailed Shearwater eggs at Kilauea Pt. NWR, Kaua`i,[113] but impacts of myna predation elsewhere are undocumented.

The brown tree snake is an extremely effective predator that has eliminated all but four of the native forest birds from Guam. It is likely they also eat seabird eggs and chicks, though population level effects are not known. Monitor lizards on several of the Mariana Islands, including Guam, may also limit ground-nesting seabirds. Spread of these pests, especially the brown tree snake, to other Pacific Islands is a serious threat. Restricting the spread of snakes and lizards from Guam is the goal of a multi-million dollar U.S. Department of Agriculture program.

## Herbivores

A wide range of herbivores, including deer, goats, sheep, cattle, horses, mules, rabbits, and hares have been introduced to islands. Feral goats and rabbits can denude small islands of vegetation leading to erosion and loss of nesting habitat. Over the past two centuries, most of the California Channel Islands were ranched. Overgrazing, drought, and introduced forage plants forever altered the habitat of these islands.[114] The main Hawaiian Islands harbor non-native populations of deer, feral goats and sheep that cause habitat alteration and erosion problems. Rabbits, introduced to Laysan and Lisianski islands in the early 1900s, denuded the islands of vegetation and fierce sand storms buried nests and filled burrows.[115] Within two decades, seabird populations crashed and three endemic landbirds went extinct before the rabbits finally ate themselves to near extinction and the remaining few were killed.[116] Rabbits are still a problem at Lehua Is., HI. There is some debate whether rabbits have a positive or negative effect on seabird populations at Destruction Is., WA. Rabbit grazing reduced the height of vegetation and may have enhanced nesting habitat for Rhinoceros Auklets on this island.[117]

## Plants

Non-native plants can displace native plants and may limit, destroy, or degrade seabird nesting and roosting habitat. Aggressive species such as European beachgrass and sea fig, reduce the amount of open coastal strand habitat preferred by California terns. Golden crown-beard forms tall, dense, and almost impenetrable stands that exclude many surface nesting seabirds on the Northwestern Hawaiian Islands. In contrast,

[109] Byrd *et al.* 1984, USFWS 1983a

[110] Atkinson and Atkinson 2000

[111] VanderWerf *et al.* 2004

[112] VanderWerf *et al.* 2004; USFWS unpubl. data

[113] Byrd 1979

[114] Johnson 1980, Brumbaugh 1980

[115] Bailey 1956

[116] Ely and Clapp 1973

[117] Ulrich Wilson, USFWS, pers. comm., 2003

sandbur lacks the height and physical structure preferred by Hawaiian seabirds that nest under vegetation.[118] Many invasive plants have shallow root systems that provide poor soil stabilization and consequently affect burrow stability and reproductive output (*e.g.,* sandbur and Bonin Petrels in Hawai`i). At the Farallons, New Zealand spinach forms dense mats over the soils and may influence densities of burrow nesting seabirds. At Midway Atoll, beggar's tick provides cool, humid habitat for introduced mosquitoes that transmit avian pox. Bufflegrass creates and perpetuates a fire cycle in the Red-footed Booby colony at Ulupa'u Crater, O`ahu. Dense forests of introduced ironwood trees at Midway Atoll, limit habitat for surface nesting species such as Laysan Albatross; but tree nesting species such as Black Noddies and White Terns benefit.

## Insects and Other Invertebrates

Of the thousands of introduced invertebrates occurring in seabird colonies, mosquitoes, ants, and scale insects are the only ones documented to have negative impacts. Mosquitoes are vectors for avian malaria and avian pox, and both diseases are known to infect seabirds. Several species of ants including: crazy, bigheaded, Argentine, and little fire ants have been recorded from Hawai`i and other USPI. Several ant species (*e.g.,* crazy, long-legged, fire, and bigheaded ants) have been documented attacking small chicks or pipping eggs, but population level effects are unknown. More important than direct effects may be the indirect effects; native woody vegetation is damaged and destroyed by introduced scale insects and sooty molds, which are promoted by the presence of ants.[119] Pu'avai or Pisonia, a tropical tree much favored by tree nesters such as Red-footed Boobies and Black Noddies has disappeared from Rose Atoll, American Samoa. The forest on Palmyra Atoll is seriously compromised by an introduced scale insect, *Pluvinaria urbicola*. The negative impacts of other invertebrates, though undocumented, could be considerable.

## Control and Eradication of Non-Native Species

Eradication of introduced vertebrates from islands where seabirds nest has been increasingly successful with a growing arsenal of tools. In this Region, there are many examples of federal, state, and private land owners successfully eradicating black rats, Norway rats, Pacific rats, feral cats, dogs, pigs, goats, and rabbits (Appendix 6). The Service has been very active in invasive species management in the USPI, and rats and cats have been eradicated from all but one of the Pacific and Remote Islands NWRs. Currently, the Service is seeking funds to eradicate rats from the one remaining refuge, Palmyra NWR. The state of Hawai`i has an active program to control and eradicate introduced predators from important seabird colonies. In the CCS, many agencies are working to control or remove rodents from seabird colonies. For example, the NPS in coordination with the NGO Island Conservation, recently completed a program to eradicate rats from Anacapa Is. with restoration funds from the American Trader oil spill.

In response to these eradication programs, seabird populations have increased, extirpated native species have returned, and social attraction projects are underway to attract seabirds of high conservation concern that have not recolonized (*e.g.*, Tristram's Storm-Petrels at Midway Atoll and Phoenix Petrels at Jarvis Is.). Complete eradication is not feasible for many introduced species on the mainland or large inhabited islands, but programs have been initiated at many of the key seabird colonies to exclude predators or reduce predator densities in the area of the colony. The highest priority colonies for predator control in the Region are listed in Table 7.

### Table 7. Top Priority Colonies for Predator Control

| Colony | Predators |
|---|---|
| Newell's Shearwater and Hawaiian Petrel Colonies in Hawai`i | cats, rats, mongoose |
| Palmyra Atoll | rats |
| Lehua Islet, HI | rats |
| Kaula Rk, HI | rats |
| Petrel and Shearwater colonies in Samoa | cats, rats |
| Wake Atoll | cats, rats |
| San Miguel Is., CA | rats |
| Cocos Is., Guam | rats, monitor lizards |
| Oregon Islands NWR, OR | mammalian |
| Farallon NWR, CA | mice |

[118] Flint and Rehkemper 2002

[119] Nishida and Evenhuis 2000

Military bases throughout the Pacific have a high incidence of introduced predators. World War II resulted in significant increases in rat colonization of islands in the period between 1840-1980.[120] Today, many of the remote island bases have initiated predator control or eradication programs. In accordance with recent policy, Navy commands must now ensure the humane capture and removal of free roaming cats and dogs. With 186 Navy bases worldwide, implementation of this policy could have a very positive effect on nesting seabirds.

Control and eradication of introduced plants has been implemented at a few colony sites. At Midway Atoll, ironwood and golden crown-beard are actively controlled and sandbur is nearly eradicated from Laysan Is. These projects are labor intensive and expensive, and much more needs to be done. The same is true of control and eradication of introduced insects. USGS, in cooperation with the Service, initiated research into the control of scale insects at Palmyra in 2004.

### Issues associated with Control and Eradication of Non-Native Species

Control and eradication of non-native species is costly in both time and money. Control programs are often controversial and outreach to the public and others is an important component of a successful eradication program. Care needs to be exercised in the planning and execution of control programs. Unsuccessful eradication programs can be extremely expensive and may produce results that are worse than no action at all. It is also important to carefully examine the predator prey relationships prior to initiating control programs, especially in complex situations where more than one predator is present. For example, eradication of top predators (*e.g.*, cats) could result in an increase in the abundance of lower level predators (*e.g.*, rats) that could potentially cause greater damage to seabird populations than the initial situation. Monitoring seabird populations before, during and after control programs is an important component of the project.

Preventing introductions of non-native species is the best conservation strategy. Many pests reach islands through human transport (*e.g.,* vessel groundings, boats moored to or near an island, in cargo, on flotsam). Regulating access to islands, immediate response to shipwrecks, regular monitoring of islands, and general vigilance by resource managers should enable early detection. Introduction of non-native species, especially predators, is an emergency and should be treated like an oil spill, with a rapid response to minimize damage and restoration cost.

## Oil Pollution

During the 20th century, seabird mortality from various petroleum products (hereafter generalized as oil pollution) has been a significant seabird conservation issue worldwide. Oiled seabirds received international attention during the 1969 Santa Barbara oil spill when an offshore oil production platform experienced a blowout,[121] and during the 1971 San Francisco oil spill when two oil tankers collided in the entrance to San Francisco Bay.[122] While these dramatic events awakened public concern, smaller oil spills occur regularly and some can kill larger numbers of seabirds than major events (*e.g.,* Apex Houston spill).[123] Recent federal and state legislation towards the prevention of oil spills have been implemented; nevertheless, spills continue to occur.

### Oil in the Marine Environment

While most spills in the Region have involved crude or bunker oil, many types of petroleum products (*e.g.,* diesel, gasoline, kerosene, lubricant, various industrial oils) enter the marine environment through diverse anthropogenic pathways, and from natural seeps.[124] Chronic release of very small amounts of oil from bilge pumping, outboard engines, and mishandling of petroleum products in marinas is an often overlooked source of oil pollution.

Most oil spills and chronic oil pollution have occurred in shipping lanes near large ports[125]

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[120] Atkinson 1985

[121] Straughan 1971

[122] Smail *et al.* 1972

[123] Page *et al.* 1990, Carter *et al.* 2003

[124] see review in Ohlendorf *et al.* 1978

[125] Burger and Fry 1993, Carter 2003

(Figure 4). Several oil spills with documented seabird mortality also have occurred near smaller ports in the Strait of Juan de Fuca and off the outer coast of Washington, but few spills have been documented in Oregon where there are relatively few shipments of oil up the Columbia River (Figure 5).

Since the 1970s, biologists have recognized chronic oil pollution in central California, based on regular occurrence of oiled birds on beaches.[126] Long-term monitoring of oiling rates of beached birds has helped document this problem. Most of the chronic oil pollution appears to result from the dumping of bilges and slops after or before entering major oil ports.[127] Leakage from sunken vessels is another source. In 2002, the tanker *Jacob Luckenbach* which sank in the Gulf of the Farallones in 1953, was determined to be the source of large "mystery" spills in this area.[128] This discovery established growing concerns about sunken vessels leaking oil. During WWII, more than 50,000 vessels sank near islands, many in the USPI. Many of these wrecks contain petroleum products that are leaking or will leak in the future. In the past few years, spills involving thousands of gallons of oil at Yap, Guam, and elsewhere in Micronesia apparently originated from these vessels, but the impacts of these spills on seabirds were not investigated.

## Effects of Oil on Seabirds

Oil pollution affects a wide array of seabird species to varying degrees.[129] Large numbers of dead and alive oiled birds have been recovered after individual spills and certain species tend to predominate. Of the seabirds, alcids (especially Common Murre, Rhinoceros and Cassin's Auklets) are the most vulnerable, although other species with small populations (*e.g.,* Marbled Murrelet and Brown Pelican) have also been recovered, in relatively high numbers after certain spills.[130] When seabirds contact floating oil, feathers and skin may be coated, ingestion typically occurs during preening, and fumes can be inhaled. Oiling causes both lethal and sublethal effects and can affect thermoregulation, flight ability, reproductive behavior, and a variety of physiological processes.[131] The degree of effect varies, depending on the type of oil product and seabird involved, amount of oiling, time of year, and weather. Even a small amount of fresh or weathered oil can result in death of a seabird or impaired biological function. In addition, chemical compounds used to disperse floating oil can injure or kill seabirds, and the effects of these compounds requires further investigation.

Assessments of seabird mortality associated with spills have been conducted regularly since the 1980s with models that use beached bird counts and other information to extrapolate to total mortality estimates. However, not all dead oiled birds reach shore or are detected after reaching the shore. Offshore and small-bodied species tend to be under represented or completely absent from data collections. This problem is greatly exacerbated in the USPI where currents, winds, geography, and the vast foraging range of the seabirds combine to minimize the likelihood that any dead birds will wash ashore or be recovered. Spills are often signaled by the appearance of oiled birds returning to colonies or roost sites.

Long-term monitoring of seabird demographic processes (*i.e.,* survival, reproductive success, recruitment, age at first breeding) is crucial for assessing impacts of oil spills on seabird populations and in designing and evaluating restoration projects.[132] Common Murre population declines in central California in the 1980s were linked to mortality from the 1984 *Puerto Rican* and 1986 *Apex Houston* oil spills, as well as to mortality from gillnet fishing and El Niño.[133] In Washington, the Common Murre population failed to recover from declines in the early 1980s and mortality from the

[126] Carter 1997, Nur et. al. 1997, Stenzel *et al.* 1988

[127] Hampton *et al.* 2003a

[128] Hampton *et al.* 2003b

[129] Loons, grebes, seaducks, and phalaropes are not included in the scope of this plan but it is important to note that these marine bird species occur in great abundance in the Region and are extremely vulnerable to oil spills.

[130] Carter 2003, McShane *et al.* 2004, Carter and Kuletz 1995

[131] see reviews in Ohlendorf *et al.* 1978, Burger and Fry 1993

[132] Nur and Sydeman 1999

[133] Takekawa *et al.* 1990; Carter *et al.* 2001

**Figure 4. Oil spills off California, Oregon, and Washington 1969–2001 (spills with >10 oiled birds documented; updated from USFWS 1997; see Carter 2003, McShane *et al.* 2004).**

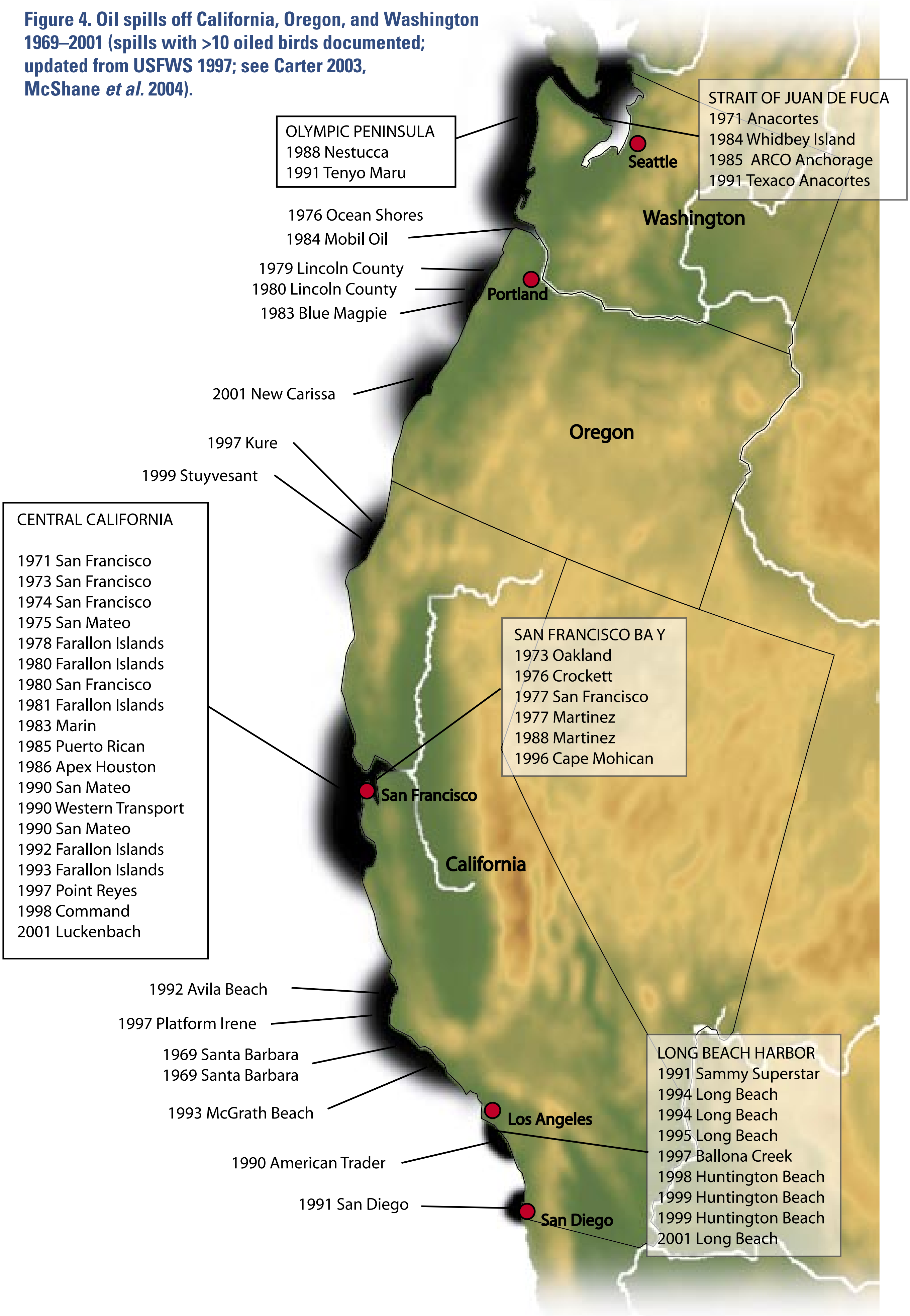
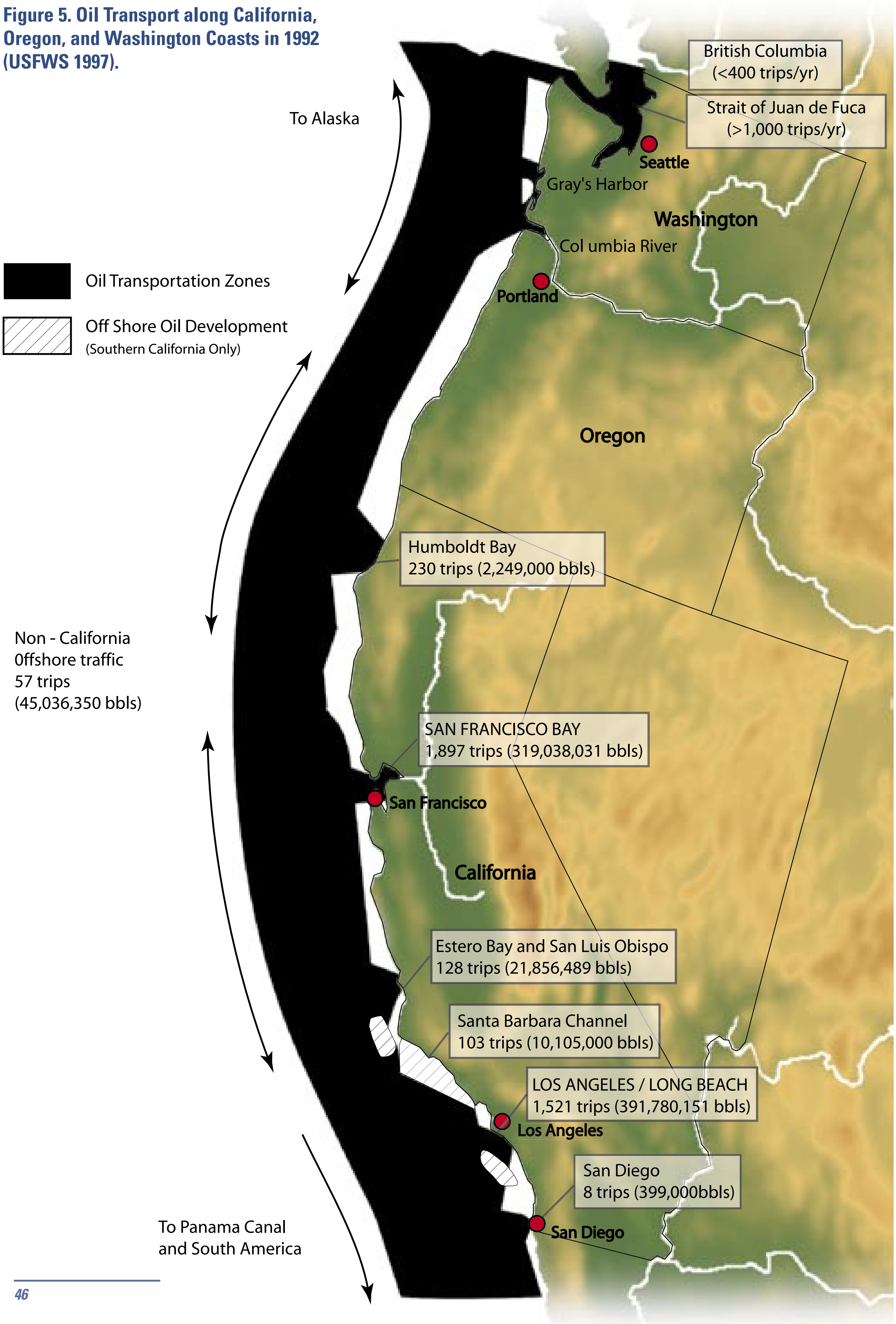


**Figure 5. Oil Transport along California, Oregon, and Washington Coasts in 1992 (USFWS 1997).**



1988 *Nestucca* and 1991 *Tenyo Maru* oil spills were identified as contributing factors.[134] Hundreds of Marbled Murrelets were killed in the 1991 *Tenyo Maru*, 1997 *Kure*, 1999 *Stuyvesant*, 1997-98 Point Reyes Tarball Incidents, and 1999 *New Carissa* oil spills. This mortality likely contributed to Marbled Murrelet population declines.[135] Oil pollution is a serious concern for localized endemics such as Xantus's Murrelets, a species whose key breeding colonies all occur near shipping lanes and offshore oil platforms.[136]

Oil spills occur throughout the central Pacific but, to date, they have been poorly documented. Oiled seabirds have been noted at the breeding colonies, but seabird injuries have been assessed for only two Hawaiian spills (*Hana* 1987 and *Tesoro* 1998) and population models to estimate total mortality have not been developed yet. There have been major spills where seabird injuries were not examined: 1) 10 million gallons of crude oil from *Irene's Challenge,* north of Lisianski, in 1977; 2) 31.2 million gallons of crude oil from the *Hawaiian Patriot,* west of Kaua`i, in 1977; and 3) an estimated one million gallons that leaked over a two-year period from a power plant on Guam during the early 1990s.[137]

In contrast to the well-developed oil spill response and seabird injury assessment programs in California and Washington, the programs in the USPI are relatively small or non-existent. Nevertheless, a large volume of oil is transported by oil tanker to O`ahu and vessel traffic is high.[138] Increased attention to the impacts of oil pollution on seabirds is needed in the islands. Birds are highly concentrated in relatively few colonies and there is potential for a spill to cause significant population-level impacts. Specialized response techniques need to be developed for detecting and assessing impacts to seabirds in this ecosystem.

## Other Contaminants and Hazardous Substances

In addition to fuel discharges, there are four major sources of contaminants present in the Region: 1) industrial and mining discharges, both historic and current; 2) agricultural runoff, encompassing pesticides, sediment, and nutrients; 3) urban runoff and sewage outfalls; and, 4) military base contaminants.

The contaminants widespread within the Region that pose the greatest potential exposure hazard to seabirds are persistent organic pollutants (*e.g.*, pesticides, dioxins, PCBs, and poly-aromatic hydrocarbons); metals (primarily mercury, lead, arsenic, cadmium, chromium, and copper); and the trace mineral selenium. All of these classes of chemicals are regulated with the exception of plutonium contamination at Johnston Atoll from above ground nuclear tests.

Organic and halogenated pollutants have been lumped into the catch-all class "persistent organic pollutants" (POPs), because they are generally found as complex mixtures in sediments and in fat of exposed animals. Newer persistent contaminant threats include polybrominated diphenyl ethers used as fire retardants, and several fluorinated organics used widely in plastic and electronics manufacturing.[139] Other "emerging" contaminant threats include endocrine disrupting chemicals (alkylphenols, estrogenic hormones, pesticides and industrial chemicals); pharmaceuticals released from non-point sources such as agricultural feedlots and public operated waste-water treatment works. The extent of regional exposure and persistence of many of these compounds is uncertain as the USGS has only recently begun to monitor these chemicals.[140]

The "traditional" organochlorine POPs (pesticides, PCBs and dioxins) are generally fat soluble, and they are biomagnified through the food web.

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[134] Wilson 1991, Warheit 1996, TMOSNRT 2000; Carter *et al.* 2001

[135] Carter and Kuletz 1995, McShane *et al.* 2004

[136] Carter *et al.* 2000

[137] USFWS 1996

[138] Demarest and Elliot 1997

[139] Inoue 2004

[140] National Research Council 1999, Kolpin *et al.* 2002, Dawson 2000

Wide ranging and long-lived top predators such as seabirds have an increased exposure risk. Adverse reproductive consequences include eggshell thinning, developmental malformations and mortality of embryos and juveniles, and immune suppression leading to increased disease susceptibility. Global atmospheric transport of POPs, including DDT, dioxins, and PCBs, results in diffuse deposition on the surface of the oceans, where surface feeding seabirds such as storm-petrels and albatross become exposed at measurable levels.[141]

Endocrine disruptors have been grouped together as a class of contaminants, but several (DDT, dioxins and PCBs) have been persistent pollutants for decades.[142] DDT pollution of the Southern California Bight resulted in seabird reproductive failures from eggshell thinning, as well as endocrine disruptive effects on gulls leading to sex ratio skews and population declines.[143] The non-persistent pesticides and industrial chemicals pose threats in localized "hot spots", such as estuaries, lagoons, and harbors, or adjacent to outfalls of major industrial or agricultural areas.

The lack of dose-response data for seabirds is a significant problem in the monitoring and evaluation of contaminant problems.

## Summary of Contaminants by State

***California.*** Major sites of contamination in California include the Southern California Bight with historic DDT contamination from the Montrose Chemical Company and PCB contamination from industrial sources; Monterey Bay contaminated by agricultural discharge and residual DDE from the Salinas River; and, San Francisco Bay with historic mercury from the 19th century gold rush, DDT from agriculture and the United Heckathorn Superfund site, metals and PCBs from industrial and military sites, and selenium from industry and agriculture. Although the contamination is centered in these areas, effects are widespread due to dispersion in the marine environment and uptake into the food web. Local hotspots in California include mercury discharges into Tomales Bay and pulp mill discharges into the ocean at Eureka.

Mercury has been detected in Caspian and Forster's Tern eggs in San Francisco Bay and Least Terns nesting at Alameda have been affected by PCBs.[144] Double-crested Cormorants in San Francisco Bay exhibit PCB and dioxin-like effects, but at levels below the threshold for adverse population effects.[145] The exposure risk to seabirds in California has been reduced over the past 30 years because of bans on DDT and PCBs, and reduced emissions of metals and other industrial pollutants. However, hotspots of contamination remain in the Southern California Bight and San Francisco Bay, near some of the largest concentrations of nesting seabirds in the state (the Channel Islands and the Farallons). The DDT contamination of the Southern California Bight still causes eggshell thinning in some seabirds (*e.g.*, cormorants, pelicans and storm-petrels).[146] Updated contaminant surveys are needed for the majority of the seabird species in the Southern California Bight that demonstrated eggshell thinning in 1992 due to DDT contamination.

***Oregon.*** Seabird colonies on small offshore islands have shown very little impact from chemical contaminants, except for widely ranging Fork-tailed Storm-Petrels that bioaccumulate DDE at sea.[147] Coos Bay estuary remains contaminated from shipyard operations and is in the process of superfund site cleanup. The major concern is the Columbia River estuary, where large populations of Double-crested Cormorants and Caspian Terns nest. Cormorant monitoring during the 1990s showed significant adverse effects from pulp mill effluent and metals, with egg mortality as high as 23%.[148] Contaminant discharge from pulp mills was regulated in the 1990s, with conversion of mills to non-chlorine bleaches, and future contaminant levels should be reduced.

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141 Fry 1994, Fry 1995, Ludwig *et al.* 1998

142 National Research Council 1999, Fry and Toone 1981, Fry *et al.* 1987

143 Fry and Toone 1981, Fry *et al.* 1987

144 Schwarzback and Adelsbach, 2002

145 Davis *et al.* 1997

146 Fry 1994, Fry 1995

147 Henny, Blus and Prouty 1982

148 Buck and Sproul 1999

***Washington.*** The sediments of Commencement and Elliott Bays remain highly contaminated and continue to pose risks to breeding seabirds, especially gulls, Caspian Terns and Pigeon Guillemots nesting in the inner harbors.[149] The north portions of Puget Sound and the Straits of Juan de Fuca have remained much less contaminated, as demonstrated by monitoring of several alcid species.[150] Bald Eagles nesting in Hood Canal bioaccumulated PCBs throughout the 1990s with reduced nesting success.[151] Investigations of seabird contamination in this area may be warrented. Several large Superfund site cleanups continue to make progress in Puget Sound.

***USPI.*** Hawai`i has contaminant issues on many islands stemming from historic and continuing military operations. Laysan and Black-footed Albatrosses at Midway are exposed to soils contaminated by lead-based paint, especially around old buildings. Chicks ingest contaminated soil and paint chips and the subsequent lead poisoning results in poor fledging success.[152] Localized lead contamination is a risk to surface nesting seabirds on most islands with historic military operations.[153]

Lagoons and harbors of Pacific islands with military bases remain contaminated with PCBs, petroleum, dioxin, selenium, lead, mercury, tributyl tin and plutonium. A portion of the Red-tailed Tropicbird colony on Johnston Is. was at risk from dioxin exposure from contaminated soil left from military operations,[154] but military cleanup of Johnston has reduced that risk. Risk to burrowing seabirds still exists from buried plutonium and metals (*e.g.*, lead, arsenic) on Johnston.

PCB contamination occurs on many Pacific Islands including Johnston, Midway, Kure, and French Frigate Shoals with possible exposure risk for ground nesters, and shearwaters and petrels that burrow in contaminated sites such as landfills and buried disposal sites. Organochlorine concentrations in Laysan and Black-footed Albatrosses are at least an order of magnitude higher than levels in southern hemisphere albatrosses and PCB and DDT concentrations were similar to those in Great Lakes fish eating birds which suffered embryo deformities and mortality.[155] Contamination levels were high enough to cause eggshell thinning and embryonic effects, and a small but measurable reduction in productivity was documented for Black-footed Albatross at Midway due to a combination of organochlorine contaminants and fisheries bycatch.[156]

## Plastic Pollution

Plastic pollution is ubiquitous in the marine environment and several studies have documented the vulnerability of seabirds to this threat. Most often seabirds are entangled or ingest the plastics. Entanglement can compromise flight and swimming capabilities, and result in injury or death. In this respect, discarded monofilament line and nets present the greatest threats to seabirds.

Seabirds ingest a wide variety of plastics from small industrial pellets to cigarette lighters, bottle caps, light sticks used in fishing, and broken bits and pieces. Spear *et al.*[157] found a strong negative correlation between the amount of ingested plastic and body condition of seabirds. Laysan Albatross chicks at Midway with heavy loads of plastics had significantly lower fledging weights than chicks with less plastic.[158] The possible effects of ingested plastics include starvation, suppressed appetite, impaction/obstruction, decreased fat deposition, and increased organochlorine contamination.[159] Plastics floating on the ocean absorb PCBs and

149 Spiech *et al.* 1992, Calambokidis *et al.* 1985, Mahaffy *et al.* 2001

150 Spiech *et al.* 1992, Grettenberger *et al.* 2004, USFWS unpubl. data

151 Mahaffy *et al.* 2001

152 Work and Smith, 1996, Burger and Gotchfeld, 2000, Finkelstein *et al.* 2003

153 Finkelstein *et al.* 2003

154 Fry *et al.* 2000

155 Auman *et al.* 1997, Jones *et al.* 1996, Gilbertson *et al.* 1991

156 Auman *et al.* 1997, Ludwig *et al.* 1998

157 Spear *et al.* 1994

158 Sievert and Sileo 1993

159 Reviewed in Auman *et al.* 1998.

other organochlorine contaminants[160] and ingestion of these materials may increase seabird contaminant loads.

Plastics are concentrated by ocean currents along the same fronts and convergences that concentrate prey items. Plastics degrade very slowly. It is not known how long it takes to recycle plastic in the ocean environment but some ecologists have estimated hundreds of years. Studies are showing the accumulation of vast amounts of plastics in the subtropical gyres.[161]

## Disease

The colonial behavior of seabirds would presumably make them highly susceptible to epizootic[162] disease but outbreaks are rare in this Region. Like other animals, seabirds are susceptible to infectious disease (viruses, bacteria, parasites) and non-infectious disease (toxins, toxicants, metabolic).

Epizootic outbreaks of Newcastle disease have occurred in Double-crested Cormorants in Canada and the U.S.[163] Newcastle's is suspected in a small die-off of nestling and fledgling cormorants at East Sand Is, OR in 2002. Large die-offs have occurred at Salton Sea cormorant colonies, and while Salton Sea is outside the geographic coverage of this plan, interchange between Salton Sea and coastal cormorant colonies is suspected. Avian pox, another viral disease, is transmitted by direct contact or by biting flies or mosquitoes. Pox mainly affects nestlings (Red-tailed Tropicbirds and albatrosses) at breeding colonies, and mortality rates are low. Mosquitoes were introduced to Midway during WWII and this is the only northwestern Hawaiian island where avian pox outbreaks occur. Since seabirds have not had much exposure to other mosquito-borne diseases (arboviruses), they may be particularly susceptible to the newly emerging threat of West Nile virus. Seabirds are also known to harbor a variety of viruses transmitted by ticks. While such viruses can cause illness in humans, epizootic mortality due to these viruses has not been documented. However, heavy infestation by ticks has been implicated in the desertion of Sooty Tern colonies, elsewhere.[164]

Naturally occurring toxins (biotoxins) can cause mortality in coastal seabirds. Biotoxins produced by unicellular phytoplankton, mostly dinoflagellates, bloom in huge amounts, often for unknown reasons. During algal blooms, these microorganisms are consumed by seabird prey that concentrate the toxin. Ingestion by birds can lead to intoxication, nervous system disorders, and death. In 1991, there was a large die-off of Brown Pelicans and Brandt's Cormorants in Monterey Bay due to the toxin domoic acid.[165] Many scientists believe that harmful algal blooms are becoming more prevalent as agricultural runoff and pollution result in increased nutrient loading (especially nitrogen and phosphorus) creating ecological conditions that favor toxic algal blooms.

Although starvation is often not considered a disease, physical and environmental factors can also cause large seabird die-offs. Thousands of murres, most emaciated, wash onshore along the Oregon coast during some years, often associated with El Niño events or stormy weather when food is less abundant or foraging is more difficult.[166] Mortalities of chicks, especially during fledging, is a common phenomenon in a wide variety of seabirds.[167] Fledging is a stressful time for chicks as they are weaned of food provided by parents and are learning to fly and forage for themselves.

There is a need for more baseline health and disease information from free-ranging seabirds. When die-offs or disease outbreaks occur, documentation and increased diagnostic testing should be conducted.

[160] Carpenter *et al.* 1972

[161] Moore 2003

[162] Epizootic - a disease affecting a greater number of animals than normal; typically occurrences involve many animals in the same area at the same time.

[163] Friend and Franson, 1999

[164] Feare, 1976

[165] Work *et al.* 1993

[166] Bayer *et al.* 1991

[167] Piatt and Van Pelt 1997

## Habitat Loss and Disturbance

More than half of the U.S. population now lives and works within 50 miles of the coastline and the degradation and loss of natural habitats in this zone has been significant. This is not just a recent phenomenon. Native peoples harvested seabird eggs, chicks, and adults for thousands of years. In Oregon, village sites and seasonal camps were located near seabird colonies and on offshore islands. Radiocarbon dating of material from various Oregon sites have indicated that coastal rocks and islands were used by native peoples for thousands of years for food gathering.[168] In Hawai`i, early Polynesians cleared huge expanses of native forests and converted lands to agriculture. Today, coastal landscapes are being paved or otherwise altered for urban, industrial and military development. Wetlands and riverine systems are diked, drained, dredged, or dammed for agricultural and hydroelectric development. Powerlines are a problem in areas where they transect flyways between the colonies and the ocean.[169] Degradation and loss of habitat continues, resulting in significant losses of seabird nesting and roosting habitat in this Region. (See the Section on Seabird Nesting and Roosting Habitat for discussion.)

Much of the development in the USPI is concentrated along the coast. Bright lights, such as those associated with resorts, greatly impact seabirds, especially Procellariiformes. The lights disorient birds transiting to and from the high elevation colonies. Fledglings are particularly attracted to artificial lights and each year they are downed in large numbers on their first flight to the ocean.

Military management of land has both degraded and protected habitat for breeding seabirds. Loss of habitat to structures, runways and other military developments is significant. Live fire exercises and military maneuvers on the beaches alter habitats, and disturb and displace birds. Sea Lion Rocks off Washington were bombed and torpedoed in the years following World War II. Disturbance from these military activities affected seabirds on non-target rocks, some of which were bombed by mistake.[170] Farallon de Medinilla, CNMI and Kaula Rock, HI are still actively bombed. Scheduled maintenance by the military at remote sites that support seabird colonies are often conducted during the peak nesting period (*e.g.,* maintenance at Destruction and Smith islands, WA). On the other hand, military bases have protected large stretches of coastal and island habitat from development. Military bases along the west coast support several important seabird colonies, especially coastal terns. Colonies of the endangered California Least Tern occur at military bases in San Diego, Seal Beach, and Vandenberg Air Force Base. Midway Atoll NWR, a Naval Air Station until it was decommissioned in 1998, supports the largest Laysan Albatross colony in the world despite the loss of tens of thousands of nesting birds during the 1960s in military control programs intended to ensure aircraft safety.

### Towers, Powerlines and Obstructions

Obstructions to bird flight are increasingly common features of the land- and seascape. Long recognized as a hazard to migrating landbirds, ill-placed powerlines and other tall structures, sometimes lit and with guy wires, are hazards to seabirds as well. The imminent likelihood of wind turbine development along coastlines and offshore raises new concerns.

Studies have documented lighting and power line impacts to Newell's Shearwaters.[171] During the first nocturnal flights of fledglings from nests to the ocean, a high percentage ($\geq$2 to $\geq$10 %) of fledglings were reported disoriented by man-made lighting and killed while colliding with lights, utility poles, wires, buildings, and automobiles. The Save Our Shearwaters Program that was initiated on Kaua`i in the 1970s has rescued more than 30,000 Newell's Shearwater fledglings that would otherwise have perished because of this coastal development. Contrary to recommendations by the Avian Power Line Interaction Committee, wide spacing of power transmission lines appeared to increase collisions of shearwaters and petrels during their nocturnal and crepuscular flights to and from colonies. Wide spacing seemed to increase the incidence of

168 See discussion in Carter *et al.* 2001

169 Harrison 1990, Podolsky *et al.* 1998

170 Speich and Wahl 1989

171 Podolsky *et al.* 1998, Ainley *et al.* 2001

collisions as birds attempted to avoid hitting one line only to hit another. Burying power lines is recommended for particular hot spots.

Lighting on towers may also affect other seabirds such as the Hawaiian Petrel.[172] The increased intensity and duration of lighting may be an attractant, becoming more problematic if towers are supported by guy wires. Reducing light intensity, reducing light duration (*e.g.,* using minimum intensity white strobes that flash once per 3 seconds), shielding lights from shining upward, using lattice or monopoles as opposed to guyed towers, and deploying bird deterrents (*e.g.*, flappers, marker balls, or swivels on towers which must be guyed) all merit additional research and may be of promise in minimizing collisions by seabirds.[173] In experimental areas, light shielding was shown to reduce attraction by as much as 40% while reducing light intensity also lowered deaths significantly. Proposals to build new communication towers or structures near seabird nesting colonies should be un-guyed and preferably unlit. The Service has prepared voluntary communication tower guidance to help reduce and avoid problems with strikes (http://migratorybirds.fws.gov/issues/towers/comtow.html).

The development of strings of wind turbines along coastlines and off-shore could be a source of mortality in the near future. Where wind energy is being considered, care should be taken to avoid using guy-wire structures to support meteorological towers and wind turbine nacelles. While European research indicates some problems with offshore wind developments (*e.g.*, site avoidance and disturbance, and varying degrees of strikes), virtually no research has been conducted in this Region to assess potential problems. Offshore wind energy generating facilities should be scrutinized carefully, preceded preferably by detailed surveys, site assessments, and evaluations.

## Global Climate Change

Sea-surface temperatures have risen 1°C over the past century and are expected to increase by up to another 3°C over the next 100 years if current trends continue. These increases in temperature can reduce the availability of phytoplankton, a major source of food for small schooling fishes that are in turn preyed upon by a variety of seabirds, producing a cascading effect at higher trophic levels. Declines in breeding populations and reproductive success attributed, at least in part, to the effects of global warming have recently been documented at seabird breeding colonies in the Arctic and Antarctic. Sea-level rise associated with global warming could significantly diminish the availability and quality of coastal nesting habitat. The low-lying islands and atolls of the tropical Pacific are among the world's most threatened by such inundation.

[172] Banko *et al.* 2001

[173] Manville in press

# Current USFWS Monitoring and Management Program

The Service's conservation activities in the Region can be summarized in two broad categories: monitoring and management.

## Inventories, Monitoring, and Special Surveys

During the past 30 years, population inventories have been conducted, at least once, for all accessible seabird breeding colonies in the Region. Initial inventories of the west coast states (California, Oregon, Washington) during the 1970s and early 1980s, provided a complete inventory of seabird nesting colonies along the continental U.S. west coast including Alaska. Subsequent inventories were generally coordinated at the state, island, or archipelago scale. More intensive monitoring has focused primarily on breeding population trends and reproductive success for selected species at a few locations.

Threatened and endangered species are monitored according to recovery plan guidelines. The majority of the monitoring programs for non-listed species have been organized and coordinated at the NWR level or they have been associated with specific projects such as oil spill monitoring. Coordinated range-wide inventories for seabirds are rare, but they have been conducted for declining species in association with species status assessments; however, many status assessments rely on existing population information rather than new survey data.

Seabird data derived from these programs are managed/stored at the NWRs, although several NWRs (most notably Pacific Remote Islands NWR Complex, Midway Atoll NWR, and Oregon Coast NWR Complex) enter data into the Pacific Seabird Monitoring Database developed under the auspices of the Pacific Seabird Group and USGS-BRD.

### Inventories

The goal of an inventory is to identify all colonies within a given area and enumerate the total breeding population (*e.g.,* breeding birds, pairs, or nests) at each colony. They provide a broad representation of the resource and delineate the distribution and abundance of breeding birds. The disastrous oil spills during the 1960s and 1970s killed large numbers of seabirds and highlighted the need for comprehensive information on the distribution and abundance of seabirds along the West Coast. In response to this need, the Service, Minerals Management Service (MMS), and the Bureau of Land Management - Outer Continental Shelf Office funded a series of surveys to inventory and catalog seabird colonies.

Seabird colonies along the California coast were inventoried between 1975-1980 and reported in the *Catalog of California Seabird Colonies.*[175] The Service and MMS funded another complete seabird inventory of California in 1989-1991 which produced a draft report: *Breeding Populations of Seabirds in California, 1989-1991.*[176] The Service also commissioned an inventory of Oregon seabird colonies, conducted in 1979. An unpublished draft colony catalog was produced: *Oregon Seabird Colony Catalog.*[177] Oregon Coast NWR Complex completed another inventory in 1988.[178] In Washington, Speich and Wahl (1989) compiled information from numerous sources to complete the *Catalog of Washington Seabird Colonies*. This report summarized colony surveys conducted between 1978 - 1982.

Migratory Birds and Habitat Programs is working with NWR staff and other cooperators to update and disseminate colony catalog information. Data are being compiled in GIS databases that are compatible with seabird colony catalog information for Alaska,

[175] Sowls *et al.* 1980

[176] Carter *et al.* 1992

[177] Varoujean and Pitman 1980

[178] USFWS in prep.

Russia, and other north Pacific Rim states/nations. Cataloging of more current California and Oregon seabird colony data is underway. These efforts are being coordinated with the Service's Region 7 (Alaska), and other federal and state land management agencies. Ultimately, colony catalog information with mapping capabilities will be available on the web.

Surveys of the central Pacific Islands were conducted during the 1960s as part of the DOD-funded Pacific Ocean Biological Survey Program (POBSP). The POBSP conducted extensive surveys and research of Pacific seabird distribution, numbers, movements, and natural history. Results of these surveys were published for many individual islands, or island groups, however, a comprehensive catalog of seabird colonies in the USPI was not compiled. In 1975, a formal agreement among the Service, NMFS, and Hawai`i Department of Land and Natural Resources was established to survey and assess the marine resources of the Northwestern Hawaiian Islands. An inventory of all seabird colonies from Nihoa to Kure was conducted between 1978-1982. These data were combined with data collected by Service research scientists and state biologists working on the main Hawaiian Islands, to produce a *Draft Atlas of Hawai`i Seabird Colonies*.[179] A final Atlas or Colony Catalog was never published but summaries of the data were presented in various publications (*e.g.* Harrison *et al.* 1984).

The Service commissioned a study (1975-1976) to document the status of wildlife and wildlife habitats of American Samoa, including seabirds.[180] The status and conservation of seabirds in the Mariana Islands was synthesized and reported by CNMI biologists from data collected during the period 1979 - 1988.[181] There are very little data for the other more isolated USPIs in the central Pacific, except Johnston Atoll. The Service has maintained a small staff at Johnston Is. NWR since 1982 and inventories of all nesting seabirds are available for this atoll.[182] A NWR was established at Palmyra Atoll in 2002 and year-round data on seabird populations were collected for selected seabird species for the first time in 2002/2003.[183] Access to Howland, Baker, and Jarvis NWRs is extremely difficult and costly, and surveys have been conducted opportunistically whenever biologists can access the islands. It is unknown if any of these visits coincided with peak numbers of nesting seabirds.

## Population Monitoring

Inventories provide invaluable information on seabird distribution and abundance at a large-scale. However, the large-scale inventories are insufficient to accurately detect or monitor population trends. Given the long life span, low fecundity, and high adult survival typical of seabirds, very small annual changes in breeding populations may signal profound long-term changes in population growth rates. Rigorous collection of population data is needed to accurately detect these trends but is currently conducted at very few sites.

***California Current System.*** Seabird population monitoring along the West Coast has traditionally been coordinated at the NWR- or state-level and has focused on a relatively small group of highly visible, surface nesting species (*e.g.,* murres and cormorants).

Common Murres are the most abundant breeding seabird in the Region and their breeding populations have been monitored via aerial photography of the colonies since 1979. Washington has conducted annual aerial surveys since 1979 and Oregon since 1986. Surveys began in California in 1979, but they were conducted sporadically until 1993 when annual surveys began. All major colonies are photographed during each survey and the photographs are labeled and archived. A synthesis of Common Murre data from the 1970s through 1995 is summarized in *Biology and Conservation of the Common Murre in California, Oregon, Washington, and British Columbia. Volume 1: Natural History and Population Trends.*[184] Washington is the only state where all colonies are counted annually (USFWS unpubl. data, Washington Maritime NWR), but

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[179] USFWS 1983c
[180] Amerson *et al.* 1982
[181] Reichel 1991
[182] USFWS unpubl. data
[183] Depkin 2003
[184] Manuwal *et al.* 2001

<2% of the Region's murre population breeds in Washington. In Oregon and California, a subset of the colonies is designated for annual counts. Counting murres from aerial photographs is more accurate than visual estimates but it is extremely labor intensive and counts of the designated colonies are years behind schedule. There is a great need to develop a less labor intensive method of monitoring this key species.

Brandt's and Double-crested Cormorant colonies from California through Oregon are photographed each year, and the photographs are labeled and archived. A subset of the colonies have been counted every year since 1988 and 1991, in California and Oregon, respectively.[185] As with the murre surveys, colony counts from aerial photographs are labor intensive and some counts are completed years after the survey flight. All major cormorant colonies along the outer coast of Washington were surveyed and counted annually between 1979 - 1991. On NWR islands in Puget Sound and the Straits of Juan de Fuca, cormorant colonies have been monitored annually since 1983.

In 2003, the Service coordinated surveys of Brandt's and Double-crested Cormorants in California, Oregon and Washington to assess the current status and distribution of these two species. Pelagic Cormorants were also surveyed in Oregon and Washington. Efforts to complete the cormorant surveys in Mexico are planned for 2005.

At Washington Maritime NWR breeding populations of Pigeon Guillemots and Rhinoceros Auklets are also monitored at regular intervals. Adult Pigeon Guillemots are counted annually on the water adjacent to the major colonies, using standardized protocols. Between 1999-2003, biologists from the Service, Washington Department of Fish and Wildlife, and private parties collaborated to inventory Pigeon Guillemots throughout the inner marine waters of Washington. As a result of this effort, the estimated population for this area increased approximately 4-fold (4,000 to 16,000).[186] This increase was not reflective of an increase in the guillemot population but rather the result of application of science based, standardized protocols over a large area.[187] Rhinoceros Auklet breeding populations are monitored at Protection and Destruction Island NWRs (the largest colonies in the Region) at irregular intervals (four surveys between 1983 - 2003) through burrow counts and estimates.

The most intensive population monitoring along the U.S. West Coast occurs at Farallon NWR where a cooperative agreement between the Service and PRBO Conservation Science (formerly Point Reyes Bird Observatory) has resulted in long-term population monitoring of selected species. Since 1971, eleven seabird species have been monitored: Ashy and Leach's Storm-Petrels; Brandt's, Double-crested, and Pelagic Cormorants; Western Gulls; Common Murres; Pigeon Guillemots; Cassin's and Rhinoceros Auklets; and Tufted Puffins.[188] Under the Service-PRBO cooperative agreement, annual estimates of breeding population size and reproductive success are provided; detailed protocols have been established and are implemented for this monitoring.

Coastal gulls and terns are monitored on NWR lands at San Diego, San Francisco, and Humboldt bays, CA. At San Francisco Bay NWR, seabird colonies are monitored by the San Francisco Bay Bird Observatory, through a cooperative agreement with the Service. In southern California, tern and skimmer colonies are closely monitored on NWRs, but monitoring of colonies on non-NWR lands is intermittent. Since 1997, USGS has annually monitored Caspian Terns in the Columbia River estuary in association with research to determine the magnitude and significance of tern predation on ESA listed salmonid smolts.[189]

The Service, in conjunction with the states, federal agencies (including the military), and other researchers, annually monitors populations of ESA listed species (*e.g.,* Brown Pelicans, California Least Terns and Marbled Murrelets). Brown Pelicans are monitored at the California breeding colonies and during post breeding migration in Washington and Oregon.

[185] USFWS unpubl. data, Carter *et al.* 1992, Wilson 1991

[186] Evenson *et al.* 2002

[187] D. Nysewander, Washington Department of Fish and Wildlife, pers. comm., 2004

[188] Ainley and Boekelheide 1990

[189] Roby *et al.* 2002; Collis *et al.* 2003

***USPI.*** Seabird monitoring in the tropical and subtropical islands of the central Pacific presents some unique challenges compared to the temperate species of the CCS. Several seabird species breed year-round in the tropics, and some species successfully reproduce more than one brood per year. Monitoring efforts are concentrated at four NWR locations: Tern Is. (French Frigate Shoals), Laysan Is., and Midway Atoll NWRs in the northwestern Hawaiian Islands and Johnston Is. NWR, in the central Pacific. Year-round Service staffing of Palmyra NWR started in 2002 and the establishment of a research station in 2005, with seven participating academic institutions and museums, will increase the probability that comprehensive monitoring of Palmyra seabirds will continue. Permanent Service staff have been stationed at Tern Is. and Midway Atoll since 1979 and 1992, respectively. A field camp has been staffed year-round at Laysan Is. since 1991. Breeding populations of Black-footed Albatross have been counted every year at each site since 1992. This effort represents a count of ~75% of the world breeding population. Laysan Albatross breeding populations are counted at least every five years at Midway. They are sampled every year at Laysan and at French Frigate Shoals they are counted annually. The Service and USGS are collaborating to design a more detailed albatross monitoring program with standardized protocols to determine albatross population trends and adult survival.

At Tern Is. and Johnston Atoll, breeding populations have been monitored year-round for all seabird species since 1980 and 1987, respectively (USFWS unpubl. data). At Midway Atoll, year-round monitoring of breeding populations of several species started in 1989.

## Detailed Demographic Monitoring

Washington Maritime NWR Complex and Farallon NWR are the only locations in the CCS where long-term programs to monitor other demographic and life history parameters have been implemented. At Washington Maritime NWR, Rhinoceros Auklet reproductive success and chick growth rates are monitored at Protection Is. NWR.

The most intensive demographic studies for seabirds occurs at Farallon NWR where PRBO studies seven species (Ashy Storm-Petrels, Brandt's Cormorants, Western Gulls, Common Murres, Pigeon Guillemots, Cassin's and Rhinoceros Auklets). For many species, banding programs were established in the early 1970s to provide estimates of annual and age-specific survivorship, breeding propensity (the probability of attempting to reproduce), reproductive success, recruitment, and age-at-first-breeding. These data have been synthesized in population models to estimate rates of population growth/decline and evaluate population viability. In addition, PRBO studies the diet of six species (Brandt's Cormorants, Western Gulls, Common Murres, Pigeon Guillemots, Cassin's and Rhinoceros Auklets) and collects information on atmospheric and oceanographic conditions daily. Special studies and investigations on numerous aspects of seabird ecology (energetics, effects of sub-lethal oiling, assessing contaminant levels in eggs, etc.) have also been conducted. this research emphasizes the effects of climate variability and change on seabird population biology and foraging ecology.

In the USPI, the most intensive population monitoring is conducted at Tern Island, French Frigate Shoals NWR, where populations of 16 seabird species nesting on the island are censused at regular intervals throughout the year. Breeding chronology is recorded, and the reproductive performance of 11 species is monitored annually. At Midway Atoll NWR, breeding chronology is recorded for all species and reproductive performance and population size is measured for Laysan and Black-footed Albatrosses, Masked Boobies, and Christmas Shearwaters. Breeding populations and reproductive performance are monitored for Laysan and Black-footed Albatross at the colonies in the main Hawaiian Islands (Kilauea Point NWR and Kaena Point).

The Service is working with USGS to analyze 50 years of albatross banding data from the northwestern Hawaiian Islands. These data were collected by different researchers for various purposes over the years. USGS has compiled a database with all available bands and recoveries to see if population growth rates and adult survival can be derived from the data. In 2003, the Service compiled and computerized 25 years of Laysan and Black-footed Albatross data on breeding population counts and estimates, breeding phenology, reproductive success, incubation shifts, and other breeding parameters. These data will be analyzed and, along with the USGS demographic analysis of banding data, will form a basis for a status assessment for these two BCC species.

## Status Assessments and Special Surveys

In addition to long-term monitoring, special surveys and assessments are designed specifically for ESA and BCC listed seabirds.

In 1995, the Service supported surveys of Xantus's Murrelets in the California Channel Islands and on Islas Coronados, Mexico to determine breeding distribution and abundance, and to assess conservation problems. In 1996, the Service also helped to support population viability analysis for Xantus's Murrelets and Ashy Storm-Petrels, conducted by PRBO. Both species are on the BCC 2002 list.[190] This status information was critical for a review of the petition to list Xantus's Murrelets under ESA that was submitted to the Service by the Pacific Seabird Group in 2002.

Due to the recent conflicts with endangered salmonid management in the Pacific Northwest, Caspian Terns are closely monitored by USGS. The Service annually compiles the results of Caspian Tern monitoring throughout the Region. In 2001, the Service coordinated a status assessment of Caspian Terns and conducted a review of Caspian Tern nesting habitat in the Region, to assess the feasibility of management opportunities.[191] In 2003, the Service coordinated with Mexico to conduct a range-wide survey of Western Gull-billed Terns. The results of this survey will provide baseline data for a status assessment of this rare tern.[192]

## Contaminants Monitoring

Several of the largest seabird colonies are located on islands with ongoing or historic military activity. Contaminants are an issue at many of these locations. Pacific Remote Islands NWR Complex implements a research and monitoring program to compile baseline information on exposure levels in breeding seabirds, identifying the source of contaminants, and measuring the effects. Most of this work is conducted at Midway Atoll and Tern Is., French Frigate Shoals NWR. Heavy metals (*e.g.*, lead) and persistent organochlorine compounds have been found in high levels in seabirds. Contaminant monitoring of soils and prey resources are underway to determine the source of contamination. A proposal for clean-up of lead contamination at Midway Atoll has been approved.

# Management

To date, the Service's management has focused primarily on acquisition and protection of breeding habitat; threat abatement; and environmental education and outreach.

## Habitat Protection and Restoration

Nearly all of the major seabird colonies in the Region are protected by the Service, other federal agencies, territorial governments, or the states as NWRs, NPs, national monuments, state parks, sanctuaries, wildlife areas, etc. Most recently Palmyra Atoll was acquired as a NWR in 2001. There are still a few key colonies where seabird conservation is not a primary emphasis, (*e.g.*, Wake Atoll and Farallon de Medinilla, CNMI). Service efforts to secure protection for all important breeding and roosting sites is an ongoing activity.

Disturbance to seabird colonies during the breeding season can cause lowered reproductive success, breeding failure, and even colony abandonment. NWR staffs work with communities, industry, the military, and state agencies to educate these groups on the effects of disturbance, and to enforce regulations that protect nesting seabirds. For example, staff from Oregon Coast NWR Complex meet regularly with U.S. Coast Guard personnel regarding the effects of low level "fly-overs" on seabirds and provide guidelines to minimize this disturbance. Oregon Coast NWR Complex also worked with the state to create a buffer zone around the important seabird colonies at Three Arch Rocks NWR. Buoys are placed each spring to restrict all boat traffic within 500 feet of the rock during the breeding season. All seabird NWRs carefully regulate human entry into seabird colonies to minimize disturbance to nesting birds.

Due to the intrinsic isolation and rugged nature of most of the offshore rocks and islands, active habitat management is typically not necessary on most of the NWRs. Exceptions include the low inshore islands in bays and estuaries. For example,

[190] USFWS 2002, Sydeman *et al.* 1998

[191] Shuford and Craig 2002, Seto *et al.* 2003

[192] Palacios and Mellink 2003, Molina 2003

the San Diego Bay NWR Complex is preparing a Comprehensive Conservation Plan for Sweetwater Marsh and South San Diego Bay NWR. All habitat management and restoration alternatives in the plan include proposals for seabird conservation such as the expansion and creation of new nesting sites and nesting substrate enhancement. Projects already underway include annual vegetation management at nesting areas and the addition of clean coarse sand on the tops of levees within the salt ponds of the south bay. The levees in south bay also provide relatively safe roosting areas for many species of seabirds including California Brown Pelicans and cormorants. In USPI, extensive projects have been conducted at Midway Atoll NWR, Johnston Is. NWR, and Kilauea Pt. NWR to restore native vegetation to enhance seabird habitat.

## Threat Abatement

Management activities directed towards limiting or eliminating threats include; invasive species control, coordinating with other agencies and industry to minimize the negative interactions between seabirds and fisheries, minimizing disturbance to colonies, response to oil spills, and identification and investigation of contaminant sites on NWRs. Considerable emphasis has been placed on the control and eradication of introduced species that threaten seabird populations. Control/eradication of introduced predators, herbivores, and specific invasive plants have been implemented in conjunction with projects to re-establish native vegetation and extirpated seabirds. The Service has conducted this work both on and off Service lands. Examples of these activities are discussed in the section on Threats: Introduced/Non-native Species. Aerial broadcast of toxicants is an important tool in the eradication of rodents from islands and the Service is working secure EPA registration for this use. Service activities with respect to oil spills and contaminants are ongoing.

The natural resource damage assessment and spill response program conducts spill response and associated injury assessment activities whenever released oil or toxic chemicals potentially or actually come into contact with birds. Through the damage assessment process, funds are obtained from the parties responsible for the releases, to restore injured natural resources, such as seabirds. For example, the Service is using restoration funds to reestablish a murre colony at Devil's Slide Rk. in central California.

Seabird bycatch in commercial fisheries and some sport fisheries continues to be a major source of mortality for some species. The Service is working at the Regional, Field Office and NWR level to address this issue. Activities include monitoring seabird populations to assess the impacts; coordinating with NOAA-Fisheries, the states and fisheries councils to develop regulations to minimize bycatch; training fisheries observers in bird identification; supporting research into new gear types or mitigation measures that reduce bycatch; and educating anglers, industry, and the public about the issue and potential solutions. Service staff are also represented on the Interagency Seabird Working Group with NOAA-Fisheries, Fisheries Councils, and Department of State to implement the National Plan of Action for the Reduction of Seabird Bycatch in longline fisheries.

## Conflict Management

Today with so many species and ecosystems facing tremendous challenges, conflicts sometimes arise between conservation management for seabirds and other natural resources or human interests. Conflicts may range from the management of endangered species (*e.g.*, ESA listed salmonids and Caspian Terns in the Columbia River) to the protection of commercial or personal property interests (*e.g.*, Double-crested Cormorants foraging at aquaculture facilities and Glaucous-winged Gulls nesting on rooftops or foraging at landfills). Resource conflicts concerning seabirds typically involve coastal nesting species that forage in estuarine, freshwater, and even terrestrial habitats. These species can occupy highly altered ecosystems (*e.g.*, dredge material islands, large ports, and marinas) and may forage opportunistically in these and other altered landscapes. Conflicts also arise when ESA and BCC listed species compete among themselves or with other species for limited nesting habitat (*e.g.*, Southern California open beach habitat). There is considerable pressure to resolve these conflicts but the relationship between endangered species recovery and predators, including seabirds, is complex and not well understood. Similarly, the management of seabirds in highly altered landscapes presents unique challenges to resource managers.

## Outreach and Education

Service personnel throughout the Region provide information on seabirds for tourists, community members, and students in grades K-12. Presentations and research lectures focus on seabird biology, monitoring, recovery efforts, threats, and the best places to view seabirds. Interpretive displays, guided birdwatching trips, workshops, and posters focus on seabird ecology and what boaters, fishers, pilots, and visitors can do to help protect seabirds. Several special programs such as the Common Murre Restoration Education Program at San Francisco Bay NWR serve to educate K-5 students about the hazards that face seabirds.

# Goals and Objectives

The Service has trust resource responsibilities for the range-wide conservation of seabirds as well as site specific management responsibilities associated with the NWRS. Habitat management, threat abatement, population monitoring, and recovery of ESA and BCC listed seabirds represent responsibilities that require a broad range of activities to affect the desired response and to support informed management decisions. In this Section we identify and group primary goals and objectives to address these responsibilities and needs under the broad categories of:

- management
- inventory & monitoring
- research
- education & outreach
- planning and coordination

These goals and objectives represent activities the Service views as key components of seabird conservation. They may be addressed or implemented by various Service programs and divisions including Migratory Birds and Habitat Programs (MBHP); National Wildlife Refuge System (NWRS); and Endangered Species, Environmental Contaminants, and Habitat Conservation (AES). Lead programs/divisions are identified after each objective. Many of these activities, particularly in the areas of management and monitoring, are critical conservation needs. Some activities are implemented on an ongoing basis (*e.g.* technical support and interagency coordination) while others are discreet actions with measurable outcomes (*e.g.* rat eradication). In most cases, implementation will be dependant upon annual budgets and increasingly, the cooperation and collaboration of other public agencies and partners with a stake in seabird conservation.

This list represents a comprehensive overview of seabird conservation needs in the CCS and Pacific Islands expressed as goals and objectives. Species specific conservation recommendations can be found in the individual Species Accounts. Objectives that the Service considers to be high priority for implementation (*i.e.* in fiscal years 2005 and 2006) are identified with a "[2005-2006]" notation at the end of the objective statement. Regularly occurring activities are noted as "[Ongoing]". Out-year priorities stemming from the goals and objectives presented in this plan will be identified in Biannual Strategic Plans for the Pacific Region's seabird conservation program. Biannual Strategic Plans will serve to update and focus Service seabird conservation activities, budget allocations, and budget requests on those activities that are deemed the highest priority. Biannual priorities may include activities that address immediate threats to seabirds, those representing common interests among partners, and those necessary to inform management. While these goals and objectives were developed to guide Service efforts in seabird conservation, they are also intended to clarify our roles, and responsibilities to our partners, and to facilitate a partnership approach to seabird conservation at an ecosystem scale.

# Management

**Goal 1. Habitat Management - Maintain, protect and enhance seabird habitats (breeding, roosting, foraging, migrating and wintering) in sufficient quantity and quality to meet seabird needs.**

Most of the important nesting and roosting areas in the Region have been identified for the more readily observable seabird species and the information is compiled in published or unpublished Seabird Colony Catalogs. Information on important foraging and wintering habitats are not as well defined. For several of the ESA and BCC listed species, information on breeding habitats is insufficient for management purposes.

**Objective 1. a.** Identify and protect important breeding, roosting, and foraging habitats through acquisition, easement, overlay NWR, special designation (*e.g.*, marine protected area), regulation, cooperative agreements, etc.

i. Identify important breeding habitat for poorly known species, emphasis on ESA and BCC species. Projects include, but are not limited to:

(1) Hawaiian Petrel, Newell's Shearwater and Band-rumped Storm-Petrel [AES/MBHP; ongoing]
(2) Tahiti and Herald Petrels, Audubon's Shearwater and Polynesian Storm-Petrel [AES/MBHP]
(3) Gull-billed Tern [MBHP/AES; 2005-2006]

ii. Compile and prioritize a list of highest priority sites in need of protection and work with partners to establish protected status. [MBHP/AES/NWR; 2005-2006]

Known sites in need of protection include but are not limited to:

(1) Tern nesting habitat in southern and central California (*e.g.*, Port of Los Angeles, Santa Ana River mouth, and Alameda Point).
(2) Newell's Shearwater nesting habitat on the island of Kaua`i.

iii. Coordinate with Tribes on a cooperative management plans or other means to protect seabird colonies on tribal lands (*e.g.*, Chief's Island, OR [NWR; ongoing]

iv. Coordinate with other federal and state agencies to protect important seabird colonies (*e.g.*, DOD to protect colonies on military bases [*e.g.*, Wake Atoll]; U.S. Army Corps of Engineers for colonies in the Columbia River estuary). [AES/NWR/MBHP; ongoing]

v. Develop and maintain a GIS database of all seabird breeding locations and key roost sites in the Region, with information on ownership and protected status. Integrate this with the Seabird Colony Catalog Database (Obj. 6.b). [MBHP/NWR/AES; 2005-2006]

vi. Coordinate with other state and federal agencies, conservation organizations, researchers, and other stakeholders to identify and protect important marine foraging habitats. [MBHP/NWR/AES; ongoing]

**Objective 1. b.** Protect seabird habitats from adverse human impacts such as disturbance through regulation, cooperative agreements, buffer zones, restricted access, public outreach, enforcement, etc.

i. Coordinate with the military to minimize disturbance to breeding seabirds in areas affected by military operations, such as overflights, base and maintenance operations, and live fire training exercises. [AES/NWR/MBHP; ongoing]

ii. Coordinate with State, City and County wildlife and beach management agencies to minimize disturbance to west coast tern nesting areas *e.g.*, seasonal fencing, restricted access, modification of beach raking practices [AES; ongoing]

iii. Work with the general public, industry, government agencies, and NGOs to minimize disturbance to colonies. [NWR/AES/MBHP; ongoing]

**Objective 1.c.** Restore lost or degraded seabird habitats. Specific projects include but are not limited to:

i. Restore, protect and maintain sandy beach, dune, and other open habitats preferred by coastal terns in central and southern California (*e.g.*, sites in San Diego Bay, Seal Beach NWR, Bolsa Chica Restoration Project, Ormond Beach, Alameda and San Francisco Bay). [AES/NWR/MBHP; ongoing]

ii. Eradicate or control invasive vegetation that degrades seabird nesting or roosting habitat (*e.g.*, golden crown-beard and bufflegrass in the northwestern Hawaiian Islands; iceplant and European beachgrass along west coast beaches; and, invasive grasses, New Zealand spinach and cheeseweed at Farallon NWR). [NWR/AES/MBHP; ongoing]

iii. Restore native habitat that has been lost or degraded at important seabird sites such as Midway Atoll NWR (coordinate with DOD). [AES/NWR/MBHP; ongoing]

iv. Remove or ameliorate hazards to seabirds at nesting and roosting sites such as concrete structures at Southeast Farallon Island; unnecessary buildings and other structures at Midway Atoll and Johnston Is. NWRs. [NWR; ongoing]

## Goal 2. Invasive Species Management - Eradicate or control introduced predators and other invasive species that have negative impacts on seabird populations.

Most control and eradication projects are multi-year undertakings and require the support and coordination of other public and private partners at the local, regional, and international scale. A more complete list of invasive species problems in the Region is contained in Appendix 9. Objectives for eradication of invasive plants are included under Goal 1 (Habitat Management).

**Objective 2. a.** Plan and implement programs to eradicate non-native predators from key seabird colonies. The Service's top priority sites are listed in Table 7. Implementation of these projects is pending funding.

i. Develop a plan and supporting NEPA documentation for the eradication of rats from Palmyra. [NWR/AES/MBHP/partners; 2005-2006]

ii. Develop a plan and supporting NEPA documentation for the eradication of rats and rabbits from Lehua. [AES/MBHP/partners; 2005-2006]

iii. Work with DOD and USDA to secure funds to implement the existing plan to eradicate rats from Wake [AES/MBHP; pending funding and cooperators schedule]

**Objective 2. b.** Where eradication programs are not feasible, work with partners at the local scale to control introduced, feral, domestic, and non-native species in the vicinity of seabird colonies.

i. Continue ongoing control programs for predators along the west coast (CCS) and the main islands of the USPI (*e.g.*, Kilauea Pt. Kaua`i and California tern colonies). [NWR/AES; ongoing]

ii. Control non-native cats, dogs, rats, mongoose, Cattle Egrets, and Barn Owls in Hawai`i where they negatively affect seabird populations, especially in Newell's Shearwater and Hawaiian Petrel colonies. [AES/NWR; ongoing]

(1) Continue support of programs to control predators at specific Kaua`i colonies to protect endangered species. [AES/partners; 2005-2006]

iii. Complete NEPA documentation, site specific plans, and secure funding for control of mammalian predators at Oregon Islands NWR, Three Arch Rocks NWR, and adjacent mainland areas. [NWR; 2005-2006 (plan and NEPA); implementation pending funding]

**Objective 2. c.** Fence and remove feral ungulates from forest habitats of Hawai`i NWRs, to restore habitat for petrels, shearwaters, and other native species. Eradicate feral ungulates and other herbivores from small islands where possible. [NWR/AES; ongoing]

i. Complete and implement a plan and supporting NEPA documentation for the eradication of rabbits from Lehua. [AES/MBHP; 2005-2006 (plan and NEPA); implementation pending funding]

**Objective 2. d.** Work with USPI territorial and commonwealth governments, to reduce impacts of introduced predators and ungulates on seabird habitats. [AES/MBHP; cooperators schedule]

i. Work with the governments of Guam and CNMI to investigate the potential for eradication of feral ungulates and introduced predators at Cocos (Guam) and select northern Mariana islands. [AES; 2005-2006]

ii. Provide technical assistance and support to NPS and the Government of American Samoa in their efforts to develop and implement plans to control predators in shearwater and petrel colonies on the main islands. [AES/MBHP; ongoing]

**Objective 2. e.** Coordinate with Canada, Mexico, and island nations of Oceania to control or eradicate introduced species on all islands where they negatively affect seabirds with emphasis on BCC and ESA listed species and shared seabird resources (*e.g.*, Phoenix and Tahiti Petrels, Band-rumped and Polynesian Storm-Petrels, Least and Gull-billed Terns, Brown Pelicans, Xantus's and Craveri's Murrelets). [MBHP/AES/NWR; ongoing]

**Objective 2. f.** Work with partners to develop a comprehensive analysis of introduced predators at island colonies within the Region and adjacent countries with shared seabird resources. [MBHP/AES]

i. Compile available data necessary to prioritize eradication projects.

ii. Develop a systematic plan to eradicate introduced predators from all small and medium islands in the Region.

iii. Seek cooperators and funding to implement priority predator control projects.

**Objective 2. g.** Obtain Special Local Need registration under Section 24c of FIFRA for aerial broadcast of diphacinone in Hawai`i. Support national effort to obtain EPA registrations for conservation use of diphacenone and brodificoum on islands. [AES; ongoing]

**Objective 2. h.** Support research to determine the effects of invasive species (especially invertebrates) on seabirds and their habitats; and, research into the development of new technologies to eradicate or control these species. Projects include, but are not limited to:

i. Research the effects and control of introduced scale insects at Rose Atoll and Palmyra NWRs where they are causing the destruction of the pu'avai (Pisonia) forests [NWR/USGS; ongoing]

ii. Research the effects and control of introduced grasshoppers at Nihoa NWR where they defoliate the island during population eruptions. [NWR]

iii. Research the effects and control of introduced ants at all USPIs where they directly attack seabirds and facilitate scale insect invasions. [NWR/AES]

iv. Research efforts to eradicate mosquitoes at Midway NWR where they are vectors for diseases such as avian pox and potentially West Nile Virus. [NWR/AES]

v. Research the control and eradication of invasive plant species such as golden crown-beard. [NWR/AES]

**Objective 2. i.** Develop operational programs including SOPs to prevent introductions of invasive species and to detect predator and invasive species "spills" at island colonies.

i. Prepare Response Plans that outline actions and responsible parties in the event of an introduction. Continue to coordinate this work with ongoing interagency efforts with Region 7 (Alaska), USGS, USCG, and other partners. [AES/NWR]

ii. Assess the need and, if deemed necessary, develop and implement SOPs for Service staff, researchers, and visitors regarding movement of personnel and gear to seabird islands to limit the potential for new introductions of invasive species. [NWR/AES]

iii. Conduct regular inventories to identify sites where invasive species are established, especially those sites where the population is still relatively small and restricted such that eradication efforts would be most cost effective. [NWR/AES; ongoing]

**Goal 3. Seabird Bycatch -** minimize bycatch and other negative impacts of fisheries interactions on seabird populations in coordination with other agencies, fisheries councils, industry, research scientists, and other partners.

Authorization and regulation of fisheries are the responsibility of various federal and state agencies (*e.g.*, NMFS and state fish and wildlife/game agencies) and the Tribes. The Service will work with these agencies, Tribes, and the Fisheries Councils to provide technical expertise regarding seabirds and to develop workable solutions in situations where fishing operations have negative impacts on seabirds. Quantifying the effects of fisheries interactions on seabird populations, requires coordination between all parties.

**Objective 3. a.** Assist in the development a National Waterbird Bycatch Action Plan to implement Service policy regarding elimination of seabird bycatch in fisheries. [DMBM/MBHP; 2005-2006]

**Objective 3. b.** Provide technical assistance to states and NOAA-Fisheries in the identification of fisheries that threaten seabirds and in the development and implementation of observer programs for fisheries that have known or high potential for seabird bycatch and other negative interactions. [AES/NWR/MBHP; ongoing]

**Objective 3. c.** Provide technical assistance to Fisheries Councils, industry, fishers, federal and state agencies, Tribes, and other stakeholders in support of workable solutions and studies to develop new gear, fishing techniques, and/or mitigation measures to reduce and eliminate bycatch and other negative interactions between fisheries and seabirds. [AES/NWR/MBHP; ongoing]

Fisheries of highest priority include but are not limited to:

i. West Coast groundfish and halibut fisheries - longline, trawl, and gillnet

ii. Highly Migratory Species fisheries based along the West Coast

iii. Hawai`i based longline fisheries for tuna and billfish

iv. Salmon gillnetting in the Pacific Northwest

v. West Coast squid fisheries and the effects of bright lights

vi. Recreational hook and line fishery

**Objective 3. d.** Review Fisheries Management Plans prepared by the states and Fisheries Councils to identify conflicts and recommend measures to reduce seabird impacts. [AES/MBHP/NWR; ongoing]

**Objective 3. e.** Conduct outreach to fishers regarding threats to seabirds and measures to minimize the problem. [AES/MBHP; ongoing]

### Goal 4. Oil Spills - Improve the effectiveness of spill response efforts and work with other response agencies to minimize the impacts of a spill to seabirds and other wildlife.

The Service has responsibilities to protect seabird resources and to respond to oil and hazardous material spills. There is a Regional Oil and Hazardous Substance Spill Contingency Plan (rev. 1997) but there is a need to develop a regional "strike team" that can mobilize quickly and has the training, equipment, and experience to respond to these emergencies.

**Objective 4. a.** Establish a regional strike team to respond to oil and hazardous substance spills. This team will need training (*e.g.*, hazardous materials handling, animal handling, sampling protocols, incident command), equipment (personal protective gear, sampling, vehicles), funding, and the flexibility within their other duties to respond immediately to an incident. [AES/NWR]

**Objective 4. b.** Increase the Service's role in spill prevention and pre-spill planning activities, including development and revision of Area Contingency Plans, coordination with the Coast Guard and other response agencies in Area Committees, and participation in spill drills. [AES/NWR; ongoing]

**Objective 4. c.** Develop a list of seabird restoration projects that is continually updated, to provide the Trustees information on highest priority restoration projects. [AES/MBHP; 2005-2006]

**Objective 4. d.** Refine methods to document seabird mortality after oil spills. Support studies to improve the accuracy of models *e.g.*, factors that influence beached bird data such as searcher efficiency, scavenging, and carcass movement studies. [AES/MBHP; ongoing]

i. Develop protocols and models to assess impacts of oil spills in the USPI. [AES]

### Goal 5. Contaminants/Hazardous Substances Identify problems and work with partners to ameliorate the effects and clean-up contaminated sites that negatively impact seabirds.

**Objective 5. a.** Develop and implement a coordinated regional monitoring program for early detection of contaminant problems. Emphasis on ESA and BCC species. Program will include but not be limited to:

i. Periodic monitoring of contaminant levels in birds and eggs of nesting seabirds. [AES/NWR]

ii. Follow-up contaminants monitoring of birds affected by the Montrose contamination [AES]

**Objective 5. b.** Identify, eliminate and/or neutralize contaminant sources at seabird colonies, important roost sites, and foraging areas. Projects include but are not limited to:

i. Clean-up lead contamination at Midway Atoll NWR [NWR/AES; 2005-2006]

ii. Clean-up contaminated "dead zone" at Laysan NWR [NWR; ongoing]

iii. Complete military clean-up of Johnston Island NWR [NWR/AES/DOD; ongoing]

**Objective 5. c.** Support research into the source and effects of contaminants on seabirds.

i. Albatrosses and storm-petrels: effects and sources of organochlorine contamination. [AES/NWR/MBHP]

ii. Coastal terns: effects of pollution and contaminants in coastal estuaries on nesting terns [AES/NWR/MBHP]

**Goal 6. Powerlines, Towers, Turbines, and Lights -** Work with industry, state and federal agencies, and other stakeholders to minimize the effects of powerlines, towers, wind turbines, and lights on seabirds.

**Objective 6. a.** Work with the state of Hawai`i, Kaua`i Electric, and other partners to minimize the take of Newell's Shearwaters and Hawaiian Petrels in powerlines and lights. [AES; ongoing]

**Objective 6. b.** Develop recommendations for industry regarding the siting of offshore wind turbines to minimize the negative impacts on seabirds. [MBHP/AES]

**Objective 6. c.** Remove unnecessary buildings and other structures (*e.g.*, light poles, powerlines) at Midway Atoll and Johnston Island NWRs. [NWR; ongoing]

## Inventory and Monitoring

A coordinated Region-wide program to assess the status and trends of Pacific Region seabird populations is essential to provide a scientific basis for management decisions. Development of this program will involve establishing and implementing standardized protocols for data collection, analysis, and reporting. The program design must be scientifically sound and statistically capable of detecting trends in sufficient time to implement warranted management actions. The program will comprise two major components: 1) inventories of all seabird colonies at long-term intervals (*e.g.*, 10 years), and, 2) intensive quantitative monitoring of specific demographic and life history parameters for a select group of breeding seabird species ("focal" species) at short-term intervals (*e.g.*, annual, biennial). The development and implementation of this program will need to be coordinated with other agencies and organizations that manage and study seabirds at the regional and international scales (*e.g.*, states, Tribes, NPS, BLM, CWS, CICESE, NGOs, universities). ESA listed species will be inventoried and monitored in accordance with respective recovery plans.

**Goal 7. Monitor breeding seabirds -** Design and implement a comprehensive monitoring program for breeding seabirds in the CCS and Pacific Islands in coordination with USGS, seabird scientists, and other public and private stakeholders.

**Objective 7. a.** Develop standard operating procedures for the periodic inventory of each seabird species, or species group in the CCS and USPI. [MBHP/NWR/USGS; 2005-2006]

**Objective 7. b.** Develop Seabird Monitoring Manuals for the CCS and USPI that identify standard operating procedures for data collection, analysis, and reporting necessary to monitor seabird population trends and selected demographic parameters within these two marine ecoregions. [MBHP/NWR/USGS; 2005-2006]

**Objective 7. c.** Implement the monitoring program upon completion of the manuals and incorporate a feedback loop for program evaluations. [NWR/MBHP/AES]

**Objective 7. d**. Periodically assess the monitoring program for sufficiency in meeting objectives and adapt protocols accordingly. [NWR/MBHP/AES]

**Objective 7. e.** Develop a "data management system" for storage and retrieval of seabird monitoring data, archiving photographs and maps, and cataloging raw data and reports to ensure that these data are accessible for analysis, interpretation, and distribution.

i. Coordinate with ongoing efforts towards a Biological Data Management System for NWRs, the Pacific Seabird Group Monitoring Database, and NBII. [MBHP/NWR]

ii. Submit summarized data to the Pacific Seabird Group Monitoring Database which will provide a mechanism for data dissemination to the public. [MBHP/NWR; 2005-2006]

**Objective 7. f.** Compile and disseminate existing seabird colony inventory information (Colony Catalogs) in electronic and printed formats using standardized GIS databases developed in coordination with the Service's Region 7 (Alaska).

i. Finalize and publish the Oregon Seabird Colony Catalog. [MBHP/NWR; 2005-2006]

ii. Compile and distribute updated California and Washington Seabird Colony Catalog information. [MBHP/NWR; 2005-2006]

iii. Compile and distribute Hawai`i and USPI Seabird Colony Catalog information. [NWR/AES/MBHP]

iv. Annually update and distribute current inventory data. [NWR/MBHP; ongoing]

**Objective 7. g.** Develop an interactive web interface with GIS mapping capabilities for the Pacific Region Seabird Colony Catalog Database, to provide access to data and integration with other North Pacific seabird colony data. Coordinate with ongoing efforts by NBII, USGS, and the Service's Region 7 (Beringian Seabird Colony Catalog).

i. Develop a data management system whereby Service personnel can enter new data and extract tabular and mapped information via the web or desktop platforms. [MBHP]

ii. Coordinate with NBII to maintain the website and update databases annually with latest inventory data. [NWR/MBHP]

**Objective 7. h.** Extract, compile, computerize, and disseminate existing survey and monitoring data contained in Service files. Enter these data into standardized GIS databases (*e.g.*, Seabird Colony Catalog Database, Pacific Seabird Monitoring Database)

i. Count archived Common Murre and cormorant aerial photographs, from 1980 through the present, from California and Oregon colonies. Highest priority to photographs taken 1995 through the present. [NWR/MBHP]

ii. Compile and computerize seabird monitoring data from the northwestern Hawaiian Islands from 1996 through the present. [NWR/MBHP]

iii. Compile, analyze, and report Service data for Laysan and Black-footed Albatross. [NWR/MBHP, 2005-2006]

**Objective 7. i.** Annually review and report the results of seabird monitoring.

i. Identify seabird species with unstable or declining populations and identify research needed to determine causal relationships. [NWR/AES/MBHP]

ii. Identify conservation and management actions. [NWR/AES/MBHP]

**Objective 7. j.** Coordinate and conduct comprehensive range-wide surveys for select species of management concern *e.g.*, ESA and BCC listed species, and overabundant species. [MBHP/AES/NWR; ongoing]

i. Complete a range-wide survey to assess the current status, distribution of the ESA listed California Brown Pelican [AES/MBHP; 2005-2006]

ii. Complete the range-wide survey for Brandt's Cormorants and the western subspecies of Double-crested Cormorants initiated in 2003 (California, Oregon, Washington) by conducting surveys of Mexican colonies. [MBHP/AES/USGS; 2005-2006]

iii. Coordinate with Mexican biologists to repeat the range-wide survey of Western Gull-billed Terns in California and Mexico [MBHP/AES; 2005-2006]

**Objective 7. k.** Complete Status Assessments for BCC species. [MBHP/AES/NWR; ongoing]

i. Complete a Status Assessment for Gull-billed Terns [MBHP; 2005-2006]

ii. Complete a Status Assessment for Black-footed and Laysan Albatross [MBHP/NWR/AES; 2005-2006]

**Goal 8. At-sea monitoring - Develop a comprehensive program for monitoring seabirds at sea in coordination with NOAA-Fisheries, USGS, seabird scientists, and other public and private stakeholders.**

Monitoring seabirds at colonies does not provide information about the millions of seabirds that migrate to the Region from other areas. Even for breeding species, monitoring at the colonies is limited to the breeding season and provides very limited data on foraging areas, feeding associations, threats at sea, etc. Data on at-sea distribution and abundance are critical for effective seabird conservation. For many species (*e.g.*, burrow and crevice nesting procellarids) surveys at sea may provide better data for assessing population status and tracking population trends.

**Objective 8. a.** Integrate seabirds into existing and planned at-sea monitoring programs (*e.g.*, PACOS, NOAA-Fisheries protected species surveys). [MBHP; ongoing]

## Research

Research is an integral component of seabird conservation and management. The Service's needs will focus on research necessary to make informed conservation and management decisions. Priority will be given to BCC and ESA listed species, specifically to understanding the cause of low or declining populations and activities that will aid in recovery. However, this focus will not be so stringent as to excluded needed research for more common seabirds. Research will often go hand-in-hand with monitoring *e.g.*, investigating the causal relationships between changes in demographic parameters and environmental factors.

**Goal 9. Identify and support research that furthers conservation or assists in the management or monitoring of Pacific seabirds.**

**Objective 9. a.** Develop methods to monitor population trends for selected species where current methods are inefficient or inadequate.

i. Investigate new technologies for remotely counting and monitoring regionally important seabirds that nest in large, dense colonies (*e.g.*, Common Murres) and improve the efficiency of current methodologies. [MBHP/NWR]

ii. Investigate new technologies or adapt/refine existing technologies (*e.g.*, radar, at-sea surveys, mark/recapture) to ascertain trends for seabird species that currently are not reliably monitored (*e.g.*, burrow and crevice nesters) and ESA and BCC listed species (*e.g.*, petrels, shearwaters, storm-petrels, and murrelets). [MBHP/AES]

**Objective 9. b.** Conduct investigations to compile or synthesize biological information fundamental to seabird conservation and management for poorly known species (*e.g.*, basic life history traits, habitat requirements, reproductive biology, population status, etc.) Emphasis on BCC species.

i. Tristram's and Band-rumped Storm-Petrels are high priority species for investigations and baseline studies preliminary to development of Status Assessments. [MBHP/NWR/AES]

ii. Investigate at-sea distribution and movement patterns for key species such as albatrosses by age, sex, and breeding status to evaluate vulnerability to threats such as fisheries bycatch and contaminants. [MBHP]

iii. Analyze data from colony and at-sea surveys to assess population status and trends for select BCC species (*e.g.*, Ashy Storm-Petrels). [MBHP]

**Objective 9. c.** Work with partners to initiate studies into the interrelationships of seabirds and their environment: foraging areas and feeding ecology; distribution, abundance, and ecology of prey; response of seabirds and prey to large and small scale oceanographic and climatological cycles; and impacts of commercial fishing on prey abundance or availability. [MBHP/NWR]

**Objective 9. d.** Investigate the efficacy of DNA markers to determine a bird's colony of origin. This information is important when assessing the effects of threats such as oil spills and fisheries bycatch. [AES/MBHP/NWR]

## Outreach and Education

Seabirds spend much of their life at sea or on isolated specs of land, out-of-sight and experience of most people. A "seagull" may be the only familiarity the average person has with seabirds. Educating the public to appreciate the unique characteristics of seabirds and the many threats that jeopardize their existence can provide great returns when agencies look for support for conservation activities or compliance with rules and regulations.

**Goal 10. Educate the public -** Develop a coordinated program about seabird resources in the Region, including seabird ecology, threats, and conservation issues that affect seabird populations.

**Objective 10. a.** Develop a K-12 curriculums on seabirds with specific chapters on the California Current System and tropical/subtropical island systems. [MBHP/NWR/AES]

**Objective 10. b.** Develop presentations about various aspects of seabird ecology, research, monitoring, threats, and other issues that can be distributed to NWRs and Service field offices. [MBHP/NWR/AES]

**Objective 10. c.** Develop a website dedicated to seabirds with links to current and recent investigations and monitoring. Include interactive teaching modules. [MBHP]

**Goal 11. Increase opportunities for the public to view and experience seabirds**

**Objective 11. a.** Provide interpretive displays, brochures, posters and other outreach materials.

i. Install interpretive panels at key access points along the coastlines where seabirds can be viewed or threats discussed (*e.g.*, problems with coastal nesting terns and disturbance). [NWR/AES/MBHP; ongoing]

ii. Establish remote camera systems on active seabird colonies to allow the public and students an opportunity to observe seabird behaviors. [NWR/MBHP]

iii. Develop watchable wildlife maps that show the best locations to view seabird colonies and roosts and individual species of seabirds without disturbing the birds. [MBHP/NWR]

iv. Design an "Oceans of Wings" poster that celebrates seabirds world-wide. [MBHP]

**Objective 11. b.** Increase the number and diversity of people reached by providing information about seabirds at visitor centers and public areas such as harbors, marinas, and piers. [NWR/AES/MBHP; ongoing]

## Planning and Coordination

Seabirds are a shared resource. They cross international, state, Tribal, and agency responsibility boundaries. Careful planning and coordination are fundamental to successful conservation and management of seabirds throughout their life cycle.

**Goal 12. Coordination with Partners -** Coordinate with other countries, U.S. Territorial and Commonwealth governments, Tribes, federal and state agencies, conservation and industry groups, and the public on the conservation and management of seabirds, at the international, national, regional, and local scales. Emphasis on ESA and BCC listed Species and shared seabird resources.

**Objective 12. a.** Develop and implement seabird components of regional waterbird plans under the North American Waterbird Conservation Plan.

i. Foster the development of an international working group for the California Current System, to coordinate the development and implementation of regional waterbird and seabird plans. [MBHP/NWR/AES]

ii. Coordinate with partners in Hawai`i and the Pacific Islands to develop and implement a seabird component for the Regional Waterbird Plan for BCRs 67 and 68. [MBHP/NWR/AES]

**Objective 12. b.** Develop, Review and Revise Recovery Plans for ESA listed species as needed.

i. Assist in the development of a Recovery Plan for Short-tailed Albatross (Region 7 lead). [AES/NWR/MBHP; ongoing]

**Objective 12. c.** Biannually update a seabird conservation Strategic Plan to focus Service efforts on priority management, monitoring and research needs. [MBHP/AES/NWR]

**Objective 12. d.** Participate in working groups, interagency teams, professional societies (*e.g.,* Pacific Seabird Group), and other venues designed to further seabird conservation in the Region.

i. Participate in the North Pacific Albatross Working Group to facilitate communication and cooperation in the conservation of Laysan, Black-footed and Short-tailed Albatross. [AES/MBHP/NWR; ongoing]

ii. Participate in the development of an Oceania Flyway Working Group and continue participation in South Pacific Regional Environment Programme (SPREP) to further conservation of seabirds in Oceania. [MBHP/AES/NWR; ongoing]

iii. Provide input to the Service representative to NAFTA Trilateral Committee for Wildlife and Ecosystem Conservation for issues involving seabirds, to further seabird conservation efforts with Mexico and Canada. [MBHP/AES/NWR; ongoing]

iv. Establish contacts with ongoing seabird conservation efforts currently underway through groups such as BirdLife International, Audubon's Living Oceans, Wetlands International, etc. [MBHP; 2005-2006]

v. Continue support for development of a Central Pacific World Heritage Site. [MBHP/NWR/AES; ongoing]

**Objective 12. e.** Improve coordination on seabird monitoring and management issues within the Service and with other agencies/landowners such as BLM, NPS, DOD, states, TNC, etc. [MBHP/NWR/AES; ongoing]

i. Improve coordination with NOAA-Fisheries on shared monitoring, management, and conservation issues.

(1) Participate in the Interagency Seabird Working Group (ISWG) to implement the National Plan of Action for the Reduction of Seabird Bycatch in Longline Fisheries (NPOA). [MBHP/NWR/AES; ongoing]

(2) Integrate Service activities with the developing NOAA-Fisheries Pacific Coast Ocean Observing System (PlCOOS) to include a monitoring program for seabirds at sea. [MBHP; 2005-2006]

(3) Technical assistance for observer programs that monitor the bycatch of seabirds in commercial fisheries. [MBHP/NWR/AES; ongoing]

ii. Improve coordination with USGS and support increased focus by this agency on key seabird issues. [MBHP/NWR/AES; ongoing]

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# Appendices

## CONTENTS

# Appendix 1. Treaties, legislation, policies, national and international initiatives, and federal jurisdictions important to seabird conservation.

The U.S. Fish and Wildlife Service (Service) has the primary responsibility for the conservation and management of migratory birds, including seabirds. Several international treaties, domestic laws and Executive Orders have been enacted that provide protection for migratory birds and the Service is largely responsible for implementing the statutes, laws and regulations, derived from these. The most important pieces of legislation are: Migratory Bird Treaty Act, Fish and Wildlife Conservation Act, Endangered Species Act, and the National Wildlife Refuge System Administration and Improvement Acts. Each of these statutes is described briefly below.

There are also regional and national policies regarding management and monitoring of seabirds and national/international agreements and initiatives that guide Service activities. These, together with the roles and responsibilities of the Service and other federal agencies, for seabird management, are summarized in this appendix.

## Treaties and Legislation

***Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. 703-718)***

The Migratory Bird Treaty Act (MBTA) decreed that all migratory birds were fully protected and, unless permitted by regulation, it was unlawful to take, capture, kill or possess any migratory bird or their parts (including eggs, nests, and feathers). This Act is the domestic law that implements four international conventions (with Canada, Mexico, Japan and Russia) for the protection of shared migratory bird resources. A full list of the species covered and the regulations derived from the Act are contained in the Code of Federal Regulations, Title 50[1] (50 C.F.R.). The consequence of this legislation is a comprehensive program for migratory bird conservation including management across international borders, maintenance of healthy migratory bird populations, conservation of habitat, and restoration of depleted populations.

***Fish and Wildlife Conservation Act of 1980, as amended (16 U.S.C. 2901-2911)***

The Fish and Wildlife Conservation Act, commonly known as the "Nongame Act", authorized federal assistance to the States for the development and implementation of conservation plans for nongame fish and wildlife, and directed Federal agencies to conserve nongame species and their habitats. A 1988 amendment directed the Service to: 1. monitor and assess migratory nongame birds (including seabirds), 2. determine the effects of environmental changes and human activities, 3. identify birds of conservation concern that were likely to be candidates for endangered species listing and actions to prevent listing, and 4. report to Congress every five years. Amended again in 1989, the Service was further directed to identify lands and waters in the Western Hemisphere where protection, management, or acquisition would foster the conservation of migratory nongame birds.

***Endangered Species Act of 1973, as amended (16 U.S.C. 1531-1544)***

The Endangered Species Act (ESA) provides for the protection of plants and animals in danger of extinction throughout all or a significant portion of their range and the conservation of ecosystems upon which they depend. The ESA implements the United States' commitment to several international treaties and conventions including: Migratory Bird Treaty; Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES); Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere; and the International Convention for the High Seas Fisheries of the North Pacific Ocean. Five seabirds that breed in this Region are listed under the ESA (Hawaiian Petrel, Newell's Shearwater, California Brown Pelican, California Least Tern and Marbled Murrelet). A sixth species (Short-tailed Albatross), has not successfully bred in the U.S., but regularly visits the Hawaiian Islands and has attempted to breed (laid eggs) several times over the past 30 years at Midway Atoll.

***National Wildlife Refuge System Administration Act of 1966, as amended (16 U.S.C. 668-668) and National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57).***

The Administration Act established the National Wildlife Refuge (NWR) System and together with the National Wildlife Refuge System Improvement Act of 1997, ensures that the National Wildlife Refuges are managed as a national system of lands and waters for the protection and conservation of national wildlife resources. The main components of the two Acts are a strong conservation mission statement for the NWR System; a requirement to maintain the biological integrity, diversity, and environmental health of the system; a process for determining compatible uses; recognition of the priority wildlife dependant recreational activities on refuges; and, comprehensive conservation planning requirements. Inventory and monitoring of the status and trends of wildlife populations is required on all refuges.

***Other Acts, Treaties and Legislation***

Several other Treaties, Conventions, Acts, Laws and Regulations have bearing on the conservation and management of seabirds, however, we will not discuss them in detail here. The Fish and Wildlife Act of 1956, as amended, established the Fish and Wildlife Service within the Department of the Interior and provides broad authority for the management, conservation, and protection of fish and wildlife resources. Other more narrowly focused laws include those governing oil spill response and damage assessment (e.g.,Oil Pollution Act) and other maritime contaminant issues (e.g.,Federal Water Pollution Control Act); regulation of commercial and sport fisheries (e.g., Magnuson-Stevens Fisheries Conservation and Management Act) including a moratorium of specific fisheries such as the high seas driftnet fisheries that was abolished, in part, due to significant incidental mortality of seabirds (High Seas Driftnet Fishing Moratorium Protection Act); management of coastal habitats where some seabirds nest (e.g., Coastal Zone Management Act and Fish and Wildlife Coordination Act); and, the management of introduced plants that degrade nesting habitat (e.g., Federal Noxious Weed Act). A more complete listing and summary of resource laws of interest to the Service can be found at http://laws.fws.gov/lawsdigest/indx.html and those more specific to migratory birds are summarized at http://migratorybirds.fws.gov/intrnltr/treatlaw.html.

## Service Policy

***Regional Marine Bird Policy***

In 1985, the Service's Region One enacted a policy that recognized the international importance of this Region to the maintenance of healthy seabird populations in the Pacific Basin. The policy stated that the Service would implement to the fullest extent possible the Migratory Bird Treaty provisions that dealt specifically with marine birds: prohibiting take of birds and eggs, establishing sanctuaries, taking actions to preserve and enhance the environment for birds, exchanging research data, and providing special protection to species and subspecies in need. The policy included directives to: 1. Utilize all available programs and divisions of the Service to maintain seabird populations, both on and off National Wildlife Refuge lands and waters, at or above current population levels, in their natural diversity and on native habitat throughout their range; 2. Work towards the establishment and active protection of colonies, roosts, loafing sites and adjacent waters as marine bird sanctuaries by private, local, state, or federal interests; 3. Encourage formulation of comprehensive land management plans, effective regulation of offshore oil and mineral development, and stringent tanker safety laws - to provide adequate protection for marine birds and their habitats; 4. Encourage appropriate research and surveys of marine birds and their ecosystems, especially long-term monitoring of populations and habitats and identification of species nearing threatened status; and, 5. Remove all introduced predators from marine bird colonies on all National Wildlife Refuges and encourage their removal from all other colonies.

***Waterbird Bycatch Policy***

In 2001, the Service established a national policy regarding bycatch of birds in fisheries operations. Substantial numbers of waterbirds (especially seabirds, but also waterfowl, shorebirds, and other related wading species) are killed annually in fisheries, making waterbird bycatch a serious conservation issue and a violation of the underlying tenets of the MBTA. The goal of the Service is the elimination of waterbird bycatch in fisheries. The Service will actively expand partnerships with Regional, national, and international organizations, States, tribes, industry, and environmental groups to meet this goal. The Service, in cooperation with interested parties, will aggressively promote public awareness of waterbird bycatch issues, and gather the scientific information to develop and provide guidelines for management, regulation, and compliance. The Service is drafting an Action Plan to implement this Policy.

## National and International Agreements and Initiatives

***International Plan of Action for the Reduction of Seabird Bycatch in Longline Fisheries (IPOA)***
***National Plan of Action for the Reduction of Seabird Bycatch in Longline Fisheries (NPOA)***

In 1999, the Food and Agriculture Organization (FAO) of the United Nations, adopted the IPOA to address concerns over the significant mortality of seabirds worldwide in connection with longline fisheries. This was in compliance with the Code of Conduct for Responsible Fisheries. The objective of the IPOA was to reduce the incidental catch of seabirds in longline fisheries. Each nation was to assess their own fisheries and those that determined they had a problem were to develop National Plans of Action. This plan would assess the magnitude of the problem, develop a prescription of mitigative measures, outline needed research and development, and direct education and outreach to address the problem. The Service and Department of State (DOS) worked with the NOAA- Fisheries to draft an NPOA for U.S. longline fisheries in 2001. An Interagency Seabird Working Group (ISWG), with representatives from NOAA-Fisheries, the Service, DOS, and the Fisheries Councils, was formed to guide implementation of the NPOA.

***Waterbirds for the Americas Initiative and the North American Waterbird Conservation Plan***
The Waterbird Conservation for the Americas Initiative (Waterbird Initiative), launched in 1998, is an international, broad-based, voluntary partnership dedicated to waterbird conservation, that complements the initiatives existing for other bird groups, specifically the North American Waterfowl Management Plan, Partners in Flight, and the national Shorebird Plans, all of which come together in the North American Bird Conservation Initiative (NABCI). *Waterbird Conservation for the Americas: North American Waterbird Conservation Plan* is one product of the Waterbird Initiative. The plan provides a broad scale framework for the conservation and management of 210 species of waterbirds, including seabirds, coastal waterbirds, wading birds, and marshbirds utilizing aquatic habitats throughout North America, Central America, the islands and pelagic waters of the Caribbean and western Atlantic, and the US Pacific Islands and pelagic north Pacific. Regional plans for seabirds of the California Current System and the tropical Pacific regions will soon be developed. The Service is involved in these planning processes and this Plan will provide much of the groundwork for the regional waterbird plans.

## Roles and Responsibilities

***U.S. Fish and Wildlife Service***
The Service is the principal federal agency, in the United States, responsible for the protection and management of migratory birds, as described above. Within the Service, the different divisions have defined, but often overlapping responsibilities concerning the conservation of seabirds.

The Division of Migratory Bird Management has the lead in implementing the Service's responsibilities with regards to migratory birds. This is most often accomplished in conjunction with national and international partners. The Division is entrusted to monitor and manage for healthy migratory bird populations and to ensure that these populations do not become threatened or endangered. Within the Service, the Division of Migratory Birds takes a broad scale approach to migratory bird conservation, managing bird populations throughout their range. Permits to allow the take and/or possession of migratory birds are administered out of this office. This Division has a small staff located in the Regional Office.

Ecological Services includes several key components: Endangered Species, Environmental Contaminants, and Habitat Conservation. Endangered Species has primary responsibility for those species listed under the ESA. Once a seabird is listed as threatened or endangered responsibility passes from the Division of Migratory Birds to Endangered Species. Currently there are six listed species in the Region. Responsibility for candidate species, species that have been petitioned for listing, and Birds of Conservation Concern (BCC) is shared by the two divisions and efforts are directed at alleviating threats and restoring populations, so that the species will not be listed. Endangered Species staff consult with other agencies on projects that might affect listed species and administer the permitting of endangered species take. Environmental Contaminants encompasses the Service's Damage Assessment and Spill Response Division. They are the primary Service contact in the event of oil or other hazardous substance spills and typically will represent the Service in the Incident Command System during a spill response. They also carry out contaminants investigations to identify and resolve or prevent contaminant impacts to seabirds and other wildlife. The Habitat and Conservation Branch includes the Coastal Program, Habitat Conservation, and Partnerships programs. Most personnel are located in the state Field Offices and local issues are usually handled at this level.

In addition to these broad responsibilities for seabirds throughout their respective ranges, the Service also has site specific management responsibilities associated with the National Wildlife Refuge (NWR) System. The largest seabird colonies in the Pacific are located on NWRs and numerically, over 80% of the Region's seabirds nest on Refuge lands. The NWRs have responsibility to inventory and monitor seabird populations on their lands and to maintain and restore where appropriate, the biological integrity, diversity, and environmental health of the Refuges.

***Other Federal Agencies***

Several other federal agencies have land management responsibilities for seabird colony sites. Bureau of Land Management (BLM) administers the California Coastal National Monument (CCNM) that encompasses most of the islands and rocks off the California coast, not including the large islands in the California Bight (Channel Islands) or the National Wildlife Refuge Islands at Castle Rock and the Farallon Islands. The CCNM colonies are managed by BLM, in partnership with California Department of Fish and Game and California State Parks.

The National Park Service (NPS) manages three important islands in the northern Channel Islands of California: San Miguel, Santa Cruz (western portion), Santa Rosa, Anacapa, and Santa Barbara islands. These islands support important Ashy Storm-Petrel, Brown Pelican, and Xantus's Murrelet colonies. NPS also manages important seabird colonies at Pt. Reyes National Seashore and Golden Gate National Recreation Area. In the tropical Pacific Islands, the NWRs support the highest number and diversity of nesting seabirds, but National Parks are especially important for species nesting on the high volcanic islands such as Hawaiian Petrels, Newell's Shearwaters and possibly Band-rumped Storm-Petrels at Volcano NP, Hawaii and Haleakala NP, Maui. On American Samoa, National Parks on Tutuila and Ta'u provide habitat for Audubon's Shearwaters, Tahiti and Herald Petrels. Many of these high islands have suffered extensive habitat loss and are infested with introduced species. These National Parks often provide important habitat for seabird species that are listed under ESA.

Historically the Department of Defense (DOD) owned, leased or managed entire islands that support important seabird colonies. Many military islands have been closed over the past three decades and management has reverted to the Service or in some cases to the state (*e.g.*, Midway Naval Air Station and French Frigate Shoals Coast Guard Loran Station reverted to USFWS and Kure Atoll Coast Guard Loran Station reverted to the state of Hawaii). Other islands (*e.g.*, Wake Atoll, in the central Pacific, and San Clemente and San Nicolas islands, CA) have remained under DOD jurisdiction. Many of these islands have significant seabird resources. Other military bases, located along the mainland coast or on portions of large islands, provide important seabird habitat (*e.g.*, Marine Corps Base Hawaii (Kaneohe Bay) and Naval Base Coronado, CA). The missions and goals of these military installations are often at odds with seabird conservation but in many cases DOD provides considerable protection and management directed towards conservation and restoration of seabird populations.

National Oceanic and Atmospheric Administration (NOAA) Fisheries (i.e. National Marine Fisheries Service) and respective state, commonwealth, and territorial agencies, manage the fishery resources that piscivorous seabirds eat and marine habitats where they forage. In 2001, NOAA Fisheries staffed a position for a national seabird coordinator as well as identifying staff in each of its regions, science centers, and headquarter offices to address issues associated with seabird/fishery issues. These staff work in collaboration with regional representatives from the Service and the Department of State as part of an Interagency Seabird Working Group. NOAA's National Ocean Service addresses important responsibilities in conjunction with oil spill response through its Office of Response and Restoration (OR&R). OR&R is the focal point in NOAA for preventing, planning for, and responding to oil spills, releases of hazardous substances, and hazardous waste sites in coastal environments and restoring affected resources. OR&R protects and restores coastal resources through the application of science and technology. On behalf of the public, OR&R addresses environmental threats from catastrophic emergencies, to chronic releases, to vessel groundings in sanctuaries.
The National Marine Sanctuary System is also a program of the National Ocean Service. National Marine Sanctuaries play an important role in the conservation of seabird resources.

1 Some of the seabirds that breed in the USPI (*e.g.*, Tahiti Petrel and Polynesian Storm-Petrel) are not listed in the 50 CFR but the family is included in the Mexican or Canadian conventions. Addition of these species is currently under review by the U.S. Solicitors office.

# Appendix 2. List of U.S. Pacific Islands, USFWS Pacific Region

| Island Name | Type | Archipelago | Group | Political Status | Administration | Special Status |
|---|---|---|---|---|---|---|
| **Hawai`i** | | Hawai`i | | State of Hawai`i | State of Hawai`i | |
| Hawai`i | Basalt Island | Hawai`i | main Hawaiian Islands | State of Hawai`i | State of Hawai`i | |
| Maui | Basalt Island | Hawai`i | main Hawaiian Islands | State of Hawai`i | State of Hawai`i | |
| Kaho`olawe | Basalt Island | Hawai`i | main Hawaiian Islands | State of Hawai`i | Kaho`olawe Commission | former military bomb range |
| Lana`i | Basalt Island | Hawai`i | main Hawaiian Islands | State of Hawai`i | State of Hawai`i | |
| Moloka`i | Basalt Island | Hawai`i | main Hawaiian Islands | State of Hawai`i | State of Hawai`i | |
| O`ahu | Basalt Island | Hawai`i | main Hawaiian Islands | State of Hawai`i | State of Hawai`i | |
| Kaua`i | Basalt Island | Hawai`i | main Hawaiian Islands | State of Hawai`i | State of Hawai`i | |
| Kaula | Basalt Island | Hawai`i | main Hawaiian Islands | State of Hawai`i | State of Hawai`i | State Seabird Sanctuary former military bomb range |
| Ni`ihau | Basalt Island | Hawai`i | main Hawaiian Islands | State of Hawai`i | State of Hawai`i; privately owned | |
| Nihoa | Basalt Island | Hawai`i | leeward/northwestern Hawaiian Islands | State of Hawai`i | USFWS | National Wildlife Refuge |
| Necker | Basalt Island | Hawai`i | leeward/northwestern Hawaiian Islands | State of Hawai`i | USFWS | National Wildlife Refuge |
| French Frigate Shoals *comprised of 10-12 sandy islets & 1 basalt pinnacle* | Atoll+Pinnacle | Hawai`i | leeward/northwestern Hawaiian Islands | State of Hawai`i | USFWS | National Wildlife Refuge; former |
| Gardner Pinnacles | Basalt Island | Hawai`i | leeward/northwestern Hawaiian Islands | State of Hawai`i | USFWS | National Wildlife Refuge |
| Maro Reef | Atoll-like reef | Hawai`i | leeward/northwestern Hawaiian Islands | State of Hawai`i | USFWS | National Wildlife Refuge |
| Laysan | Coral Island | Hawai`i | leeward/northwestern Hawaiian Islands | State of Hawai`i | USFWS | National Wildlife Refuge |
| Lisianski & Neva Shoal | Coral Island & atoll-like reef | Hawai`i | leeward/northwestern Hawaiian Islands | State of Hawai`i | USFWS | National Wildlife Refuge |
| Pearl and Hermes Reef *comprised of 7 islets* | Atoll | Hawai`i | leeward/northwestern Hawaiian Islands | State of Hawai`i | USFWS | National Wildlife Refuge |
| Kure *comprised of 4 islets* | Atoll | Hawai`i | leeward/northwestern Hawaiian Islands | State of Hawai`i | State of Hawai`i | State Seabird Sanctuary; former Coast Guard station |

## Appendix 2. List of U.S. Pacific Islands, USFWS Pacific Region (continued).

| Island Name | Type | Archipelago | Group | Political Status | Administration | Special Status |
|---|---|---|---|---|---|---|
| **Midway Atoll** *comprised of 4 islets* | Atoll | Hawai`i | leeward/northwestern Hawaiian Islands | unincorporated unorganized insular area | USFWS | National Wildlife Refuge; former Naval Air Station |
| **Johnston Island** *comprised of 4 islets* | Atoll | | | unincorporated unorganized territory | jointly administered: USFWS & Defense Threat Reduction Agency | National Wildlife Refuge; military base |
| **Wake Island** *comprised of 3 islets* | Atoll | Marshall | | unincorporated territory | Air Force/ Department of Interior | Air Force Base |
| **Palmyra** *comprised of 50+ islets* | Atoll | Line | | incorporated territory | USFWS & The Nature Conservancy | National Wildlife Refuge; TNC Reserve |
| **Kingman Reef** | Atoll-like reef | Line | | | USFWS | National Wildlife Refuge |
| **Jarvis Island** | Coral Island | Line | | possession | USFWS | National Wildlife Refuge |
| **Baker Island** | Coral Island | Phoenix | | possession | USFWS | National Wildlife Refuge |
| **Howland Island** | Coral Island | Phoenix | | possession | USFWS | National Wildlife Refuge |
| **American Samoa** | | Samoa | | unincorporated unorganized territory | American Samoa Government | |
| Tutuila | Basalt Island | Samoa | | | American Samoa Government | |
| Aunu`u | Basalt Island | Samoa | | | American Samoa Government | |
| Ta`u | Basalt Island | Samoa | Manua Islands | | American Samoa Government | |
| Ofu | Basalt Island | Samoa | Manua Islands | | American Samoa Government | |
| Olosega | Basalt Island | Samoa | Manua Islands | | American Samoa Government | |
| Swains (*To`elau Lata Mai*)* | Coral Island | Tokelau | | | American Samoa Government | |
| Rose (*Nu`u Manu*)* | Atoll | Samoan | | | USFWS | National Wildlife Refuge |

** Samoan names for Swains Island and Rose Atoll*

## Appendix 2. List of U.S. Pacific Islands, USFWS Pacific Region (continued).

| Island Name | Type | Archipelago | Group | Political Status | Administration | Special Status |
|---|---|---|---|---|---|---|
| **Commonwealth Northern Mariana Islands** (CNMI) | | Mariana | | commonwealth in political union with United States | CNMI Government | |
| Farallon de Pajaros | Basalt Island | Mariana | | | CNMI Government | |
| Maug *comprised of 3 islands* | Basalt Island | Mariana | | | CNMI Government | seabird sanctuary |
| Ascuncion | Basalt Island | Mariana | | | CNMI Government | |
| Agrihan | Basalt Island | Mariana | | | CNMI Government | |
| Pagan | Basalt Island | Mariana | | | CNMI Government | |
| Alamagan | Basalt Island | Mariana | | | CNMI Government | |
| Guguan | Basalt Island | Mariana | | | CNMI Government | |
| Sarigan | Basalt Island | Mariana | | | CNMI Government | |
| Anatahan | Basalt Island | Mariana | | | CNMI Government | |
| Farallon de Medinilla | Limestone Island | Mariana | | | CNMI Government | military bomb range |
| Saipan | Limestone/ Basalt Islands | Mariana | | | CNMI Government | |
| Tinian | Limestone Island | Mariana | | | CNMI Government | |
| Aguijan | Limestone Island | Mariana | | | CNMI Government | |
| Rota | Limestone/ Basalt Islands | Mariana | | | CNMI Government | |
| **Guam** | Limestone/ Basalt Islands | Mariana | unincorporated | organized territory | Guam Government | |
| Cocos | Coral Island | Mariana | Guam | | Guam Government | |

# Appendix 3. National and International Significance of Breeding Seabird Populations in USFWS Pacific Region.

| | Significance of Region 1 Populations | | | | | Official Status | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | global[1] | US[2] | signifi-cant | manage-able | periph-eral | ESA[3] | IUCN[4] | BCC[5]-Nat. | BCC[5]-Reg. | BCC[5]-BCR | |
| Order PROCELLARIIFORMES | | | | | | | | | | | |
| Family DIOMEDEIDAE | | | | | | | | | | | |
| Short-tailed Albatross | | x | | | x | E | VU | | | | |
| Black-footed Albatross | x | | | | | | VU | x | x | 5,32,67,68 | >95% of the global population breed in HI |
| Laysan Albatross | x | | | | | | | | | 5,67,68 | >95% of the global population breed in HI |
| Family PROCELLARIIDAE | | | | | | | | | | | |
| Hawaiian Petrel | x | | | | | E | VU | | | | endemic to Hawaii |
| Herald Petrel | | x | | | | | | | | 68 | |
| Tahiti Petrel | | x | | | | | NT | | x | 68 | |
| Bonin Petrel | x | | | | | | | | | | Global populations poorly known but it is likely that US supports ≥50% |
| Phoenix Petrel | | | | | | | VU | x | x | 68 | Does not currently breed in US, but colonies in the Phoenix & Line groups are near US islands |
| Bulwer's Petrel | x | | | | | | | | | | largest colony in the Pacific on Nihoa, HI |
| Wedge-tailed Shearwater | | x | | | | | | | | | |
| Christmas Shearwater | | x | | | | | | | | 67,68 | |
| Newell's Shearwater | x | | | | | T | VU | | | | *P.a.newelli* endemic to Hawaii |
| Audubon's Shearwater | | | | x | | | | | | | |
| Family HYDROBATIDAE | | | | | | | | | | | |
| Fork-tailed Storm-Petrel | | | | x | | | | | | | |
| Leach's Storm-Petrel | | | | x | | | | | | | |
| Ashy Storm-Petrel | x | | | | | | NT | x | x | 32 | majority of the global population breed in CA |
| Band-rumped Storm-Petrel | | x | | | | C | | x | x | 67 | |
| Black Storm-Petrel | | x | | | | | | | | | |
| Tristram's Storm-Petrel | | x | | | | | NT | | x | 67 | Global populations poorly known but it is possible that US supports ≥50% |

## Appendix 3. National and International Significance of Breeding Seabird Populations in USFWS Pacific Region (continued).

| | Significance of Region 1 Populations | | | | | Official Status | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | global[1] | US[2] | signifi-cant | manage-able | periph-eral | ESA[3] | IUCN[4] | BCC[5]-Nat. | BCC[5]-Reg. | BCC[5]-BCR | |
| Polynesian Storm-Petrel | | x | | | | | VU | | x | 68 | |
| Order PELECANIFORMES | | | | | | | | | | | |
| Family PHAETHONTIDAE | | | | | | | | | | | |
| White-tailed Tropicbird | | | x | | | | | | | | large populations on main islands of HI & Samoa |
| Red-tailed Tropicbird | | x | | | | | | | | | |
| Family SULIDAE | | | | | | | | | | | |
| Masked Booby | | | x | | | | | | | | |
| Brown Booby | | | x | | | | | | | | |
| Red-footed Booby | | | x | | | | | | | | |
| Family PELECANIDAE | | | | | | | | | | | |
| Brown Pelican | | | x | | | E | | | | | total US population of western subspp in R1 |
| Family PHALACROCORACIDAE | | | | | | | | | | | |
| Double-crested Cormorant | | | x | | | | | | | | majority of western subspecies in R1 |
| Brandt's Cormorant | x | | | | | | | | | | 75% of global population in R1 |
| Pelagic Cormorant | | | x | | | | | | | | significant % of southern subspecies in R1 |
| Family FREGATIDAE | | | | | | | | | | | |
| Great Frigatebird | | x | | | | | | | | | |
| Lesser Frigatebird | | x | | | | | | | | 68 | |
| Order CHARADRIIFORMES | | | | | | | | | | | |
| Family LARIDAE | | | | | | | | | | | |
| Ring-billed Gull | | | | x | | | | | | | |
| California Gull | | | | x | | | | | | | large colonies in CA; important wintering population |
| Western Gull | x | | | | | | | | | | estimate 55-85% of global population in R1 |

## Appendix 3. National and International Significance of Breeding Seabird Populations in USFWS Pacific Region (continued).

| | Significance of Region 1 Populations | | | | | Official Status | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | global[1] | US[2] | signifi-cant | manage-able | periph-eral | ESA[3] | IUCN[4] | BCC[5]-Nat. | BCC[5]-Reg. | BCC[5]-BCR | |
| Glaucous-winged Gull | | | | x | | | | | | | |
| Heermann's Gull | | | | | x | | NT | | | | peripheral breeder; important wintering population |
| Gull-billed Tern | | | x | | | | | x | x | 32 | total US population of western subspp in R1 |
| Caspian Tern | | | x | | | | | | | 5 | hemispherically important numbers |
| Royal Tern | | | | x | | | | | | | |
| Elegant Tern | | x | | | | | NT | | x | 32 | 10% of the global population in R1 |
| Arctic Tern | | | | | x | | | | | 5 | BCC in BCR 5 but peripheral in R1 |
| Forster's Tern | | | | x | | | | | | | |
| Little Tern | | x | | | x | | | | | | range expansion (Clapp et al. 1993) |
| Least Tern | | | x | | | E | | | | | total US population of western subspp in R1 |
| Gray-backed Tern | x | | | | | | | | | | >65% of the global population may breed in R1 |
| Bridled Tern | | | | | x | | | | | | range expansion to Samoa |
| Sooty Tern | | | x | | | | | | | | globally important colonies |
| Brown Noddy | | | x | | | | | | | | estimate 10-25% of global population in R1 |
| Black Noddy | | x | | | | | | | | | *A.m. melanogenys* endemic to Hawaii |
| Blue-gray Noddy | | x | | | | | | | x | 67,68 | |
| White Tern | | x | | | | | | | | | |
| Black Skimmer | | | | x | | | | x | x | 32 | |
| Family ALCIDAE | | | | | | | | | | | |
| Common Murre | | | x | | | | | | | | >98% *U.a. californica* breed in R1 |
| Pigeon Guillemot | | | x | | | | | | | | distinct subspecies in OR & CA |
| Marbled Murrelet | | | x | | | T | VU | | | | ESA listed in CA, OR, and WA |

## Appendix 3. National and International Significance of Breeding Seabird Populations in USFWS Pacific Region (continued).

| | Significance of Region 1 Populations | | | | | Official Status | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | global[1] | US[2] | signifi-cant | manage-able | periph-eral | ESA[3] | IUCN[4] | BCC[5]-Nat. | BCC[5]-Reg. | BCC[5]-BCR | |
| Xantus's Murrelet | | x | | | | P | VU | x | x | 32 | estimate 30-35% of global population in R1 |
| Ancient Murrelet | | | | | x | | | | | | peripheral breeder; important wintering population |
| Cassin's Auklet | | | | x | | | | | | 32 | |
| Rhinoceros Auklet | | | x | | | | | | | | 2 of the 8 largest colonies located at Protection and Destruction islands, WA |
| Tufted Puffin | | | | x | | | | | | | |

[1] >50% of the global population breed in Region 1 (R1).

[2] Entire US population breeds in Region 1.

[3] Endangered Species Act Listing status: E-endangered; T-threatened; C-candidate; P-petitioned

[4] IUCN rankings: 3 categories for threatened species: CR-critically endangered; EN-endangered; VU-Vulnerable; 3 categories for species at lower risk: CD-conservation dependant; NT-near threatened; LC-least concern.

[5] BCC = Birds of Conservation Concern (USFWS 2002); Indicates a species listed at the national, regional, or BCR level (including a list of the BCRs.)
BCR = Bird Conservation Region.

## Appendix 4. Subspecies of seabirds breeding in USFWS Pacific Region.

| Scientific Name | Common Name | WA | OR | CA | HI | USPI | # Sub species | Subspecies that breed in Region 1 - Range (From Clements 2000) |
|---|---|---|---|---|---|---|---|---|
| Order PROCELLARIIFORMES | | | | | | | | |
| Family DIOMEDEIDAE | | | | | | | | |
| *Phoebastria albatrus* | Short-tailed Albatross | | | | b | | 0 | |
| *Phoebastria nigripes* | Black-footed Albatross | | | | B | | 0 | |
| *Phoebastria immutabilis* | Laysan Albatross | | | | B | | 0 | |
| Family PROCELLARIIDAE | | | | | | | | |
| *Pterodroma sandwichensis* | Hawaiian Petrel | | | | B | | 0 | |
| *Pterodroma arminjoniana* | Herald Petrel | | | | | B | 2 | *P.a. heraldica* - Raine I., Tonga & French Polynesia to Easter I. |
| *Pterodroma rostrata* | Tahiti Petrel | | | | | B | 3 | *P.r. rostrata* - Marquesas & Society; confined to tropical Pacific |
| *Pterodroma hypoleuca* | Bonin Petrel | | | | B | | 0 | |
| *Pterodroma alba* | Phoenix Petrel | | | | | Ex | 0 | possibly occurred historically on U.S. Line & Phoenix islands |
| *Bulweria bulwerii* | Bulwer's Petrel | | | | B | | 0 | |
| *Puffinus pacificus* | Wedge-tailed Shearwater | | | | B | B | 0 | |
| *Puffinus nativitatis* | Christmas Shearwater | | | | B | B | 0 | |
| *Puffinus auricularis newelli* | Newell's Shearwater | | | | B | | 2 | *P.a. newelli* - Hawaii endemic |
| *Puffinus lherminieri* | Audubon's Shearwater | | | | | B | 9 | *P.l. dichrous* - islands throughout cent Pacific, Samoa to Marquesas |
| Family HYDROBATIDAE | | | | | | | | |
| *Oceanodroma furcata* | Fork-tailed Storm-Petrel | B | B | B | | | 2 | *O.f. plumbea* - islands off s AK to n CA |
| *Oceanodroma leucorhoa* | Leach's Storm-Petrel | B | B | B | | | 5 | *O.l. leucorhoa* - n Atlantic; Japan to Aleutians & islands off n MX |
| *Oceanodroma homochroa* | Ashy Storm-Petrel | | | B | | | 0 | |
| *Oceanodroma castro* | Band-rumped Storm-Petrel | | | | B | | 0 | |
| *Oceanodroma melania* | Black Storm-Petrel | | | B | | | 0 | |
| *Oceanodroma tristrami* | Tristram's Storm-Petrel | | | | B | | 0 | |
| *Nesofregetta fuliginosa* | Polynesian Storm-Petrel | | | | | B | 0 | |

## Appendix 4. Subspecies of seabirds breeding in USFWS Pacific Region (continued).

| Scientific Name | Common Name | WA | OR | CA | HI | USPI | # Sub species | Subspecies that breed in Region 1 - Range (From Clements 2000) |
|---|---|---|---|---|---|---|---|---|
| Order PELECANIFORMES | | | | | | | | |
| Family PHAETHONTIDAE | | | | | | | | |
| *Phaethon lepturus* | White-tailed Tropicbird | | | | B | B | 6 | *P.l. dorothea* - islands in tropical w Pacific (HI to New Caladonia) |
| *Phaethon rubricauda* | Red-tailed Tropicbird | | | | B | B | 3 | *P.r. melanorhynchos* - tropical Pacific |
| Family SULIDAE | | | | | | | | |
| *Sula dactylatra* | Masked Booby | | | | B | B | 5 | *S.d. personata* - islands in cent & w Pacific to islands off w Australia |
| *Sula leucogaster* | Brown Booby | | | | B | B | 4 | *S.l. plotus* - cent Pacific to Indian O and Red Sea |
| *Sula sula* | Red-footed Booby | | | | B | B | 3 | *S.s. rubripes* - islands in tropical Pacific & Indian O |
| Family PELECANIDAE | | | | | | | | |
| *Pelecanus occidentalis* | Brown Pelican | | | B | | | 5 | *P.o. californicus* - CA and islands off Baja & in Gulf of CA, MX |
| Family PHALACROCORACIDAE | | | | | | | | |
| *Phalacrocorax auritus* | Double-crested Cormorant | B | B | B | | | 4 | *P.a. albociliatus* - sw BC to Gulf of CA |
| *Phalacrocorax penicillatus* | Brandt's Cormorant | B | B | B | | | 0 | |
| *Phalacrocorax pelagicus* | Pelagic Cormorant | B | B | B | | | 2 | *P.p. resplendens* - sw BC to s Baja |
| Family FREGATIDAE | | | | | | | | |
| *Fregata minor* | Great Frigatebird | | | | B | B | 5 | *F.m. palmerstoni* - islands in w and cent Pacific |
| *Fregata ariel* | Lesser Frigatebird | | | | | B | 3 | *F.a. ariel* - islands in Indian O & Pacific |

## Appendix 4. Subspecies of seabirds breeding in USFWS Pacific Region (continued).

| Scientific Name | Common Name | WA | OR | CA | HI | USPI | # Sub species | Subspecies that breed in Region 1 - Range (From Clements 2000) |
|---|---|---|---|---|---|---|---|---|
| Order CHARADRIIFORMES | | | | | | | | |
| Family LARIDAE | | | | | | | | |
| *Larus delawarensis* | Ring-billed Gull | B | B | | | | 0 | |
| *Larus californicus* | California Gull | | | B | | | 2 | *L.c. californicus* - e WA to WY and CA. |
| *Larus occidentalis* | Western Gull | B | B | B | | | 2 | *L.o. occidentalis* - BC to Monterey; *L.o. wymani* - Monterey to Baja |
| *Larus glaucescens* | Glaucous-winged Gull | B | B | | | | 0 | |
| *Larus heermanni* | Heermann's Gull | | | B | | | 0 | |
| *Sterna nilotica* | Gull-billed Tern | | | B | | | 6 | *S.n. vanrossemi* - So CA to n Baja and nw MX |
| *Sterna caspia* | Caspian Tern | B | B | B | | | 0 | |
| *Sterna maxima* | Royal Tern | | | B | | | 2 | *S.m. maxima* - coastal US to w Indies, Guianas, Brazil |
| *Sterna elegans* | Elegant Tern | | | B | | | 0 | |
| *Sterna paradisaea* | Arctic Tern | B | | | | | 0 | |
| *Sterna forsteri* | Forster's Tern | | | B | | | 0 | |
| *Sterna albifrons* | Little Tern | | | | B | B | 6 | *S.a. sinensis* - w Pacific; recent expansion to CNMI & HI |
| *Sterna antillarum browni* | California Least Tern | | | B | | | 3 | *S.a. browni* - So CA to Baja & w MX |
| *Sterna lunata* | Gray-backed Tern | | | | B | B | 0 | |
| Sterna anaethetus | Bridled Tern | | | | | B? | 6 | *S.a. anaethetus* - Ryukyu Is, Taiwan, Philipines, Indonesia & Australia. Recent expansion to Samoa |
| *Sterna fuscata* | Sooty Tern | | | | B | B | 8 | *S.f. oahuensis* - Bonin Is to HI & s Pacific |
| *Anous stolidus* | Brown Noddy | | | | B | B | 5 | *A.s. pileatus* - Seychelles & Madagascar to Australia, Polynesia & HI. |
| *Anous minutus* | Black Noddy | | | | B | B | 7 | *A.m. melanogenys* - Hawaii; *A.m. marcusi* - Wake & CNMI?; *A.m. minutus* - Samoa, Line & Phoenix |

## Appendix 4. Subspecies of seabirds breeding in USFWS Pacific Region (continued).

| Scientific Name | Common Name | WA | OR | CA | HI | USPI | # Sub species | Subspecies that breed in Region 1 - Range (From Clements 2000) |
|---|---|---|---|---|---|---|---|---|
| *Procelsterna cerulea* | Blue-gray Noddy | | | | B | B | 5 | *P.c. saxatilis* - Marcus I. & n Marshalls to nw HI |
| *Gygis alba* | White Tern | | | | B | B | 4 | *G.a. alba* - Caroline I. To HI, Clipperton, Cocos & s Atlantic islands |
| *Rynchops niger* | Black Skimmer | | | B | | | 3 | *R.n. niger* - coastal US and MX |
| Family ALCIDAE | | | | | | | | |
| *Uria aalge* | Common Murre | B | B | B | | | 5 | *U.a. californica* - n WA to s CA |
| *Cepphus columba* | Pigeon Guillemot | B | B | B | | | 5 | *C.c. eureka* - OR & CA;<br>*C.c. adianta* - cent Aleutians to WA |
| *Brachyramphus marmoratus* | Marbled Murrelet | B | B | B | | | 0 | |
| *Synthliboramphus hypoleucus* | Xantus' Murrelet | | | B | | | 2 | *S.h. scrippsi* - Channel I and islands off w coast of Baja |
| *Synthliboramphus antiquus* | Ancient Murrelet | B | | | | | 2 | *S.a. antiquus* - e Asia, Aleutians, s AK & BC |
| *Ptychoramphus aleuticus* | Cassin's Auklet | B | B | B | | | 2 | *P.a. aleuticus* - Aleutians & AK to n Baja |
| *Cerorhinca monocerata* | Rhinoceros Auklet | B | B | B | | | 0 | |
| *Fratercula cirrhata* | Tufted Puffin | B | B | B | | | 0 | |

B=breeding; B?=breeding suspected but not documented; b=unsuccessful breeding attempts; Ex=extirpated breeder.

## Appendix 5. List of common and scientific names.

### *Birds*

| | |
|---|---|
| Ancient Murrelet | *Synthliboramphus antiquus* |
| Arctic Tern | *Sterna paradisaea* |
| Ashy Storm-Petrel | *Oceanodroma homochroa* |
| Audubon's Shearwater | *Puffinus lherminieri* |
| Bald Eagle | *Haliaeetus leucocephalus* |
| Band-rumped Storm-Petrel | *Oceanodroma castro* |
| Barn Owl | *Tyto alba* |
| Beck's Petrel | *Pterodroma* |
| Black Skimmer | *Rhynchops niger* |
| Black Noddy | *Anous minutus* |
| Black Tern | *Chlidonias niger* |
| Black Storm-Petrel | *Oceanodroma melania* |
| Black Oystercatcher | *Haematopus bachmani* |
| Black-footed Albatross | *Phoebastria nigripes* |
| Black-legged Kittiwake | *Rissa tridactyla* |
| Black-vented Shearwater | *Puffinus opisthomelas* |
| Blue Noddy | *Procelsterna cerulea* |
| Bonaparte's Gull | *Larus philadelphia* |
| Bonin Petrel | *Pterodroma hypoleuca* |
| Brandt's Cormorant | *Phalacrocorax penicillatusg* |
| Bristle-thighed Curlew | *Numenius tahitiensis* |
| Brown Pelican | *Pelecanus occidentalis* |
| Brown Booby | *Sula leucogaster* |
| Brown Noddy | *Anous stolidus* |
| Bulwer's Petrel | *Bulweria bulwerii* |
| Burrowing Owl | *Athene cunicularia* |
| California Brown Pelican | *Pelecanus occidentalis californicus* |
| California Least Tern | *Sterna antillarum browni* |
| California Gull | *Larus californicus* |
| Caspian Tern | *Sterna caspia* |
| Cassin's Auklet | *Ptychoramphus aleuticus* |
| Cattle Egret | *Bubulcus ibis* |
| Christmas Shearwater | *Puffinus nativitatis* |
| Common Murre | *Uria aalge* |
| Craveri's Murrelet | *Synthliboramphus craveri* |
| Dark-rumped Petrel | *Pterodroma phaeopygia sandwichensis* |
| Double-crested Cormorant | *Phalacrocorax auritus* |

## Appendix 5. List of common and scientific names (continued).

| | |
|---|---|
| Elegant Tern | *Sterna elegans* |
| Fork-tailed Storm-Petrel | *Oceanodroma furcata* |
| Forster's Tern | *Sterna forsteri* |
| Galapagos Storm-Petrel | *Oceanodroma tethys* |
| Glaucous-winged Gull | *Larus hyperboreus* |
| Gray-backed Tern | *Sterna lunata* |
| Great Frigatebird | *Fregata minor* |
| Gull-billed Tern | *Sterna nilotica* |
| Hawaiian Petrel | *Pterodroma phaeopygia* |
| Heermann's Gull | *Larus heermanni* |
| Herald Petrel | *Pterodroma arminjoniana* |
| Herring Gull | *Larus argentatus* |
| Horned Puffin | *Fratercula corniculata* |
| Indian Myna | *Acridotheres tristis* |
| Juan Fernandez Petrel | *Pterodroma externa* |
| Laysan Albatross | *Phoebastria immutabilis* |
| Leach's Storm-Petrel | *Oceanodroma leucorhoa* |
| Least Tern | *Sterna antillarum* |
| Lesser Frigatebird | *Fregata ariel* |
| Little Tern | *Sterna albifrons* |
| Long-billed Murrelet | *Brachyramphus perdix* |
| Manx Shearwater | *Puffinus puffinus* |
| Marbled Murrelet | *Brachyramphus marmoratus* |
| Masked Booby | *Sula dactylatra* |
| Mew Gull | *Larus canus* |
| Newell's Shearwater | *Puffinus auricularis newelli* |
| Northern Fulmar | *Fulmarus glacialis* |
| Pelagic Cormorant | *Phalacrocorax pelagicus* |
| Peregrine Falcon | *Falco peregrinus* |
| Phoenix Petrel | *Pterodroma alba* |
| Pigeon Guillemot | *Cepphus columba* |
| Polynesian Storm-Petrel | *Nesofregetta fuliginosa* |
| Pueo (Hawaiian Owl) | *Asio flammeus sandwichensis* |
| Red-footed Booby | *Sula sula* |
| Red-tailed Tropicbird | *Phaethon rubricauda* |
| Rhinoceros Auklet | *Cerorhinca monocerata* |
| Ring-billed Gull | *Larus delawarensis* |
| Royal Tern | *Sterna maxima* |
| Ruddy Turnstone | *Arenaria interpres* |

## Appendix 5. List of common and scientific names (continued).

| | |
|---|---|
| Short-tailed Shearwater | *Puffinus tenuirostris* |
| Short-tailed Albatross | *Phoebastria albatrus* |
| Snowy Plover | *Charadrius alexandrinus* |
| Sooty Shearwater | *Puffinus griseus* |
| Sooty Tern | *Sterna fuscata* |
| Tahiti Petrel | *Pterodroma rostrata* |
| Townsend's Shearwater | *Puffinus auricularis* |
| Tristram's Storm-Petrel | *Oceanodroma tristrami* |
| Tufted Puffin | *Fratercula cirrhata* |
| Wedge-tailed Shearwater | *Puffinus pacificus* |
| Western Gull | *Larus occidentalis* |
| Western Gull-billed Tern | *Sterna nilotica vanrossemi* |
| White Tern | *Gygis alba* |
| White-tailed Tropicbird | *Phaethon lepturus* |
| Xantus's Murrelet | *Synthliboramphus hypoleucus* |

### *Mammals*

| | |
|---|---|
| Asian ship rat | *Rattus tanezumi* |
| black or ship rat | *Rattus rattus* |
| cat | *Felis catus* |
| deer mice | *Peromyscus maniculatus* |
| dog | *Canis familiaris* |
| feral goat | *Capra hircus* |
| feral pig | *Sus scrofa* |
| gray fox | *Urocyon cinereoargenteus* |
| house mouse | *Mus musculus* |
| Indian mongoose | *Herpestes auropunctatus* |
| island fox | *Urocyon littoralis* |
| Norway rat | *Rattus norvegicus* |
| Pacific or Polynesian rat | *Rattus exulans* |
| rabbit (old world) | *Oryctolagus cuniculus* |
| red fox | *Vulpes vulpes* |

### *Reptiles and Amphibians*

| | |
|---|---|
| brown tree snake | *Boiga irregularis* |
| monitor lizards | *Varanus indicus* |

### *Fish*

| | |
|---|---|
| anchovy | Engraulidae |
| baloonfish | *Lagocephalus lagocephalus* |

## Appendix 5. List of common and scientific names (continued).

| | |
|---|---|
| blacksmith | *Chromis punctipinnis* |
| California grunion | *Leuresthes tenuis* |
| California halfbeak | *Hyporhamphus rosae* |
| California killifish | *Fundulus parvipinnis* |
| chum salmon | *Oncorhynchus keta* |
| deepbody anchovy | *Anchoa compressa* |
| dolphinfish | *Coryphaena spp.* |
| flyingfish | Exocoetidae |
| goatfish | Mullidae |
| halfbeak | Hemiramphidae |
| hatchetfishes | Sternoptychidae |
| herring | Clupeidae |
| herring | *Clupea pallasi* |
| jack | *Caranx spp.* |
| jack mackerel | *Trachurus symmetricus* |
| jacksmelt | *Atherinopsis californiensis* |
| lanternfishes | Myctophidae |
| mackerel scad | *Decapterus spp.* |
| midshipman | *Poricthys spp.* |
| northern anchovy | *Engraulis mordax* |
| Pacific saury | *Cololabis saira* |
| Pacific sardine | *Sardinops sagax* |
| Pacific whiting | *Merluccius productus* |
| rockfish | *Sebastes spp.* |
| sandlance | *Ammodytes spp.* |
| saury | *Cololabis spp.* |
| shiner perch | *Cymatogaster aggregata* |
| skipjack tuna | *Katsuwonus pelamis* |
| slough anchovy | *Anchoa delicatissima* |
| spotted cusk eel | *Chilara taylori* |
| squirrelfish | Holocentridae |
| staghorn sculpin | *Leptocottus armatus* |
| surfperch | Embiotocidae |
| swordfish | Xiphiidae |
| topsmelt | *Antherinops affinis* |
| truncated sungish | *Ranzania laevis* |
| white croaker | *Genyonemus lineatus* |
| yellowfin tuna | *Thunnus albacares* |

## Appendix 5. List of common and scientific names (continued).

### *Invertebrates*

| | |
|---|---|
| flying squid | Ommastrephidae |
| gooseneck barnacles | *Lepas spp.* |
| pelagic red crab | *Pleuroncodes* |
| sea-striders | *Halobates spp.* |
| wind sailor | *Velella velella* |

### *Plants*

| | |
|---|---|
| begger's tick | *Bidens spp.* |
| bufflegrass | *Cenchrus ciliaris* |
| bunchgrass | *Eragrostis spp.* |
| coast sandalwood | *Santalum ellipticum* |
| European beachgrass | *Ammophila arenaria* |
| golden crown-beard | *Verbesina encelioides* |
| hottentot fig or ice plant | *Carpobrotus edulis* |
| ironwood | *Casuarina equisetifolia* |
| `ohia | *Metrosideros polymorpha* |
| New Zealand spinach | *Tetragonia tetragonioides* |
| pu'avai or Pisonia | *Pisonia grandis* |
| sandbur | *Cenchrus echinatus* |
| sandalwood | *Santalum spp.* |
| sea-fig or iceplant | *Carpobrotus chilensis* |
| `uluhe fern | *Dicranopteris linearis* |
| wild mustard | *Brassica campestris* |

## Appendix 6. Invasive species that affect seabirds in USFWS Pacific Region.

| Alien Species | Key Seabirds Affected | Island | Success/Failure of Control |
|---|---|---|---|
| **Rats**<br>Prey on eggs, chicks, & adults of all breeding seabirds but especially the ground nesting petrels, shearwaters, storm-petrels, terns, and alcids. Also destroy vegetation that provides seabird nesting habitat and at some locations can affect seabird predator cycles.<br>*R. rattus,*<br>*R. norviegicus,*<br>*R. exulans,*<br>*R. tanezumi* is | ashy storm-petrel & Xantus's murrelet in CA, OR, WA<br><br>Bonin petrels, Christmas shearwaters at Midway<br><br>petrels, shearwaters, storm-petrels in HI and USPI<br><br>noddies, terns, shearwaters in CNMI | Anacapa, CA<br>San Miguel, CA<br>Santa Catalina, CA<br>San Clemente, CA<br>Midway, HI<br>Howland, USPI<br>Palmyra, USPI<br>Baker, USPI<br>Kure, HI<br>Lehua, HI<br>Kaula, HI<br>Rose, Am. Samoa<br>Wake, USPI<br>Hawaii-main islands<br><br>Samoa-main island<br>Marianas-all islands<br>Guam | complete eradication<br>complete eradication<br><br><br>complete eradication<br>complete eradication<br>planning eradication<br>complete eradication<br>complete eradication<br>planning eradication<br><br>complete eradication<br>limited control<br>limited site specific control |
| **House Mouse**<br>Prey primarily on the eggs and potentially small chicks of small petrels, storm-petrels, and Xantus's murrelets. Also destroy vegetation that provides nesting habitat and at some locations can affect seabird predator cycles.<br>*Mus musculus* | Ashy Storm-Petrel | Farallon, CA | eradication planned |
| | Tristram's Storm-Petrel, Bulwer's Petrel | Lisianski, HI | complete eradication |
| | Tristram's Storm-Petrel, Bulwer's Petrel | Midway, HI | eradication planned |
| | Bulwer's Petrel | Johnston, USPI | |
| | Polynesian Storm-Petrel, Bulwer's Petrel | Baker, USPI | |

## Appendix 6. Invasive species that affect seabirds in USFWS Pacific Region (continued).

| Alien Species | Key Seabirds Affected | Island | Success/Failure of Control |
|---|---|---|---|
| **Cat** Prey on eggs, chicks, & adults of all breeding seabirds, especially the ground nesting petrels, shearwaters, storm-petrels, frigatebirds, boobies, gulls, terns, and alcids. Able to take much larger prey then rats. *Felis catus* | noddies, terns | Sarigan, CNMI | ongoing control |
| | red-footed boobies | Rota, CNMI | virtually extirpated |
| | brown noddies | Saipan, CNMI | complete eradication |
| | ground nesting seabirds | San Clemente, CA | |
| | ground nesting seabirds | San Nicolas, CA | complete eradication |
| | Cassin's auklet, Xantus's Murrelet | Santa Barbara, CA | complete eradication; recovery of Xantus's Murrelet |
| | ground nesting seabirds | Santa Catalina, CA | |
| | ground nesting seabirds | San Miguel, CA | complete eradication |
| | ground nesting seabirds | Santa Cruz, CA | complete eradication |
| | ground nesting seabirds | Anacapa, CA | complete eradication |
| | ground nesting seabirds | Jarvis Island | complete eradication; recovery of small birds; Audubon shearwater and Polynesian storm-petrel colonize. |
| | ground nesting seabirds | Baker, USPI | complete eradication |
| | ground nesting seabirds | Howland, USPI | complete eradication return of BGNO, GBTE, BRNO; shearwater colonize |
| | ground nesting seabirds | Wake, USPI | eradication in progress |
| **Dog** Prey on eggs, chicks, & adults of all breeding seabirds but especially the ground nesting albatross, boobies, terns, and gulls. *Canis familiaris* | albatross, boobies terns, petrels | Main Islands Hawaii | Limited control at specific locations |
| | | Main islands Samoa | |
| | | Guam | |
| | | CNMI | |
| **Red Fox** Prey on eggs, chicks, & adults of all breeding seabirds but especially the ground nesting cormorants, alcids, gulls and terns. *Vulpes vulpes* | Cormorants, gulls, auklets | Bandon area rocks, OR | Control planned |
| | Terns | San Francisco Bay, CA | Ongoing control |
| | Terns | San Diego Bay, CA | Ongoing control |
| | Terns | Bolsa Chica/Seal Beach, CA | Ongoing control |
| **Mongoose** *Herpestes javanicus* | Newell's shearwater, Hawaiian petrel | Main islands Hawaii except Kauai | |

## Appendix 6. Invasive species that affect seabirds in USFWS Pacific Region (continued).

| Alien Species | Key Seabirds Affected | Island | Success/Failure of Control |
|---|---|---|---|
| **Pig**<br>Prey on eggs, chicks, & adults of breeding seabirds but especially the ground nesting petrels & shearwaters. Also destroy vegetation that effects seabird nesting habitat.<br>*Sus scrofa* | ground nesting seabirds | Santa Cruz, CA | eradication planned |
| | | Santa Rosa, CA | complete eradication |
| | | Santa Barbara, CA | complete eradication |
| | | Santa Catalina, CA | |
| | | San Miguel, CA | complete eradication |
| | Newell's Shearwaters | main Hawaiian Is | controlled in specific locations |
| | ground nesting seabirds | Am. Samoa (except Rose) | |
| | ground nesting seabirds | Marianas | |
| **Common Myna**<br>Taste aversion program at Kilauea Pt. NWR<br>*Acridotheres tristis* | Black & Brown Noddies, White Tern Wedge-tailed Shearwater | Midway Atoll | |
| | | Main HI islands | Control program at Kilauea Pt., Kauai |
| **Barn Owl**<br>*Tito alba* | Shearwaters, Petrels, Storm-Petrels | Hawaiian Islands | |
| **Cattle Egret**<br>*Bubulcus ibis* | Terns and Red-footed boobies | Lehua, HI | control planned |
| | Terns | Midway, HI | eradication planned |
| | | main Hawaiian Islands | |
| **Goat**<br>judas goat program, successful<br>*Capra hircus* | general landscape effects | San Clemente I. | complete eradication |
| **Rabbits & Hares**<br>Consume vegetation that provides seabird nesting habitat. In worst case scenario will completely denude island of all vegetation. Affects all nesting seabirds but especially those that nest on or under vegetation.<br>*Oryctolagus cuniculus, Lepus europaeus* | all breeding seabirds<br>all breeding seabirds<br><br>Xantus's murrelets<br>Tufted puffin, rhinoceros auklet rhinoceros auklet | Laysan, HI | complete eradication |
| | | Lisianski, HI | complete eradication |
| | | Pearl & Hermes, HI | complete eradication |
| | | Lehua, HI | eradication planned |
| | | Santa Barbara, CA | complete eradication |
| | | Farallon, CA | complete eradication |
| | | Protection, WA | |
| **Monitor Lizard**<br>*Varanus salvator* | Red-footed booby<br>Brown noddy<br>Sooty Tern | Rota | |
| | | Saipan | |
| | | Cocos, Guam | |

## Appendix 6. Invasive species that affect seabirds in USFWS Pacific Region (continued).

| Alien Species | Key Seabirds Affected | Island | Success/Failure of Control |
|---|---|---|---|
| **Brown Tree Snake**<br>*Boiga irregularis*<br>Research underway to develop novel means of controlling or eradicating this predator. | Brown noddy<br>Wedge-tailed shearwater, brown booby | Saipan | |
| | | Guam | control program ongoing |
| **Ants**<br>Many species of ants have become established on seabird colonies but the effects on seabirds are poorly understood. Numerous species.<br>*Pheidole megacephala* | may affect seabirds, terns, shearwaters and boobies | Kure, HI | |
| | | Wake, USPI | |
| **Scale Insects**<br>These insects are causing the loss of the native Pisonia forests at Rose and Palmyra and infecting native shrub vegetation at Kure.<br>*Pluvinaria urbicola* | Tree nesting seabirds especially Red-footed Boobies, Black Noddies and White Terns | Rose Atoll, American Samoa | |
| | | Palmyra, USPI | research in progress |
| | | Kure, HI | |
| **Grasshoppers**<br>invasive species that can almost completely defoliate Nihoa during population explosions. | unknown | Nihoa, HI | |
| **Mosquito**<br>Mosquitoes are vectors for avian pox and avian malaria that affect some species of seabirds. Numerous species | Albatross, red-tailed tropicbird<br><br>Newell's shearwaters | Midway, HI | |
| | | Baker, USPI | died out naturally |
| | | Main islands Hawaii | |
| **New Zealand Spinach**<br>*Tetragonia tetragonioides* | Ashy storm-petrel, Cassin's auklet | Farallon, CA | ongoing control program |
| | | Ano Nuevo, CA | |

## Appendix 6. Invasive species that affect seabirds in USFWS Pacific Region (continued).

| Alien Species | Key Seabirds Affected | Island | Success/Failure of Control |
|---|---|---|---|
| **Ironwood** Dense forest habitat on low islands and atolls supports lower densities of surface and burrow nesting species and higher densities of tree nesting terns. *Casuarina equisetifolia* | Albatross, Bonin petrel, tropicbird | Midway, HI | near eradication Eastern Is, Midway |
| | | Wake, USPI | |
| **Sandbur** Alters the habitat by reducing the vertical structure of the vegetation thereby eliminating species that nest under vegetation and provides less binding structure to the soil thereby limiting burrow nesters. *Cenchrus echinatus* | Petrels, shearwaters & tropicbirds | Laysan, HI | control ongoing; near eradication |
| | | French Frigate Shoal, HI | control ongoing; near eradication |
| | | Lisianski, HI | |
| | | Pearl & Hermes, HI | limited control |
| | | Kure, HI | limited control |
| **Golden crown-beard** *Verbesina encelioides* | all breeding birds but especially ground nesting boobies and albatross | Midway, HI | |
| | | Pearl & Hermes, HI | |
| | | Kure, HI | |
| **European beachgrass** *Ammophila arenaria* | Least tern | Pt. Mugu | ongoing control program |
| **Knot Grass** Limits nesting habitat for species that prefer open habitat. *Digitaria* spp. | Sooty tern ground-nesting birds, especially boobies and terns. | Johnston, USPI | |
| | | Howland Island, USPI | |

## Appendix 7. List of seabird species abbreviations (alpha codes) from Patuxent Wildlife Research Center, Bird Banding Lab, USGS.

| Common Name | Alpha Code |
|---|---|
| Short-tailed Albatross | STAL |
| Black-footed Albatross | BFAL |
| Laysan Albatross | LAAL |
| Audubon's Shearwater | AUSH |
| Little Shearwater | LISH |
| Newell's Shearwater | NESH |
| Sooty Shearwater | SOSH |
| Flesh-footed Shearwater | FFSH |
| Short-tailed Shearwater | SHOS |
| Wedge-tailed Shearwater | WTSH |
| Christmas Shearwater | CHSH |
| Hawaiian Petrel | HAPE |
| Dark-rumped Petrel | DRPE |
| Phoenix Petrel | PHPE |
| Bonin Petrel | BOPE |
| Bulwer's Petrel | BUPE |
| Fork-tailed Storm-Petrel | FTSP |
| Leach's Storm-Petrel | LHSP |
| Band-rumped Storm-Petrel | BANP |
| Black Storm-Petrel | BLSP |
| Tristram's Storm-Petrel | TRSP |
| Ashy Storm-Petrel | ASSP |
| Polynesian Storm-Petrel (=White-throated Storm-Petrel) | WHSP |
| White-tailed Tropicbird | WTTR |
| Red-tailed Tropicbird | RTTR |
| Masked Booby | MABO |
| Brown Booby | BRBO |
| Red-footed Booby | RFBO |
| Double-crested Cormorant | DCCO |
| Brandt's Cormorant | BRAC |
| Pelagic Cormorant | PECO |
| Brown Pelican | BRPE |
| Great Frigatebird | GRFR |
| Lesser Frigatebird | LEFR |
| Glaucous-winged Gull | GWGU |
| Western Gull | WEGU |
| California Gull | CAGU |
| Unidentified Gull | UNGU |
| Ring-billed Gull | RBGU |
| Heermann's Gull | HEEG |
| Gull-billed Tern | GBTE |
| Caspian Tern | CATE |
| Royal Tern | ROYT |
| Elegant Tern | ELTE |
| Forster's Tern | FOTE |
| Arctic Tern | ARTE |
| Least Tern | LETE |
| Little Tern | LITE |
| Sooty Tern | SOTE |
| Bridled Tern | BRTE |
| Gray-backed Tern | GRAT |
| Brown Noddy | BRNO |
| Black Noddy | BLNO |
| Blue-gray Noddy (Blue Noddy) | BGNO |
| White Tern | WHTE |
| Black Skimmer | BLSK |
| Tufted Puffin | TUPU |
| Rhinoceros Auklet | RHAU |
| Cassin's Auklet | CAAU |
| Ancient Murrelet | ANMU |
| Marbled Murrelet | MAMU |
| Xantus's Murrelet | XAMU |
| Pigeon Guillemot | PIGU |
| Common Murre | COMU |

## Appendix 8. List of abbreviations and acronyms.

| | |
|---|---|
| ac | acre |
| AES | USFWS, Ecological Services Program |
| BCC | Birds of Conservation Concern (USFWS 2002) |
| BCR | Bird Conservation Region |
| BCR 67 | Hawaiian Islands Bird Conservation Region |
| BCR 68 | U. S. Pacific Islands Bird Conservation Region |
| C | Candidate for threatened or endangered status |
| CA | California |
| CCS | California Current System |
| CDFG | California Department of Fish and Game |
| CNMI | Commonwealth of the Northern Mariana Islands |
| CR | Critically Endangered (IUCN status category) |
| d | day |
| DDE | Dichlorodiphenyldichloroethylene |
| DDT | Dichlorodiphenyltrichloroethane |
| DLNR | Department of Land and Natural Resources, State of Hawaii |
| DMBM | Division of Migratory Bird Management, Washington DC |
| DOD | Department of Defense |
| DOF | Department of Forestry |
| DOFAW | Hawaii Division of Forestry and Wildlife |
| E | Endangered |
| EC | USFWS, Division of Environmental Contaminants |
| EEZ | Exclusive Economic Zone |
| EN | Endangered (IUCN status category) |
| ENSO | El Nino/Southern Oscillation |
| ESA | Endangered Species Act |
| FAO | Food and Agriculture Organization |
| FDM | Farallon de Medinilla, CNMI |
| FMP | Fisheries Management Plan |
| FPS | Fully Protected Species (CA category) |
| FWO | USFWS Fish and Wildlife Office |
| ha | hectare |
| HC | High Concern (NAWCP rank-national/regional) |
| HI | Hawaii OR Highly Imperiled (NAWCP rank-national/regional) |
| HMS | Highly Migratory Species |
| HDAR | Hawaii Division of Aquatic Resources |
| INRMP | Integrated Resources Management Plan |
| IPOA-Seabirds | International Plan of Action for the Reduction of Seabird Bycatch in Longline Fisheries |
| IUCN | The World Conservation Union (International Union for the Conservation of Nature) |
| km | kilometer |
| LC | Low Concern (NAWCP rank-national/regional) |
| LE | USFWS, Division of Law Enforcement |
| LR/nt | Lower Risk/near threatened (IUCN status category: see also NT) |
| LOF | List of Fisheries (NOAA) |
| MBHP | USFWS, Division of Migratory Birds and Habitat Programs |
| MBTA | Migratory Bird Treaty Act |

## Appendix 8. List of abbreviations and acronyms (continued).

| | |
|---|---|
| m | meter |
| MC | Moderate Concern (NAWCP rank-national/regional) |
| mi | mile |
| MMPA | Marine Mammal Protection Act |
| MX | Mexico |
| NAWCP | North American Waterbird Conservation Plan |
| NBII | National Biological Information Infrastructure |
| nm | nautical mile |
| NCR | Not Currently at Risk (NAWCP rank-national/regional) |
| NMFS | National Marine Fisheries Service (NOAA-Fisheries) |
| NMS | National Marine Sanctuary |
| NOAA | National Oceanographic and Atmospheric Administration |
| NP | National Park |
| NPOA-Seabirds | National Plan of Action for the Reduction of Seabird Bycatch in Longline Fisheries |
| NPS | National Park Service |
| NT | Near Threatened (IUCN status category: see also LR/nt) |
| NWHI | Northwestern Hawaiian Islands |
| NWR | National Wildlife Refuge |
| NWRS | National Wildlife Refuge System |
| ODFW | Oregon Department of Fish and Wildlife |
| OR | Oregon |
| OSPR | Oil Spill Protection and Response |
| PAH | poly-aromatic hydrocarbons |
| PAH | Polycyclic aromatic hydrocarbons |
| PBDE | polybrominated diphenyl ether |
| PCB | polychlorinated biphenyls |
| PDO | Pacific Decadal Oscillation |
| POBSP | Pacific Ocean Biological Survey Program |
| POP | persistent organic pollutants |
| PRBO | Point Reyes Bird Observatory |
| Service | U.S. Fish and Wildlife Service |
| S or SS | Sensitive Species (state) |
| SC | Species of Concern |
| SM | State Monitor (WA category) |
| T | Threatened |
| TE | USFWS, Division of Endangered Species |
| TNC | The Nature Conservancy |
| USFWS | U.S. Fish and Wildlife Service |
| USGS | U.S. Geological Survey |
| USPI | U.S. Pacific Islands |
| VU | Vulnerable (IUCN status category) |
| WA | Washington |
| WDFW | Washington Department of Fish and Wildlife |
| WNV | West Nile Virus |

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# Part II. Species Accounts

## CONTENTS

# California Current System Species Profiles

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# Fork-tailed Storm-Petrel *Oceanodroma furcata*

## Status

**Federal: None** **State: CA-SC, OR-S** **IUCN: None** **NAWCP: NCR/NCR**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | yes | 1 | 60d | ~56d | Mar-Nov | crevice/burrow | surface-seizing | pelagic |

## Distribution, Population Status and Trends

The Fork-tailed Storm-Petrel (FTSP) is widely distributed throughout the North Pacific, from Japan to the Aleutian Islands, and down the Pacific coast of North America to northern CA, with the core of the population in AK and decreasing numbers at lower latitudes.[1,4] There are two subspecies recognized: *O. f. plumbea* breeds along the west coast of North America from southern AK to northern CA.[1] Post breeding *O. f. plumbea* tends to disperse to adjacent seas and ranges as far south as southern CA,[1] although infrequently observed.[12] Abundances at sea generally reflect abundances of breeding birds on land with a declining gradient of abundance from AK to CA.[15] FTSP occur in highest abundance near the shelf break in summer and farther offshore during the non-breeding season.[15]

Population estimates for this species, as for other storm-petrels, are difficult to obtain due to their nocturnal attendance at colonies and their burrow/crevice-nesting habits.[11] There are an estimated 5,000 breeding birds in this Region, representing <1% of the North American population[8]: 3,900 in WA, hundreds in OR, and 400 in CA.[10,11] There is little information on population trends of FTSP in this Region,[11,14] although populations in CA have shown a decrease since historical times.[11]

## Ecology

As with other storm-petrel species, the FTSP is colonial and active in the colony at night.[1,2] Adults breed in crevices, and natural or excavated burrows on rocky islands.[2] Long-term pair bonds are formed, although mate switching occurs more often when pairs are unsuccessful raising chicks.[2] Egg neglect is common, with eggs remaining unattended for several days, and surviving up to 28 days of neglect in some areas.[2,5] Chicks are brooded up to 8 days and studies in AK indicate that nest attendance patterns during incubation and chick-rearing appear to be dependent on food availability.[7] FTSP breeding

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in the Gulf of AK show variability in the initiation of egg-laying, egg size, chick growth rates, and chick mortality, which may also be adaptations to a variable environment, high predation rates, and climate.[2]

Diet consists of crustaceans, fish, and animal detritus from the ocean surface.[10] FTSP are often seen feeding on dead or wounded marine mammals, even beached animals.[3] Chicks are fed an oily regurgitant that consists of partially digested crustaceans or fish.[2] FTSP may forage closer inshore during the breeding season when feeding chicks.[2,12]

## Conservation Concerns and Activities

Threats include loss of nesting habitat, predation, oil spills, and contaminants. Changes in vegetation and soil, has led to the loss or reduction of several colonies in CA.[11] Whaler Is., the largest historical colony in CA, was destroyed when rock was quarried and a breakwater was constructed in the 1930s, connecting the island to the mainland and allowing introduction of rats. Other predators include gulls, ravens, eagles, owls, peregrine falcons, and occasionally mammals such as river otters.[2,6] Plastic ingestion is common for storm-petrels that feed on neuston, and is potentially a concern for FTSP. Relatively high levels of DDE have been found in the eggs of FTSP breeding on the Queen Charlotte Islands, Canada.[9] Oil spills, both chronic and catastrophic, can have devastating effects on seabird populations,[13] although documentation of FTSP mortality in oil spills is low.

## Recommended Actions

- Investigate contaminant levels in FTSP eggs and determine the effects on reproductive performance.
- Develop standardized protocols to accurately assess and monitor population size and trends.

## Regional Contacts

P. Dee Boersma - University of Washington, Seattle, WA

***References:*** 1. Harrison 1983; 2. Boersma *et al.* 1980; 3. Gill 1977; 4. Osborne 1985; 5. Boersma and Wheelwright 1979; 6. Harris 1974; 7. Simons 1981; 8. Kushlan *et al.* 2002; 9. Elliott *et al.* 1989; 10. Boersma and Silva 2001; 11. Carter *et al.* 1992; 12. Briggs *et al.* 1987b; 13. PRBO 1997; 14. Speich and Wahl 1989; 15. Briggs *et al.* 1992.

# Leach's Storm-Petrel *Oceanodroma leucorhoa*

## Status

**Federal: None** **State: None** **IUCN: None** **NAWC: LC/LC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | yes | 1 | ~42d | ~67d | May-Oct | burrow/crevice | surface-seizing | pelagic |

## Distribution, Population Status and Trends

The Leach's Storm-Petrel (LHSP) is the most widespread procellariform in the Northern Hemisphere, breeding in both the Atlantic and Pacific.[1,8] In the Pacific, breeding colonies are found as far west as Japan, and as far south as Guadalupe Is., MX.[1,2] Taxonomy is controversial, with 3-4 subspecies generally recognized; *O.l. leucorhoa* breeds in the north Atlantic and eastern north Pacific from the Aleutian Islands south to central CA.[1,8] LHSP are pelagic during the non-breeding season, wintering primarily in central and eastern tropical waters,[1] although they are found year-round from the Gulf of AK, south. In the north Pacific, LHSP are rarely seen close to shore, preferring warmer, less productive oceanic waters. They are most abundant seaward of the continental slope, usually more than 75 km from shore.[9] As the breeding season approaches, they move closer to shore.[9,14]

Population estimates for this species, as for other storm-petrels, are difficult to obtain due to their nocturnal attendance at colonies and their burrow/crevice-nesting habits. The global breeding population estimate is greater than 16 million birds,[13] with approximately 3% breeding in this Region: 36,000 in WA; 435,000 in OR; and, 12,500 in CA.[10,15,16] Overall population trends are unknown, although many individual colonies have been extirpated by introduced animals or habitat changes (*e.g.*, Castle Rk, CA).[1,10] The largest colonies in the Region (>50,000 birds) are in OR (North Crook Point, Goat, Saddle, and Whalehead islands).[15] Trends are unknown.

## Ecology

LHSP nest in burrows or crevices, and breeding chronology varies with location.[1,2,7] Breeding begins at 5 or 6 years of age and once started, is annual.[1,3] Breeding site fidelity is high, with pairs usually occupying the same burrow for many seasons.[1] Birds that return to natal colonies tend to nest in burrows

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close to their natal sites.[1] Incubation stints last 3 days, during which the incubating bird may lose 5% of its body weight.[1]

Chicks are fed an oily regurgitant, averaging 20% of adult body weight[4] and containing up to 60% lipid, every 1 to 3 nights.[1] Adults feed mostly at fronts or eddies, where prey is more concentrated and closer to the surface.[9] Diet varies geographically and seasonally but primarily plankton and nekton, including fishes, squid, crustaceans, and jellyfish.[1,5]

## Conservation Concerns and Activities

Habitat degradation caused by changes in vegetation or soil have been a factor in the decline at some CA colonies. At some colonies, LHSP may be displaced by larger seabirds, such as Cassin's Auklets.[1] The main cause of mortality at breeding colonies in this Region is predation, and introduced mammals, especially foxes, cats, dogs, rats, and pigs have caused colony extirpations.[1] House mice may prey on newly hatched chicks and eggs.[1,11,12] Native predators, such as river otters, gulls, raptors (especially owls), and corvids, and kleptoparasitism (by jaegers and other birds) also cause adult mortality.[1] Other potential threats include eggshell thinning due to organochlorine contamination from pesticides.[6] While at sea, oil pollution or oil-dispersant emulsions may affect LHSP, as well as ingestion of plastics and other man-made products.[1]

## Recommended Actions

- Develop standardized protocols to accurately assess and monitor population size and trends.
- Investigate contaminant levels in eggs and determine the effects on reproductive performance.
- Investigate population dynamics by analyzing data from the long-term mark-recapture study at Saddle Rk, OR.

## Regional Contacts

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Dan Roby - USGS, Oregon Cooperative Research Unit, Corvallis, OR

***References:*** 1. Huntington *et al.* 1996; 2. Harrison 1983; 3. Grubb 1973; 4. Ricklefs 1992; 5. Montevecchi *et al.* 1992; 6. Pearce *et al.* 1989; 7. Ainley *et al.* 1975; 8. Whittington *et al.* 2001; 9. Briggs *et al.* 1987b; 10. Carter *et al.* 1992; 11. Sydeman *et al.* 1998; 12. Ainley and Boekelheide 1990; 13. Kushlan *et al.* 2002; 14. Briggs *et al.* 1992; 15. USFWS in prep; 16. Speich and Wahl 1989.

# Ashy Storm-Petrel *Oceanodroma homochroa*

## Status

**Federal: None** **State: CA-SC** **IUCN: EN** **NAWCP: HI/HI**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | rare | 1 | ~45d | ~84d | May-Nov | crevice | surface-seizing | pelagic |

## Distribution, Population Status and Trends

The Ashy Storm-Petrel (ASSP) is a small pelagic seabird, endemic to the California Current System. The majority of the population breeds in coastal areas and islands off central and southern CA, with a few small colonies off northern CA.[1,2,16] ASSP are non-migratory, exhibiting little post-breeding dispersal.[2] They are frequently seen on the edges of upwelling zones in the spring, summer, and fall and are found year-round in waters just seaward of the continental slope from Cape Mendocino, CA south to Baja California, with large fall concentrations in Monterey Bay, CA.[2,10,14]

Except for a small colony at Los Coronados Islands, MX, the world population breeds within CA, and is estimated at approximately 10,000 breeding birds.[2] The largest breeding colonies are on the Farallon and Channel islands, which together support approximately 98% of the global population.[2,3,16] On the Farallon Islands, the breeding population is estimated to have declined 42% between 1972 and 1992.[3] This significant decline is mainly attributed to adult predation by Western Gulls, owls, and possibly mice.[3,4,5] Population trends at other colonies are not known, although there is no apparent trend in the at-sea numbers in Monterey Bay.[2] ASSP reproductive performance on the Farallon Islands has decreased since the late 1980s.[13]

## Ecology

ASSP are pelagic, only visiting land to court and breed.[2] Visits to breeding colonies can occur year-round, although are most frequent from Feb-Oct, with a long period of courtship that can last up to 3 months.[2,7] ASSP are nocturnal at breeding colonies.[2] Compared to other storm-petrels, ASSP egg-laying is asynchronous, spread over several months.[2,7] Both sexes share incubation equally and egg neglect is less frequent in this species than other storm-petrels, with average egg neglect of 2-4 days.[2] After hatching, chicks are initially brooded an average of 4 days.[2] ASSP are long-lived; one individual at the Farallon Islands was 30 years old.

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Diet consists of larval fish, squid, and zooplankton,[2,7,13] and chicks are fed a meal of semi-digested, oily liquid every 1-3 nights.[7] ASSP will scavenge and are frequently seen around fishing vessels.[2]

## Conservation Concerns and Activities

Small population size, restricted distribution, concentration at a few colonies, extended chick-rearing period, and low reproductive rates make the ASSP especially vulnerable to threats. Rats at Anacapa likely had significant effects and the recent eradication of rats should result in a population increase. Predation of eggs and chicks by introduced house mice (Farallon Islands) and native deer mice (Channel Islands) occurs, although population effects are unknown.[4,7,18] Various species of owls migrate to the Farallon Islands in the fall and are supported through the winter by the abundant mouse population. With decreasing food supplies in the late winter, owls may shift their diet from mice to ASSP returning to the island.[5,6,11] Barn Owls prey on ASSP adults and chicks at Santa

Cruz Is.[18] A study to quantify mouse, gull, and owl predation is underway at the Farallon Islands. Predation of adults by Western Gulls is believed to have increased in recent years on the Farallon Islands, as the gull colony has expanded into storm-petrel habitat.[3,5,10] The Service has unsuccessfully experimented with gull exclusion zones to restrict gulls from ASSP habitat.[17]

A more recent conservation issue is the potential negative impacts of bright lights used by squid boats in the vicinity of the Farallon and Channel islands, which may disorient storm-petrels, affect their behavior, or enhance avian predation. A proposed liquid natural gas port off Los Coronados, MX could negatively impact this southernmost colony. Plastic ingestion is common for storm-petrels that feed on neuston, and is a potential threat.[2] Eggshell thinning was of concern in the early 1970s,[8] and recently relatively high levels of DDT and PCB were found in birds nesting on Santa Cruz Is., CA.[9] Oil spills can have devastating effects on seabird populations,[12] although documentation of ASSP mortality in oil spills is low.[15]

## Recommended Actions

- Eradicate introduced predators from all breeding islands and evaluate the response of ASSP populations at Anacapa to rat eradication.
- Work with partners at the state, national and international levels to minimize the negative impacts of fisheries activities and gas development.
- Conduct a Status Assessment to review population status and trends, limiting factors, and conservation recommendations.
- Monitor contaminant levels in eggs and determine the source and the effects of contaminants on reproductive performance.
- Develop standardized protocols to accurately assess and monitor population size and trends. Conduct surveys to locate all active colonies.

## Regional Contacts

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***References:*** 1. McChesney *et al.* 2000; 2. Ainley 1995; 3. Sydeman *et al.* 1998a; 4. Sydeman *et al.* 1998b; 5. Mills 2000; 6. Pyle and Desante 1994; 7. Ainley *et al.* 1990; 8. Coulter and Risebrough 1973; 9. Carter *et al.* 2000b; 10. Ainley *et al.* 1975; 11. Mills *et al.* 2002; 12. PRBO 1997; 13. Sydeman *et al.* 2001; 14. Briggs *et al.* 1987b; 15. Nur *et al.* 1999; 16. Carter *et al.* 1992; 17. Roth *et al.* 2000; 18. McIver 2002.

# Black Storm-Petrel *Oceanodroma melania*

## Status

**Federal: None** **State: CA-SC** **IUCN: None** **NAWCP: HC/HC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | rare | 1 | 40-53d | 77-84d | Apr-Aug | crevice | surface-seizing | coastal pelagic |

## Distribution, Population Status and Trends

The Black Storm-Petrel (BLSP) has a limited breeding range from the Channel Islands, CA, to islands in the Gulf of California and off the west coast of Baja, MX.[1] After the breeding season, a portion of the population moves north to waters off southern and central CA.[1,2] A larger portion moves south to waters off Central America and northern South America.[1,2] BLSP have been recorded off CA in all months, but reach peak abundance in late summer/fall.[3] They are most common in the warm coastal waters in the eastern half of the Southern California Bight and in central CA over the continental shelf, especially over the Monterey submarine canyon.[3] Highest densities were recorded within 50 km of the mainland.[3] During El Niño years, large numbers are seen as far north as Monterey Bay and Point Reyes in the autumn.[1] BLSP concentrations off CA have increased in recent decades, most likely because of rising sea-surface temperatures.[1]

Little information is available on historical numbers or trends, but there has likely been population declines as a result of mammal introductions to breeding islands.[1] The total population is estimated at approximately 600,000 breeders, most of which breed on Islas San Benito, MX (approx. 95% of the world's population) (S. Wolf and B. Keitt, pers. comm.). Approximately 300 individuals breed at Santa Barbara Is. and associated Sutil Is., CA.[4] Breeding is also possible at Prince (San Miguel), Anacapa, and San Clemente islands.[4]

## Ecology

Similar to other storm-petrels, BLSP spend most of their time at sea, coming to land only to breed.[1] Breeding habitat is predominantly small, rocky islands or sloping terrain on larger islands.[1] BLSP nest in old burrows or crevices, often occupying previously used nesting cavities; rarely excavating their own cavity.[2] Birds return to the CA colonies in Apr/May and are active at colonies only at night.[1,2]

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BLSP probably begin breeding around 5 years of age, but life span and survivorship are unknown.[1]

Little is known about the diet of BLSP; probably small fish, crustaceans, and squid that occur near the surface.[1] They are also known to scavenge from large floating items.[1] BLSP forage closer to shore than congenerics, in areas of high ocean productivity such as thermal fronts adjacent to upwellings, tide rips, and shelf-break fronts.[1]

## Conservation Concerns and Activities

Little information exists concerning the breeding biology of the BLSP.[2] Furthermore, population estimates are difficult because of their nocturnal habits at colonies and difficult terrain.[1] BLSP appears to be limited by the availability of suitable nesting habitat and introduced mammalian predators on Mexican islands; as a result, colonies have not fully recovered or have disappeared entirely from some islands.[1] Eradication of feral animals has occurred on several islands and is under way at other islands within the range.[1] Predation of eggs by native deer mice on Santa Barbara Is. is likely to occur. Owls and Peregrine Falcons are also likely predators at most breeding sites.[1] A more recent conservation issue is the potential negative impacts of bright lights used by squid boats in the vicinity of the Channel Islands, which may disorient storm-petrels, affect their behavior, or enhance avian predation, although currently there is no data on the effects of this disturbance.[1]

Storm-petrels are inherently vulnerable to ingestion of plastics and other marine debris,[5] although it is unknown to what degree this occurs in BLSP. There is recent evidence of eggshell thinning caused by high levels of DDT and PCBs in Ashy Storm-Petrel eggs at Santa Cruz Is., CA.[1,6] BLSP feed closer inshore, potentially increasing the chances of contamination.[1]

## Recommended Actions

- Support efforts to eradicate introduced predators from current and potential breeding islands within the range.

## Regional Contacts

William Everett - Endangered Species Recovery Council, La Jolla, CA
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***References:*** 1. Ainley and Everett 2001; 2. Harrison 1983; 3. Briggs *et al.* 1987b; 4. Carter *et al.* 1992; 5. Ainley 1995; 6. Carter *et al.* 2000b.

# Brown Pelican *Pelecanus occidentalis*

## Status

**Federal: E** **State: CA-E, OR-E, WA-E** **IUCN: None** **NAWCP: MC/HC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 2-3 | yes | 1-2 | ~30d | ~80d | Feb-Oct | surface stick | plunge-diving | nearshore |

## Distribution, Population Status and Trends

The Brown Pelican (BRPE) is found throughout the temperate and tropical regions of the Americas, along both Atlantic and Pacific coasts.[12] Six subspecies have been recognized; *P. o. californicus* breeds in western North America.[12] BRPE were listed as endangered in 1970. *P. o. californicus* breed primarily on islands off southern CA and western MX, including the Gulf of California. Large numbers disperse northward during summer and fall as far as British Columbia[2,20] and inland to the Salton Sea (probably birds from the Gulf of California; F. Gress, pers. comm.). BRPE tend to aggregate at fronts with strong thermal gradients, foraging within 20 km of the coast, although they have been recorded up to 190 km offshore.[20]

An estimated 12,000 BRPE breed in southern CA, comprising approximately 12% of the western subspecies (100,000 breeding birds) and approximately 6% of the North American populations.[19] Currently, there are two colonies in CA, at Anacapa and Santa Barbara islands (formerly bred at Prince Is., San Miguel and Scorpion Rk., Santa Cruz).[3] North American populations underwent dramatic declines during the 1960s and early 1970s due to eggshell thinning induced by pesticides.[11,13,17] Although populations have recovered substantially from these declines,[5,7,17] they continue to show considerable inter-annual variation in productivity as related to prey availability,[6] disturbance at colonies, and disease outbreaks (F. Gress, pers. comm.). Breeding effort, productivity and survival are lower during El Niño events.[22] Populations at CA colonies increased during the 1980s and were relatively stable through the 1990s.[2]

## Ecology

BRPE build nests in low shrubbery or on the ground on islands or remote coastal areas. They breed primarily in the spring but breeding phenology can be quite variable and asynchronous with egg laying starting as early as Nov and as late

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as Jun: most nesting occurs Feb-Oct. [2,3,4] Age of first breeding can be as young as 1-3 years [12] but 4-7 years is more typical.[2] Both sexes participate in incubation.[12,16] Siblicide often occurs, and mean reproductive output is usually less than one,[6,12,13,16] although it can occasionally be higher when food is plentiful. Maximum recorded age is 43 years.[21] Young are altricial and may creche when several weeks old.[21]

Feathers of BRPE are not waterproof and therefore they feed close to shore and return regularly to roosting sites.[20] The diet of BRPE in western North America consists almost exclusively of small schooling fish, in particular, northern anchovy and Pacific sardine.[4,6]

## Conservation Concerns and Activities

BRPE are potentially at risk due to many human-related factors. Although DDE and other eggshell thinning contaminants were banned in the U.S. in the early 1970s, the long persistence of these chemicals in the environment and their continued use elsewhere may still cause problems, especially for colonies in the Gulf of California.[5,13] Introduced mammals such as cats and possibly rats can affect reproductive success.[9] Adult mortality occurs when birds become entangled in fishing gear, especially hook and line.[14] Disturbance from bright lights used in the squid fishery, is thought to cause nest abandonment and low reproductive success at CA colonies (F. Gress, pers. comm.). Populations may be affected by declines in prey stocks due to overfishing or general environmental degradation off the CA coast.[4] Disturbances to breeding colonies and critical roost sites by fisherman, researchers, or the general public could result in high levels of nest abandonment and roost disturbance.[1,8] Loss of quality night roosts is of particular concern. The CA colonies are within the Channel Islands National Park, which offers some protection, although there is still human disturbance to these colonies. Oil pollution also causes adult mortality and reproductive failure.[14,15] Die-offs of BRPE due to domoic acid intoxication from phytoplankton blooms,[18] bacteriological outbreaks at sewage outflows,[10] and botulism (*e.g.,* at the Salton Sea) contribute to local population declines.

## Recommended Actions

- Reduce human disturbance at colonies and roost sites (*e.g.,* buffer zones, community outreach, signs, community outreach, restricted airspace) and enhance or create secure roost habitat in areas where this habitat is limited.
- Provide technical assistance to fisheries managers regarding anchovy, sardine, squid, and other fisheries to minimize impacts to pelicans. Work with partners to devise solutions to problems of entanglement in fishing gear and minimize negative impacts of disturbance due to fishing activities *e.g.*, squid boat lights.
- Support efforts by MX to remove introduced mammalian predators from major breeding colonies and roosting sites, and protect from future introductions.
- Determine the current distribution, abundance and status of *P. o. californicus* rangewide.
- Monitor contaminants levels and the effects on pelican populations.
- Research into the factors influencing productivity in CA and MX including investigations into diet and prey resources and the inter-relationships.

## Regional Contacts

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***References:*** 1. Anderson 1988; 2. Anderson and Anderson 1976; 3. Anderson *et al.* 1994; 4. Anderson and Gress 1984; 5. Anderson and Gress 1983; 6. Anderson *et al.* 1982; 7. Anderson *et al.* 1975; 8. Anderson and Keith 1980; 9. Anderson *et al.* 1989; 10. Ankerberg 1984; 11. Jehl 1973; 12. Johnsgard 1993; 13. Keith 1983; 14. Page *et al.* 1990; 15. Parnell *et al.* 1984; 16. Schreiber 1979; 17. Wilkinson *et al.* 1994; 18. Work *et al.* 1993; 19. Kushlan *et al.* 2002; 20. Briggs *et al.* 1987a; 21. Shields 2002; 22. Ainley *et al.* 1986.

# Double-crested Cormorant *Phalacrocorax auritus*

## Status

**Federal: None** **State: CA-SC** **IUCN: None** **NAWCP: NCR/NCR**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 2-5 | yes | 1-2 | ~28d | ~42d | Mar-Jul | surface stick | pursuit diving | coastal |

## Distribution, Population Status and Trends

Double-crested Cormorants (DCCO) are widely distributed throughout marine, estuarine, and freshwater habitats of North America, with breeding colonies both inland and along the coast.[1] There are five subspecies recognized; the western subspecies (*P. a. albociliatus*) ranges from British Columbia to Baja California, MX.[1] *P. a. albociliatus* is the most marine and non-migratory of the subspecies[9] but does not venture far offshore.[13] Some migration does occur, but most birds remain in the area year-round; some inland birds migrate to coastal regions.[1]

Historically, numbers and range of DCCO were greatly reduced due to reproductive failure caused by DDT, human destruction of nests and shooting of adults.[1] Populations have been recovering since the DDT ban in 1972[1,2] and current trends in the Region are increasing, although numbers in southern CA have not yet fully recovered to historical levels.[1,2] During 2001-2003 a complete census of coastal colonies in CA, OR, and WA was conducted. The breeding population has approximately doubled over the past 10-15 years (25,600 pairs compared to 12,200 pairs in 1989-91[3]). The greatest increase was in the Columbia River estuary (>40% of the total breeding birds). Populations in San Francisco and Humboldt bays, CA also increased, but colonies at the Farallon Islands were an order of magnitude smaller than in the mid 19th century.[7] Colonies in British Columbia and Washington declined, apparently due to increased disturbance from eagles and boaters. Historically the largest DCCO colonies were in MX and surveys are needed to complete the current assessment of *P. a. albociliatus*. Pacific coast colonies fluctuate annually, with low reproduction and population numbers influenced by El Niño events.[15,16]

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## Ecology

DCCO inhabit a variety of aquatic habitats and often roost on exposed rocks, sandbars, high-tension wires, and trees near their favorite fishing areas.[1] Along the coast DCCO are predominantly ground-nesters, mainly on cliffs and islands, however, a few colonies are located in trees.[8] There has been increased use of artificial structures (*e.g.*, bridges in San Francisco Bay) and low estuarine islands (*e.g.*, East Sand Is. in the Columbia River estuary).[1] Adult males choose nest sites and display to females; both adults construct the nest.[1] Females lay 1-7 eggs but the average clutch size is typically 3-4 eggs.[14] Young are altricial and form creches at 2-3 weeks. Although fully feathered at 3-4 weeks, the young are unable to fly for another 2-3 weeks.[1]

DCCO mostly forage in shallow, open water, and the main prey includes schooling species that occur from the surface to near-bottom.[1 2,4] Surfperch, sticklebacks, sandlance, and herring are species of importance in DCCO diets,[2,4,5] but diet varies both temporally and spatially. Salmonids are an important, but not dominant, part of the diet in Columbia River estuary.[5] Cormorants have high wing loading, and feathers that are not waterproof; while these qualities increase underwater maneuverability and diving capabilities, they also restrict cormorant foraging distribution to nearshore waters, where they must return daily to dry their feathers.[10,11,12]

## Conservation Concerns and Activities

Recent recovery of DCCO populations can be attributed to bans on DDT, protection provided by the Migratory Bird Treaty Act, and the creation/enhancement of breeding and foraging habitat.[2,3,8] Commercial and sports fisheries often view DCCO as a pest species and a competitor.[6] The colony at East Sand Is. has been studied extensively for predation on endangered juvenile salmonids.[5] Most studies on the impacts of the DCCO on fish species are inconclusive, as the dynamics between fish populations and responses to predation are not well understood.[2] Disturbance at breeding sites can be devastating, causing eggs and young to be exposed to predation and inclement weather.[1] Aquaculture activities are expanding and are likely to become of increasing importance in estuaries. Given ongoing conflicts between DCCO and aquaculture in other areas, attention must be paid to this potential conflict.

## Recommended Actions

- Protect colonies and important roost sites from human disturbance and mammalian predators.
- Research into the relationship between DCCO predation and fisheries stocks including predator-prey interactions, fish population fluctuations, and foraging competition.
- Technical assistance to industry and regulators regarding minimization of conflicts between seabirds and aquaculture.
- Coordinate with Mexico to complete a rangewide survey of *P. a. albociliatus*. Conduct regular standardized surveys to monitor changes in population size and distribution.
- Monitor contaminant levels in DCCO, especially organochlorines.

## Regional Contacts

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***References***: 1. Hatch and Weseloh 1999; 2. Wires *et al.* 2001; 3. Carter *et al.* 1995b; 4. Ainley *et al.* 1981a; 5. Roby *et al.* 1998; 6. Duffy 1995; 7. Capitolo *et al.* 2004; 8. Carter *et al.* 1992; 9. Harrison 1983; 10. Boekelheide *et al.* 1990; 11. Johnsgard 1993; 12. Grémillet *et al.* 1998; 13. Briggs *et al.* 1987b; 14. Anderson 2002; 15. Ainley and Boekelheide 1990b; 16. Ainley *et al.* 1986.

# Brandt's Cormorant *Phalacrocorax penicillatus*

## Status

**Federal: None** **State: WA- C** **IUCN: None** **NAWCP: HC/MC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 3-5 | yes | 3-4 | ~30d | ~35d | Feb-Aug | surface, veg | pursuit diving | coastal |

### Distribution, Population Status and Trends

Brandt's Cormorants (BRAC) are endemic to the west coast of North America, where they inhabit nearshore marine and estuarine environments.[2] The breeding range extends from southeast AK to Baja California. Breeding and winter distribution overlap as birds disperse from the colonies post-breeding and move back to the colonies in the spring.[9,11] BRAC are rarely seen far offshore, most commonly foraging within 25 km of their island or mainland colonies and rarely >10 km from shore.[7]

The most recent surveys indicate a total breeding population of <100,000 birds, approximately 75% of which breed in OR and CA. A complete census of breeding colonies in CA, OR and WA was conducted in 2001-2003 and approximately 37,000 nests were counted (USFWS unpubl. data).[17] This represents 10% and 25% declines compared to censuses conducted during 1975-1981 and 1989-1991, respectively.[6,11] Surveys of colonies in MX are needed. There has also been a regional shift in abundance. Historically, the Farallons supported the largest BRAC colony with 23,800 breeding birds in 1974;[2] however, there has been a steady decline at this colony and a concomitant increase at other colonies along the central CA coast and the Channel Islands.[2,5,16] There was no well documented population decline during the 1960s and 1970s due to eggshell thinning. Individual colony size[3,5] and productivity[2,8,12] vary interannually in response to changing oceanographic conditions (*e.g.*, El Niño).[2,12,13]

### Ecology

BRAC nest in dense colonies on islands and occasionally at mainland sites along rocky promontories.[11] Nests are constructed of vegetation on flat or sloping areas and on ledges of steep cliffs.[2] The breeding season begins earlier and is more protracted with decreasing latitude; egg-laying occurs from late Feb- Jun in the Channel Islands versus May-Jun in WA.[9] BRAC will relay if eggs are

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lost early in the breeding season, and usually raise only one brood per year.[2] Chicks from neighboring nests form small creches at 10-20 days old and later join larger subcolony creches.[11] BRAC are monogamous but show low mate and site fidelity[4] and will occasionally switch mates during the season after a failed breeding attempt.[2]

BRAC, like other cormorants, are foot-propelled pursuit-divers. They feed on both schooling and non-schooling fish at or near the bottom, as well as squid and other invertebrates.[11] Primary prey include rockfish and anchovy in the northern portion of their range, while blacksmith (*Chromis* spp.) are predominant prey items in the south.[1] BRAC often forage in large mixed-species feeding flocks along with Pelagic and Double-crested Cormorants, Brown Pelicans, gulls, shearwaters, and alcids. BRAC are believed to be deep divers, capable of achieving depths greater than 100 m,[2] although they commonly forage in shallower waters. Cormorants have high wing loading, and feathers that are not waterproof. While these qualities increase underwater maneuverability and diving capabilities, they also restrict their foraging distribution to nearshore waters, where they can return to land daily to dry their feathers.[2,9,11,14]

## Conservation Concerns and Activities

The most serious conservation concern for BRAC is human disturbance at dense breeding colonies, resulting in increased predation by gulls and ravens and nest abandonment.[2,4,11,17] Exploitation of the prey base by human fisheries[3] is also an important concern. Relatively small numbers of BRAC are killed as a result of oil contamination and gillnet fisheries, though the impacts of these events on populations are not well-studied.[10] Organochlorine concentration in BRAC collected at the Farallon Islands in 1993 were relatively high but is unknown if contaminants currently pose a serious threat.[15] If aquaculture activities increase in protected marine waters there could be a potential conflict.

## Recommended Actions

- Protect breeding colonies and roost sites from human disturbance.
- Investigate the relationships among factors affecting population trends to determine the cause of recent declines (*e.g.*, El Niño, prey resources, oil spills, disturbance, fisheries, etc.).
- Assess contaminant levels and determine the effects on BRAC.
- Complete inventory of all BRAC colonies; support efforts to survey colonies in Mexico.

## Regional Contacts

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***References:*** 1. Ainley *et al.* 1981a; 2. Boekelheide *et al.* 1990b; 3. Ainley *et al.* 1994; 4. Boekelheide and Ainley 1989; 5. Carter *et al.* 1995c; 6. Carter *et al.* 1992; 7. Briggs *et al.* 1992; 8. Hodder and Graybill 1985; 9. Johnsgard 1993; 10. McChesney *et al.* 1998; 11. Wallace and Wallace 1998; 12. Sydeman *et al.* 2001; 13. Wilson 1991; 14. Grémillet *et al.* 1998; 15. Pyle *et al.* 1999; 16. Warzybok *et al.* 2002; 17. Capitolo *et al.* 2004.

# Pelagic Cormorant *Phalacrocorax pelagicus*

## Status

**Federal: None** **State: None** **IUCN: None** **NAWCP: HC/HC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 3-4 | yes | 2-4 | ~30d | ~45d | Mar-Aug | surface, veg | pursuit diving | coastal |

### Distribution, Population Status and Trends

Pelagic Cormorants (PECO) breed along the coast and on islands from the Chukchi and Bering Seas south to Japan and northern Baja California, MX.[6,8] There are two recognized subspecies; *P. p. resplendens* is distributed from British Columbia to Baja California.[6,8,11] PECO disperse throughout their range during the non-breeding season and reach as far south as southern Baja California.[11] They forage relatively close to shore, usually within 10 km from land, during both the breeding and non-breeding seasons.[5,12]

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Breeding sites are generally dispersed along the coast and complete surveys are more difficult than for the other cormorant species. The global population is estimated at approximately 400,000 birds[6] of which 69,000 breed in North America.[13] Approximately 29,000 PECO breed in WA (6,100), OR (8,400), and CA (14,300), representing >40% of the North American population.[4,14,19,20] Overall numbers in the Region have been relatively stable[4,6,14] although colony size and reproductive success appear to be sensitive to El Niño conditions and year-to-year variability is high.[2,4,7,15,18]

## Ecology

PECO are the smallest of the North American cormorants and the least gregarious.[8] They nest on steep cliffs of the mainland and offshore islands, where they form loose colonies, generally fewer than 100 birds per colony.[16] They will also utilize artificial structures such as bridges and buoys. Young birds return to breed at 3 years of age[2,6] and both sexes participate in nest building and incubation. Timing of clutch initiation varies with latitude and food availability.[2,6] PECO are only capable of raising one brood per season, but will occasionally lay a replacement clutch if the entire clutch is lost early in the breeding season.[2,6]

PECO are foot-propelled pursuit divers, generally feeding on small to medium-sized non-schooling fish as well as invertebrates.[1,8,17] Foraging is primarily in shallow, intertidal waters over rocky substrate,[1] but PECO have been recorded diving to more than 100 m.[2] Sculpins and rockfish are important components of their diet in southern and central CA,[1] whereas sandlance becomes more important to northern populations.[1,6] Numbers of breeding birds and breeding success decline dramatically during warm water El Niño events, when food resources are depleted.[3,7,18]

### Conservation Concerns and Activities

PECO are highly sensitive to human disturbance at breeding colonies and will readily abandon nests if disturbed.[2,3] There is a history of mortality from pesticides and oiling events[6,10] but the species' vulnerability to oiling is considered moderate.[9] Organochlorine contaminants may still be an issue, especially in CA.[6] Mortality in gillnet fisheries is a concern,[6] although it does not appear to be a major threat. Significant declines have been noted recently in AK populations but not in WA or OR where colonies were surveyed in 2003. The last inventory of PECO colonies in CA was conducted in 1989-1991 and should be repeated.[4]

## Recommended Actions

- Resurvey CA colonies and establish a standardized program to monitor trends in population size and distribution.
- More research is needed on factors that affect PECO inter-annual reproductive variability and survival, and potential interaction with commercial fisheries.

## Regional Contacts

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***References:*** 1. Ainley *et al.* 1981a; 2. Ainley and Boekelheide 1990; 3. Ainley *et al.* 1994; 4. Carter *et al.* 1992; 5. Briggs *et al.* 1992; 6. Hobson 1997; 7. Hodder and Graybill 1985; 8. Johnsgard 1993; 9. King and Sanger 1979; 10. Piatt *et al.* 1990; 11. Harrison 1983; 12. Briggs *et al.* 1987b; 13. Kushlan *et al.* 2002; 14. Carter *et al.* 1995c; 15. Warzybok *et al.* 2002; 16. Sowls *et al.* 1980; 17. Sydeman *et al.* 1997b; 18. Sydeman *et al.* 2001; 19. Speich and Wahl 1989; 20. USFWS in prep.

# Ring-billed Gull *Larus delawarensis*

## Status

**Federal: None** **State: None** **IUCN: None** **NAWCP: MCR/MCR**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 2-3 | yes | 1-3 | ~25d | ~45d | Apr-Aug | ground scrape | opportunistic | coastal |

## Distribution, Population Status and Trends

The Ring-billed Gull (RBGU) is primarily an inland breeder, distributed across North America, in the northern U.S. and southern Canadian provinces.[12] Wintering range is throughout North America. Along the Pacific coast they are found from southern British Columbia to southern MX.[12] RBGU are common birds on mainland beaches, but are rarely seen more than 1 km from shore.[1]

The population is estimated at 1,700,000 breeders, with <1% breeding along the Pacific coast.[9] RBGU were recorded nesting in Willapa Bay, WA in 1976.[13] In 2003, RBGU did not nest along the WA coast but about 300 pairs nested on two islands in the Columbia River estuary (D. Roby, pers. comm.). As with other gull species, overall populations of RBGU have increased throughout the mid-1900s in response to increased man-related food availability and decreased harvest of eggs and feathers.[2,8,12,14,19] However, western populations of RBGU may be leveling off at the turn of the 21st century due to changes in dumping practices,[10] especially on the wintering grounds along the coast.[11,14]

## Ecology

RBGU migrate from the coast to inland breeding colonies between Mar- May. Age of first breeding is 3-5 years[5,7,8,16] but probably can be as late as 6-8+ years in some individuals. Non-breeding individuals spend their first summer on the winter grounds and subsequent summers in the vicinity of breeding colonies.

At inland colonies, chicks are fed a variety of foods including fish, arthropods, garbage from dumps, earthworms, bird chicks (including those of conspecifics), small mammals, and vegetative matter.[6,15,19] Little is known about the diet of the RBGU that breed or winter along the Pacific coast. Migration to the wintering grounds occurs in Aug-Oct. Annual survival of adults is likely between 75% and 90%[8,18] with longevity ranging up to 27-30 years.[17]



## Conservation Concerns and Activities

The most serious threat is disturbance to breeding colonies, resulting in increased intra-specific predation of chicks.[3,4] Other conservation concerns include ingestion of plastics and other toxins from garbage dumps, contaminants, and oil spills.

## Recommended Actions

- Monitor changes in population size and distribution.
- Minimize disturbance to breeding colonies.

## Regional Contacts

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***References:*** 1. Briggs *et al.* 1987b; 2. Conover 1983; 3. Conover and Miller 1978; 4. Emlen *et al.* 1966; 5. Haymes and Blokpoel 1980; 6. Kirkham and Morris 1979; 7. Kovacs and Ryder 1983; 8. Ludwig 1974; 9. Kushlan *et al.* 2002; 10. Patton 1988; 11. Pyle and DeSante 1994; 12. Ryder 1993; 13. Penland and Jeffries 1977; 14. Shuford and Alexander 1994; 15. Welham 1987; 16. Southern 1968; 17. Southern 1975; 18. Southern 1977; 19. Vermeer 1970.

# California Gull *Larus californicus*

## Status

**Federal: None** **State: CA-SC** **IUCN: None** **NAWCP: MC/LC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 2-3 | yes | 1-3 | ~25d | ~50d | Apr-Aug | ground scrape | opportunistic | coastal |

## Distribution, Population Status and Trends


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California Gulls (CAGU) breed primarily on predator-free islands in interior lakes throughout the Great Basin and prairie states and provinces of North America, as far north as the central taiga. They winter along the west coast of North America from British Columbia to central MX.[12] Two subspecies have been recognized; the smaller and darker *L. c. californicus* breeds in the west.[3,15] CAGU are numerous in nearshore and offshore waters of CA in the fall and winter, with densities being highest within 50 km offshore.[14]

The North American breeding population was estimated at 276,000 birds in 1980.[1] The overall population estimate was 500,000 - 1,000,000 individuals during the early 1990's.[12] CAGU began breeding in coastal CA in 1981 and the colony complex in San Francisco Bay is now one of the largest in the U.S. Approximately 4,800 CAGU nested at three colonies within San Francisco Bay in 1989-1990.[15] In 2002, they bred at five sites; approximately 9,500 nests (19,000 breeders) (C. Strong, pers. comm.). Continental populations of CAGU likely increased throughout the mid-1900s in response to increased man-related food availability and decreased harvest of eggs and feathers.[1,11,13] Populations may be leveling off at the turn of the 21st century due to changes in dump management.[9,13] Population size at the San Francisco colonies continues to increase.

## Ecology

CAGU migrate from the Pacific coast to inland breeding colonies in late Feb through May. The age of first breeding can be as early as 3 years in males and 4 years in females[5,7] and probably as late as 8-10+ years in some individuals. Non-breeding individuals spend their first 1-2 summers on the winter grounds and subsequent summers in the vicinity of breeding colonies.[12]

At inland colonies, chicks are fed a variety of opportunistically-gained diet items, including brine flies and shrimp, other arthropods, fish, garbage from dumps, bird chicks (including those of conspecifics), carrion, and vegetative matter;[2,12] there is little information on diet at coastal colonies. Winter diet data are limited but include anchovies, Pacific saury, squid, and other invertebrates.[16,17] Migration to coastal wintering grounds occurs in Aug-Oct at which time the diet switches to fish and crabs.[12] Annual adult survival is between 75% and 90%[8,12] with longevity ranging up to 30 years.[8]

## Conservation Concerns and Activities

The most serious threat to coastal CAGU is disturbance of breeding colonies, resulting in increased intra-specific predation of chicks.[4,10,13] Other threats include non-native predators, ingestion of plastics and other toxins from garbage dumps, contaminants, and oil spills.[11,12] There is some concern that the rapidly increasing gull colony may be adversely affecting other colonial waterbirds nesting in the bay. CAGU are considered pests at fish hatcheries.[6]

## Recommended Actions

- Protect breeding colonies in San Francisco Bay from disturbance and introduced predators.
- Assess the relationship between CAGU and other colonial waterbirds breeding in San Francisco Bay.

## Regional Contacts

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***References:*** 1. Conover 1983; 2. Greenhalgh 1952; 3. Jehl 1987; 4. Jehl and Chase 1987; 5. Johnston 1956; 6. Pitt and Conover 1996; 7. Pugesek and Diem 1983; 8. Pugesek *et al.* 1995; 9. Pyle and DeSante 1994; 10. Shivik and Crabtree 1995; 11. Vermeer 1970; 12. Winkler 1996; 13. Winkler and Shuford 1988; 14. Briggs *et al.* 1987b; 15. Carter *et al.* 1992; 16. Baltz and Morejohn 1977; 17. Wahl 1977.

# Western Gull *Larus occidentalis*

## Status

**Federal: None** **State: None** **IUCN: None** **NAWCP: LC/LC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 2-3 | yes | 2-3 | ~30d | ~45d | Apr-Jul | surface, veg | surface, scavenging | coastal |

## Distribution, Population Status and Trends

The Western Gull (WEGU) is endemic to the west coast of North America, ranging between British Columbia, and the southern tip of Baja California, MX.[7,9,10] There are two recognized subspecies: *L. o. occidentalis* (British Columbia to central CA), and *L. o. wymani* (central CA to Baja).[6] The yellow-footed gull (*L. livens*) was once considered a subspecies. Extensive hybridization occurs with Glaucous-winged Gulls (GWGU) in the northern part of the range.[7,9] During the non-breeding season, WEGU are distributed throughout the breeding range, although at greater distances from the colonies than during the breeding season.[6,12] WEGU forage in inshore and coastal waters and are rarely seen seaward of 25 km from the shelf break.[12,21] During El Niño events, at-sea WEGU abundance declines, with a possible redistribution of birds to other sites such as more coastal and inland areas, as well as a greater concentration at garbage dumps.[12]

The total population is estimated between 80,000 and 126,000 breeding birds,[10,14] with the majority of the population in CA (50-77%).[4,13] The largest single colony is found on Southeast Farallon Island, CA, with approximately 16,000-20,000 birds.[4,11] Historically, WEGU populations were reduced as a result of human efforts to reduce gull numbers in the 1800s.[1] However, populations appear to have increased during the past century due to the restriction of human activity at important breeding sites[5] and increased food availability at dumps[7] but may be leveling off at the turn of the 21st century due to changes in dump management.[8] California population trends indicate a 39% increase between the late 1970s and 1989-1991 (~62,800 breeding birds in 1990), with the greatest increases in the San Francisco Bay and Channel Islands.[4] Population sizes and trends are not well known in OR and WA, and are further complicated by the high degree of hybridization with GWGU[9,22] (see population discussion in GWGU species profile).

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## Ecology

WEGU breed primarily on offshore rocks and islands.[2,7,9] Males typically arrive at breeding colonies first, where they defend territories and build up to 3 nests.[1] Females then choose a nest and will lay a single clutch of up to 3 eggs (less in poor food years).[1,7] WEGU are capable of replacing a clutch if it is lost early in the season, but replacement clutches are generally smaller and less successful.[1] WEGU are generally monogamous and female-female pairs that lay supernormal clutches of 4-6 eggs have been documented.[1,2,17] Reproductive performance at the Farallons and Santa Barbara Is. have shown a steady decline since the 1970s and 1980s.[3] During El Niño events, increased adult mortality and low reproductive rates are typical.[1,18]

WEGU are generalist predators, feeding predominantly on fish, marine invertebrates and human refuse.[7] They are also opportunistic scavengers and will feed on eggs, chicks and adult birds.[1,7] Diet studies have been conducted at several sites throughout the range and composition varies geographically, seasonally, at different stages of the breeding cycle, and in response to large scale oceanographic conditions, such as El Niño. Some major prey items include anchovy, rockfish, Pacific whiting, jack mackerel, Pacific saury, midshipman, white croaker, euphausiids, squid, gooseneck barnacles, pelagic red crabs, sea urchins, clams, limpets and mussels.[7]

## Conservation Concerns and Activities

Human impacts on WEGU are limited due to remote breeding localities and the resilience of gull individuals and populations. However, the relatively small population size and limited range make WEGU vulnerable to threats such as introduced predators, human disturbance, oil, pesticide contamination, other toxins, and the spread of avian diseases. Disturbance to breeding colonies can result in lowered reproductive success and increased intra-specific predation of chicks.[16] Female-female pairing was recorded at several of the Channel Islands in the 1970s, and resulted in decreased reproductive success.[17] Female-female pairing was linked to exposure to DDT.[19,20] Organochlorine concentrations in central CA eggs have decreased since the 1970s[15] and there has been a concurrent decrease in female-female pairing and recovery of the Southern California Bight WEGU population. Increased abundance of anchovies may also have been a factor fueling the recovery of WEGU populations (G.L. Hunt pers. comm.). Other concerns include the spread of avian botulism within colonies.

## Recommended Actions

- Protect major breeding colonies from human disturbance and introduced predators.
- Assess and monitor contaminant levels.
- Resurvey colonies in Oregon and Washington to determine population trends and document changes in distribution.
- Monitor the WEGU x GWWG hybridization zone at regular intervals to track changes.

## Regional Contacts

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***References:*** 1. Ainley and Boekelheide 1990; 2. Bent 1921; 3. Sydeman *et al.* 2001; 4. Carter *et al.* 1992; 5. Carter *et al.* 1995c; 6. Harrison 1983; 7. Pierotti and Annett 1995; 8. Spear 1993; 9. Speich and Wahl 1989; 10. Sowls *et al.* 1980; 11. Warzybok *et al.* 2002; 12. Briggs *et al.* 1987b; 13. Kushlan *et al.* 2002; 14. Martin and Sydeman 1998; 15. Pyle *et al.* 1999; 16. Carney and Sydeman 1999; 17. Hunt and Hunt 1977; 18. Ainley *et al.* 1986; 19. Fry and Toone 1981; 20. Fry *et al.* 1987; 21. Briggs et al 1992; 22. USFWS in prep.

# Glaucous-winged Gull *Larus glaucescens*

## Status

**Federal: None** **State: None** **IUCN: None** **NAWCP: LC/NCR**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1-3 | yes | 1-3 | ~28d | 31-52d | Apr-Aug | surface, stick | surface dipping | coastal |

## Distribution, Population Status and Trends

Glaucous-winged Gulls (GWGU) breed along the Pacific rim, from the Commander Islands, Russia, to AK and south to northwestern OR, where they hybridize extensively with Western Gulls (WEGU).[1] Hybrid gulls breed as far south as central CA.[20] During the non-breeding season, many GWGU are resident, while others disperse along the Pacific coast, as far south as the tip of Baja California, MX.[14,21] GWGU are most common along coastal areas and waters over the continental shelf and as far out as 150 km or more.[22]

The North American population is estimated at 380,000 breeding birds.[19] Because of extensive hybridization with WEGU in WA and OR, estimating population size in this Region is difficult and most colony surveys have not distinguished between the two species. In WA, approximately 37,000 GWGU/WEGU (combined) were estimated during the last complete inventory, in the early 1980s.[11] In OR, the estimate is 36,000 breeding GWGU/WEGU: 13,800 gulls (6,900 nests) along the outer coast from the 1988 inventory[18] and 22,500 breeding birds (predominantly hybrids) estimated in the Columbia River estuary in 2001 (D. Roby pers. comm.). As with other gull species, continental populations of GWGU increased throughout the mid-1900s in response to increased man-related food availability and decreased harvest of eggs and feathers, but may be leveling off at the turn of the 21st century.[8,9,14] Numbers in the Columbia River estuary continued to increase through the 1990s from 1,750 birds in 1981.[11] In Puget Sound there appears to be a shift in distribution as numbers decline at island colonies but increase in urban and industrial habitats and the Columbia River (J. Galusha pers. comm., R. Woodruff pers. comm.).

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## Ecology

Breeding occurs in small to large colonies (and even isolated pairs) on coastal islands and artificial structures.[2,4] The mean age of first breeding in one colony was 5.4 years with a range of 4-7 years,[10] although it probably can be as late as 8-10 years in some individuals. Non-breeding individuals spend their first summer along the coast and subsequent summers in the vicinity of breeding colonies. Annual survival of adults is 83-87%[3,10,15] and average life expectancy of adults is 9.5 years[15] with longevity ranging up to 32 years.[14]

GWGU feed in marine, estuarine, intertidal and terrestrial (*e.g.*, dumps, farm fields) environments. Specific diet studies are generally lacking in WA, OR and CA but it is known that GWGU are omnivorous, eating a wide variety of marine organisms including intertidal invertebrates and fish, terrestrial invertebrates such as earthworms, garbage, chicks (including conspecifics), and a variety of other food items.[7,11,12,13,16]

## Conservation Concerns and Activities

Minor impacts on the population include ingestion of plastics and other toxins from garbage dumps[5] and the effects of contaminants and oil spills on the wintering grounds. The most serious potential impact involves disturbance to breeding colonies, resulting in increased intra-specific predation of chicks[6] although effects on the overall population appear to be minimal.[10,13,17] There are increasing conflicts and demands for population control, as the number of gulls nesting in urban and industrial habitats increases, especially in Puget Sound.

## Recommended Actions

- Protection of island breeding colonies from human disturbance and introduction of non-native predators.
- Complete survey of Oregon and Washington colonies to determine population status and trends and document changes in distribution.
- Monitor the WEGU x GWWG hybridization zone at regular intervals to track changes.

## Regional Contacts

Joe Galusha - Walla Walla College, College Place, WA

Daniel Roby - USGS, Oregon Cooperative Research Unit, Corvallis, OR

Douglas Bell - California State University, Sacramento, CA

***References:*** 1. Bell 1996; 2. Binford and Johnson 1995; 3. Butler *et al.* 1980; 4. Conover and Thompson 1984; 5. Fry *et al.* 1987; 6. Gillet *et al.* 1975; 7. Irons *et al.* 1986; 8. Pyle and DeSante 1994; 9. Reid 1988a; 10. Reid 1988b; 11. Speich and Wahl 1989; 12. Trapp 1979; 13. Verbeek 1986; 14. Verbeek 1993; 15. Vermeer 1963; 16. Vermeer 1982; 17. Vermeer and Irons 1991; 18. USFWS in prep.; 19. Kushlan *et al.* 2002; 20. Carter *et al.* 1992; 21. Harrison 1983; 22. Briggs *et al.* 1987b.



*Glaucous-winged x Western Gull hybird.*

# Gull-billed Tern *Sterna nilotica*

**Status**

**Federal: BCC** **State: CA-SC** **IUCN: None** **NAWCP: HC/HC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 2-3 | yes | 2-3 | ~22d | ~30d | Mar-Aug | ground scrape | surface seizing | coastal |

## Distribution, Population Status, and Trends

Gull-billed Terns (GBTE) are found on all continents except Antarctica.[1] There are 6 recognized subspecies: *S.n. vanrossemi* breeds in southern CA and northwest MX.[1,11,12] A rangewide survey in 2003 documented 10 active *S.n. vanrossemi* colonies (2 in the U.S. and 8 in MX). California colonies are located at the Salton Sea and San Diego Bay and the Mexican colonies are in the Gulf of California and the Pacific coast of Baja.[1,8,11,12,13] The non-breeding distribution is not well documented but appears to extend from Baja, south along the coasts of Central and South America.[1,7] There is little information on at-sea distribution, but they presumably remain in inshore waters.

In 2003, USFWS coordinated with Mexican and U.S. biologists to conduct an inventory of all *S.n. vanrossemi* colonies. About 1,100 breeding birds (550 pairs) were documented at 10 locations and the 2 small U.S. colonies accounted for approximately 35% of the birds. South San Diego Bay was colonized in the 1980s and currently 80-120 birds (40-60 pairs) breed there annually (R. Patton pers. comm.).[3,4,9] Pemberton[2] estimated the Salton Sea population at 500 pairs in 1927; approximately 300 birds (150 pairs) currently nest.[14] The CA population declined significantly over the past century but recent trends appear relatively stable.[14] Population trends in MX are unknown.

## Ecology

GBTE historically nested in marshes, but now seem restricted to gravel, sand, or shell beaches.[1] Birds migrate to breeding sites by mid-Mar and breed on eroded earthen levees and small islets.[1] GBTE nest in colonies or singly, often in proximity to other terns such as Caspian, Least, and Elegant Terns.[1] Breeding begins at 5 years of age,[1] and they have monogamous long-term pair bonds[5] but low site fidelity.[1] Chicks make their first flight at ~1 month of age, but may be fed by their parents for another

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2-3 months, through the beginning of migration.[1] Most birds have departed southern CA by the beginning of Sep.[10]

GBTE are opportunistic feeders, preying on insects, lizards, crustaceans, fish and occasionally chicks of other birds and small mammals.[1] This species does not plunge-dive, as do most other terns, but feeds during flight.[1]

## Conservation Concerns and Activities

Extremely small population size and limited breeding distribution is a major concern for this subspecies. As with many species of terns along the Pacific coast, GBTE suffer from loss of nesting habitat, predation, human disturbance, and organochlorine contamination.[1] GBTE seem more vulnerable to disturbance than other terns, and during the breeding season disturbance can cause chick and adult mortality from predation, and early dispersal of young.[6] A preliminary analysis of eggs from the Salton Sea suggests possible contamination by selenium and DDE.[1] GBTE prey upon endangered California Least Terns and Western Snowy Plovers which are federally listed as endangered and threatened, respectively. This has resulted in management conflicts in CA.

## Recommended Actions

- Complete a status assessment of *S.n. vanrossemi* which identifies the limiting factors and major threats and implement actions to address these threats. Repeat the rangewide survey in support of this status assessment.
- Coordinate with MX to protect existing breeding habitat, restore historic habitat, and initiate regular monitoring programs of breeding populations.
- Investigate chemical contaminants and their effects on survival and reproductive success.

## Regional Contacts

Kathy Molina - Natural History Museum, Los Angeles, CA
Eric Mellink - Centro de Investigación Científica de Educación Superior de Ensenada, MX
Eduardo Palacios- Pronatura Noroeste Mar de Cortes, Gulf of California, MX
Xicoténcatl Vega Picos - Pronatura, Sinaloa, MX
Brian Collins - USFWS, Sweetwater Marsh NWR, San Diego, CA

***References:*** 1. Parnell *et al.* 1995; 2. Pemberton 1927; 3. Carter *et al.* 1992; 4. Molina 2001; 5. Moller 1981; 6. Sears 1978; 7. Harrison 1983; 8. Molina and Garrett (in press); 9. McCaskie 1991; 10. Garrett and Dunn 1981; 11. Palacios and Mellink 1993; 12. Danemann and Carmona 2000; 13. Xico Vega, pers. comm. 2002; 14. Molina and Erwin in prep.

# Caspian Tern *Sterna caspia*

## Status

**Federal: BCC (5)** **State: WA-SM** **IUCN: None** **NAWCP: LC/MC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1-3 | yes | 1-2 | ~27d | ~35d | Apr-Jul | surface scrape | plunge diving | coastal |

## Distribution, Population Status and Trends

Caspian Terns (CATE) are widely distributed in scattered colonies on all continents (except Antarctica and South America) along coastlines, and inland along rivers, lakes and marshes.[1] In this Region, CATE breed on the coast as well as inland from WA south to the MX border.[1] Pacific birds winter primarily from southern CA throughout western MX and south to Guatemala.[1,5,6] CATE favor estuarine habitats and secondarily inshore marine waters when foraging and migrating along the coast.[5]

In North America there are an estimated 32,000-34,000 breeding pairs.[4] Approximately 12,200 pairs (37%) nested in Pacific coastal areas in 2002; the majority concentrated at one colony in the Columbia River estuary - East Sand Is. (ESI), OR.[12] This is the largest CATE colony in the world (9,933 pairs in 2002),[13] supporting almost 70% of the U.S. Pacific coastal population. Smaller colonies include Brooks Is., CA (825 pairs); and South San Diego Bay, CA (379 pairs).[12] There has been a general increase in the Pacific population of CATE since the 1960s, which is probably due, in part, to colonization of human-enhanced nesting sites on the coast in close proximity to abundant fish resources.[2,5] There was a dramatic increase in the Columbia River estuary colony in the 1990s, which was probably influenced by numerous anthropogenic and natural factors (*e.g.*, abundant hatchery salmon, creation of dredge spoil islands and loss of habitat elsewhere).[5] Concomitant with this general increase and shift to the Columbia River estuary has been a decline in the number of colonies in the west, over the past 20 years.[5]

## Ecology

CATE are the largest of all terns, generally breeding on open, flat areas, dredge-material islands, and salt pond dikes. They often nest in colonies adjacent to gulls and other tern species and while most nest in colonies of at least 100 pairs, some nest singly.[1] Attempts to attract CATE to new

Dan Roby, USGS

sites using decoys and taped vocalizations have been very successful.[10] CATE begin breeding at 3 years of age and are generally monogamous.[1] Chicks fledge at approximately 5 weeks, although parents continue feeding young for several months post-fledging.[7]

CATE forage in estuarine and inshore coastal waters, and their diet is comprised almost exclusively of fish acquired through shallow plunge dives.[5] Composition varies by location but main prey items included jacksmelt, topsmelt, shiner perch, staghorn sculpin, northern anchovy, Pacific sardine, and salmonids.[1] In the Columbia River estuary, salmonids were the dominant prey item at Rice Is., OR (74-90%), however, when the birds moved to ESI, closer to the mouth of the estuary, the proportion of salmon in the diet fell by approximately 50% and anchovy, herring, shiner perch, sandlance, sculpins, smelt and flatfish increased.[3]

## Conservation Concerns and Activities

CATE colonies are highly susceptible to habitat loss and degradation. This can be natural (*e.g.*, vegetative succession, erosion, or inundation) or human-caused.[5] The greatest conservation concern for CATE in this Region is the concentration of breeding birds at one colony. This results in increased risk from stochastic events such as disease, contaminant and fuel spills, natural disasters, introduced predators, and human disturbance. Additionally, there have been conflicts with management for endangered salmonids in the Columbia River. Mammalian predation, especially red foxes, has been a problem at CA colonies. Human activity (including researcher disturbance) at or near nesting sites can greatly reduce reproductive success.[1]

There is evidence that contaminants may be impacting CATE reproduction in San Francisco Bay, CA and Commencement Bay, WA.[11] High concentrations of organochlorine pollutants, such as PCB and DDE, were identified in the mid 1980s and more recent studies indicate that PCB concentrations have not declined in recent decades.[8,9,11] CATE eggs from San Francisco Bay had high concentrations of mercury; 85-90% of eggs had mercury concentrations above the level expected to have an adverse effect.[11]

## Recommended Actions

- Protect, enhance, or create nesting areas, distributed throughout the Region to provide multiple suitable nesting sites along the coast.
- Coordinate with other agencies to manage CATE colonies in the Columbia River estuary including continued research of the impact of CATE relocation on productivity and population size. Monitor populations throughout the Pacific Coast/Western Region.
- Develop public education programs on CATE natural history and the negative effects of human disturbance.
- Continue to monitor contaminant levels and document the effects on reproduction.

## Regional Contacts

Daniel Roby - USGS, Oregon Cooperative Research Unit, Corvallis, OR
David Craig - Willamette University, Salem, OR
David Shuford - PRBO Conservation Science, Stinson Beach, CA
Nanette Seto - U.S. Fish and Wildlife Service, Regional Office, Portland, OR

***References***: 1. Cuthbert and Wires 1999; 2. Gill and Mewaldt 1983; 3. Roby *et al.* 1998; 4. Kushlan *et al.* 2002; 5. Shuford and Craig 2002; 6. Harrison 1983; 7. Wires and Cuthbert 2000; 8. Ohlendorf *et al.* 1985; 9. Ohlendorf *et al.* 1988; 10. Roby *et al.* 2002; 11. Schwarzbach and Adelsbach 2002; 12. USFWS 2004; 13. CBR 2003.

# Royal Tern *Sterna maxima*

## Status

**Federal: None** **State: CA - SC** **IUCN: None** **NAWCP: MC/LC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1-2 | yes | 1-2 | ~30d | ~31d | Apr-Aug | surface scrape | plunge diving | coastal |

## Distribution, Population Status, and Trends

Royal Terns (ROTE) breed in North and Central America, the Caribbean, and west Africa.[6] Two subspecies are recognized; *S. m. maxima* breeds along the Pacific coast from southern CA along the west coast of MX and the Gulf of Mexico.[1,2] Post breeding, Pacific ROTE depart the colonies and migrate north, as far as northern CA, followed by a southern migration, reaching as far south as southern Peru.[1,6] ROTE are found primarily along the coast and estuaries, and rarely seen more than 1 km offshore.[7]

Approximately 125,000 ROTE breed in the Americas and West Indies.[3] ROTE are peripheral breeders in this Region. They were first reported breeding on the salt ponds of San Diego Bay in 1959.[5] A small group of 70 birds bred in 1999.[3,10,11] Breeding was also documented at Bolsa Chica Ecological Reserve, CA in 1988-1990 (4-20 birds).[4] ROTE were once more common in CA[8] but numbers declined over the past half century, possibly as a result of the sardine crash in the 1950s or range expansion of Elegant Terns.[9,12]

## Ecology

In CA, ROTE nest on salt pond dikes and dredge spoil islands. They frequently nest with other terns, *e.g.*, Caspian and Elegant.[12] Age of first breeding is 3-4 years.[14] Birds often remain at wintering grounds their first year.[14] Chicks form creches at 2-3 days and adults recognize their chicks by their response to the adult's calls.[14]

ROTE are opportunistic feeders in other areas but the diet of southern CA breeders is unknown, although there is evidence that Pacific sardines were historically important.[12,14] ROTE plunge-dive after hovering, and feed singly or in small flocks.[14] ROTE feed close to shore in marine, estuarine, and even freshwater areas.[7,13]

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## Conservation Concerns and Activities

CA colonies are small and at the northern extent of the range. These breeding populations are vulnerable to disturbance from humans and animals. Colonies are often destroyed by natural events *e.g.*, high tides and storms.[3] Analysis of band recovery records indicated that ROTE, especially <1 year old birds, are captured or entangled in fishing lines or hooks.[13]

## Recommended Actions

- Protect breeding colonies at San Diego NWR and Bolsa Chica Ecological Reserve, CA.
- Monitor range expansion to determine where future habitat conservation may be warranted.
- Provide outreach materials to fishers to minimize take and the proper handling of captured birds.

## Regional Contacts

Robert Patton - San Diego Zoo, San Diego, CA
Charlie Collins - California State University, Long Beach, CA

***References:*** 1. Clapp *et al.* 1993; 2. Everett and Anderson 1991; 3. McCaskie 1988; 4. Collins *et al.* 1991; 5. Gallup and Bailey 1960; 6. Briggs *et al.* 1989; 7. Briggs *et al.* 1987b; 8. Grinnell and Miller 1944; 9. Cogswell 1977; 10. Garrett and Dunn 1981; 11. Unitt 2000; 12. Schaffner 1986; 13. Buckley and Buckley 1974; 14. Buckley and Buckley 2002.

# Elegant Tern *Sterna elegans*

## Status

**Federal: BCC** **State: CA-SC** **IUCN: LR/nt** **NAWCP: MC/HC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1-2 | yes | 1-2 | ~26d | ~35d | Apr-Jul | surface scrape | plunge diving | coastal |

### Distribution, Population Status and Trends

Elegant Tern (ELTE) breeding distribution is restricted to southern CA and the northern Gulf of CA, MX.[14] Historically, colonies also occurred along the Pacific Coast of Baja and further south in the Gulf.[1] There is a post-fledging northward migration of juveniles and adults, primarily along the coast, resulting in peak numbers from Jul - Sep in CA coastal waters (common as far north as San Francisco).[11] By the end of Oct, most birds leave CA and disperse south to wintering grounds from Guatemala to Chile.[6] ELTE forage close to shore (usually within 4 km) in marine and estuarine habitats (including near shore lagoons and harbors).[10,16]


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Total breeding population is estimated at <30,000 pairs (60,000 birds), with an estimated 90% located at one colony on Isla Rasa, MX.[15] Only five colonies are currently active: two in MX and three in southern CA.[1] Birds first began breeding in the U.S. in 1959, in San Diego Bay, CA;[3,4] since then, ELTE have expanded their breeding range to Bolsa Chica and Los Angeles Harbor. Approximately 10,000 birds bred at these three U.S. colonies in 2003 (Brian Collins, pers. comm.), constituting ~10% of the global population, although these numbers are highly variable among years.[17] There has been a general range expansion into southern CA, although attendance at these breeding sites fluctuates among years in response to El Niño conditions, habitat changes, and disturbance events. Population size at Isla Rasa increased following the establishment of the island reserve in 1964, but recent trends are unclear.[13]

### Ecology

This coastal tern arrives at southern CA sites to begin breeding activities in early Mar.[14] Breeding pairs form tight groups and nest among more aggressive birds, such as Caspian and Forster's Terns, and Black Skimmers. Habitat generally has little vegetation and is on low, flat, and sandy areas.[1] San Diego and Los Angeles sites are on dredge-filled dikes and Bolsa Chica nests are on two sand-filled islands. ELTE lay one, rarely two, eggs and both parents incubate.[1] Chicks form creches at an average age of 6 days.[1] Dependence on parents is protracted and feeding can continue for 6 months after the young are able to fly.[1]

Primary prey is northern anchovy and other schooling fish.[1,5,7,8] Studies reported strong associations in ELTE breeding success and dispersal with anchovy availability.[2,8,12,13] Feeds in marine and estuarine habitats, and rarely in freshwater.[5]

### Conservation Concerns and Activities

ELTE breeding range and population size have not recovered to known historical levels, when colonies were more widespread than at present.[1,2] The world population is vulnerable due to its restricted range, concentration of >90% of the population at one colony, sensitivity to disturbance, and major loss of breeding habitat. Urban development threatens sites in San Diego and Los Angeles,[5] although several groups such as the Bolsa Chica Land Trust and the Amigos de Bolsa Chica, are actively involved in preserving this wetland and preventing urban development. Predation by dogs and cats has caused loss of chicks in San Diego.[9] Continued northern expansion is potentially limited due to dense human development along most of the coast. In addition, colonization may require prior establishment of other breeding gulls or terns. Contaminant concerns include oil-spills and other chemical pollutants at breeding sites and wintering areas. Organochlorine compounds were present in ELTE eggs in San Diego Bay in 1985, although hatching success at this colony was, and continues to be, high.[10,18] Entanglement with fishing gear, degradation of habitat, and disturbance at breeding colonies and roost sites are all issues of conservation concern for this species.

## Recommended Actions

- Protection of all occupied breeding sites from disturbance and non-native predators.
- Develop a U.S. and Mexico partnership to begin joint recovery programs and integrate conservation with bilingual education and outreach.
- Investigate historic breeding sites and evaluate the potential for restoration.
- Investigate population dynamics through long-term demographic studies with marked individuals.
- Assess fishery threats (both direct and indirect) at breeding and wintering areas.

## Regional Contacts

Kathy Molina - Natural History Museum, Los Angeles, CA

Charles Collins - California State University, Long Beach, CA

Enriqueta Velarde - Isla Rasa Biosphere Reserve, Mexico

Brian Collins - USFWS, Sweetwater Marsh NWR, San Diego, CA

***References:*** 1. Burness *et al.* 1999; 2. Clapp *et al.* 1993; 3. Collins *et al.* 1991; 4. Gallup and Bailey 1960; 5. Horn *et al.* 1996; 6. Howell and Webb 1995; 7. Loeffler 1996; 8. Schaffner 1986; 9. Schaffner 1985; 10. Schaffner 1982; 11. Small 1994; 12. Velarde *et al.* 1994; 13. Velarde and Anderson 1994; 14. Harrison 1983; 15. Kushlan *et al.* 2002; 16. Briggs *et al.* 1987b; 17. Carter *et al.* 1992; 18. Ohlendorf *et al.* 1988.

# Arctic Tern *Sterna paradisaea*

## Status

**Federal: BCC (5)** **State: WA - SM** **IUCN: None** **NAWCP: HC/LC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1-3 | unk | 1-3 | ~22d | ~24d | May-Aug | surface scrape | plunge diving | offshore |

## Distribution, Population Status, and Trends

Arctic Terns (ARTE) have an arctic circumpolar breeding distribution.[1,4] In North America ARTE breed as far south as Puget Sound, WA on the Pacific coast and to Massachusetts on the Atlantic.[3] ARTE have one of the most impressive migrations, breeding in the arctic and wintering in Antarctic and sub-Antarctic waters.[1,3] During migration in the Pacific, ARTE are most numerous seaward of 25 km offshore,[5] with spring densities usually much lower than those in the fall.[6] ARTE concentrations are found primarily in clear waters over the continental slope.[5]

Population estimates from 1980 suggest that more than 30,000 ARTE pairs breed in south to south-central AK and in the Russian Far East.[1] ARTE are peripheral breeders in this Region. A small colony (20-40 birds) nested on Jetty Is. in the Puget Sound, WA in 1977 and 1978[2,4] and small numbers present in 2001 indicate that they still nest in the area (R. Milner pers. comm.).

## Ecology

In WA, ARTE nest on Jetty Is., a dredge spoil island in Everett Harbor, Puget Sound near the Glaucous-winged Gull colony.[4] Nesting habitat is grass and sedge vegetation surrounded by bare ground.[2] Although ARTE can lay 1-3 eggs, they generally lay 2.[4,8] ARTE are monogamous, with long-term pair bonds and strong nest site fidelity.[9]

ARTE are surface feeding plunge-divers, eating primarily fish as well as crustaceans, and occasionally scavenging or pirating food,[4] although prey choice appears to be site-specific.[8] Little is known about the breeding biology or foraging ecology of ARTE in WA.

Kathy Kuletz, USFWS

## Conservation Concerns and Activities

The small breeding population in this Region, which has been completely absent at times,[4] is extremely vulnerable to impacts from human disturbance.

## Recommended Actions

- Protection of breeding colonies from disturbance and non-native predators.

## Regional Contacts

David Manuwal - University of Washington, Seattle, WA

***References:*** 1. Clapp *et al.* 1993; 2. Manuwal *et al.* 1979; 3. Harrison 1983; 4. Speich and Wahl 1989; 5. Briggs *et al.* 1987b; 6. Briggs *et al.* 1992; 7. Hatch 2002; 8. Robinson *et al.* 2001; 9. Suddaby and Ratcliffe 1997.

# Forster's Tern *Sterna forsteri*

## Status

**Federal: None** **State: WA- SM** **IUCN: None** **NAWCP: MC/MC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 2-3 | yes | 2-3 | ~21d | ~35d | May-Aug | surface | plunge diving | coastal |

## Distribution, Population Status, and Trends

Forster's Terns (FOTE) breed primarily at scattered inland locations throughout North America.[1,9] In the coastal area of this Region, FOTE breed in CA at San Francisco Bay, San Diego Bay and Bolsa Chica.[9] Prior to 1980, they also nested in Monterey Bay. Non-breeding distribution of FOTE is along the southern Pacific and Atlantic coasts to northern Central America,[1,10] out to 15 km offshore in CA.[3]

Spendelow and Patton[13] compiled an estimate for the Pacific coast of 8,100 FOTE breeding at 15 colonies in 1979-1980. This represented approximately 22% of the total U.S. coastal breeding population; 6,000 (74%) of these birds nested in San Francisco Bay.[13] More recent estimates (1989-1991) of 3,550 breeding birds at 21 colonies in the San Francisco Bay area and the loss of the Monterey colonies indicate a decline in central CA.[9] Declines were attributed to human disturbance and predation.[9] Numbers nesting in San Diego Bay are quite variable but relatively stable since 1991, fluctuating between 600-1,200 breeding birds (R. Patton pers. comm.). FOTE also nest at Seal Beach NWR, Bolsa Chica, and Upper Newport Bay in southern CA (L. Hays pers. comm.).

## Ecology

FOTE breed in freshwater and saltwater marshes, and along the borders of ponds and lakes;[1] in San Francisco Bay they nest on salt pond levees.[9] FOTE form monogamous pair bonds and typically breed in small, loose colonies of 2-100 nests[1,5] Both adults care for the young.[1] FOTE breed annually, starting at age 2 years, though few demographic data are available for this species.[1]

The FOTE surface-feeds during flight, primarily in shallow water, on small fishes,[1] though most information on diet is anecdotal. There is some evidence that Pacific coastal birds feed on shiner perch and anchovies.[11]

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## Conservation Concerns and Activities

Organochlorine pollutants (DDE) have been correlated with eggshell thinning in CA and PCB concentrations in birds nesting at San Francisco Bay showed no significant decline in recent decades and were at or near adverse effects levels.[7,12] Approximately 75-80% of FOTE eggs collected from the San Francisco Bay area in 2000 also had high levels of mercury, above the level of adverse effects.[12] As an upper trophic predator in the littoral zone, FOTE can serve as a biomonitor of potentially harmful chemicals.[8] Development in wetland areas can degrade breeding habitat through draining, filling, or flooding riparian areas.[1,9] Nests are vulnerable to wave action and a suite of mammalian, avian, and reptilian wetland predators.[1] Colonies have been displaced or reduced in numbers because of human disturbance and predation by introduced red fox.[9]

## Recommended Actions

- Protection of FOTE breeding sites from disturbance and non-native predators.
- Monitor contaminant levels and their effects on reproductive success.
- Long-term demographic data in the CA coastal populations is needed to determine status and dynamics of FOTE populations.

## Regional Contacts

Cheryl Strong - San Francisco Bay Bird Observatory, San Francisco, CA
Michael Horn - California State University, Fullerton, CA
Robert Patton - San Diego Zoo, San Diego, CA

***References:*** 1. McNicholl *et al.* 2001; 2. Kushlan *et al.* 2002; 3. Briggs *et al.* 1987b; 4. Moynihan 1959; 5. McNicholl 1971; 6. Hall 1989; 7. Ohlendorf *et al.* 1988; 8. Harris *et al.* 1985; 9. Carter *et al.* 1992; 10. Harrison 1983; 11. Gochfeld and Burger 1996; 12 Schwarzbach and Adelsbach 2002; 13. Spendelow and Patton 1988.

# Least Tern *Sterna antillarum*

## Status

**Federal: E** **State: CA-E, OR-E** **IUCN: None** **NAWCP: HC/HC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1-3 | yes | 1-2 | ~20d | ~25d | Apr-Jul | surface scrape | plunge diving | coastal |

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### Distribution, Population Status and Trends

Least Terns (LETE) nest along both the Atlantic and Pacific coasts and up major rivers of North and South America. Three subspecies are recognized; the Pacific coast subspecies, California LETE *S. a. browni*, breeds from central CA to Baja California, MX and winters along the coast of southern MX[1] (the rest of this account refers to this subspecies).While migrating, LETE remain near the coast, although they have been observed foraging in multispecies feeding flocks 2-30 km off the western coast of Baja California in late Apr and early May.[12]

The LETE population in CA averaged ~4,300 pairs between 2000-2002 (CDFG, unpubl. data), representing 10% of the North American population.[2] Current significant breeding sites, include Camp Pendelton (584 pairs), Naval Air Base Coronado (534 pairs), Alameda Pt. in San Francisco Bay (300 pairs), Los Angeles Harbor (287 pairs) and Huntington State Beach (316 pairs) (CDFG, unpubl. data). The population has contracted remarkably from historical distribution due to loss of habitat, predation, and some losses due to shooting and egg collecting.[1,6] There are no reliable historical estimates, but qualitative reports from the late 1800s and early 1900s indicated that LETE were abundant in southern CA.[6] LETE were federally listed in 1970[6] and the CA population has increased almost 8-fold from a low of 600 pairs in 1973-1975.

### Ecology

LETE arrive at breeding sites in mid- to late-Apr and nest in open, non-vegetated habitat along coastal beaches and rivers.[1] Prior to incubation birds roost at night on open sandy beaches, departing at first light.[5] They are monogamous, colonial, and defend territories.[1] Birds lay 1-4 eggs but 2 egg clutches are the most common.[8] Young are capable of flight at approximately 3 weeks but parents continue to feed them until sometime after they depart from the breeding grounds.[8] In southern CA, LETE had high rates of site fidelity, returning to their natal site to nest.[10] First breeding occurs at 2-3 years of age and the oldest bird was 21 years old.[11]

Important prey include small surface-swimming fishes such as northern anchovy, topsmelt, jacksmelt, killifish, shiner perch and other surfperch species, deep-body anchovies, and slough anchovies.[1,3] Foraging habitat includes coastal areas, bays, lagoons, estuaries, and any shallow water habitat (such as lakes, ponds, streams, etc.).[1] El Niño conditions can significantly effect reproductive success and adult survival.[4]

### Conservation Concerns and Activities

Major conservation concerns include habitat loss, predation, contaminants and human disturbance.[7,8,9] Non-native plants, such as iceplant, invade colony sites and can render habitat unsuitable if not managed. Analysis of failed LETE eggs collected at Alameda indicated that PCB contamination may be a factor in reduced reproductive performance at this site.[13] Mercury levels were also elevated but appear to be below the level of adverse effects.[13] The potential of domoic acid poisoning from contaminated prey (D. Robinette, pers. comm.) is also of concern.

A recovery goal of at least 1,200 pairs, in at least 20 managed areas, was established in 1977.[6] These goals may change when the latest revision of the recovery plan is finalized (in prep.). To date, monitoring programs have been implemented at most of the CA LETE sites and active management and protection of colonies has helped reduce human disturbance and other threats at many of these sites. In 2001 and 2002, Gull-billed Tern (GBTE) predation on LETE chicks was identified as a significant factor at some San Diego colonies. Resolution of this problem, however, is difficult given that the western GBTE may actually be more vulnerable to extinction than the LETE. (See GBTE species profile.)

## Recommended Actions

- Manage, maintain, and protect current breeding sites and protect, restore, and enhance new breeding sites to meet recovery goals.
- Investigate solutions to the Least/Gull-billed Tern conflict that do not adversely affect either species.
- Control non-native plants and animals that adversely affect LETE.
- Continue monitoring contaminants and research the effects on reproductive success.
- Investigate LETE movement and migration to help to define wintering areas and potential threats at these sites.
- Maintain surveys to monitor population trends and reproductive success.

## Regional Contacts

Patricia Baird and Charles Collins - California State University, Long Beach, CA

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***References:*** 1. Thompson *et al.* 1997; 2. Kushlan *et al.* 2002; 3. Atwood and Kelly 1984; 4. Massey *et al.* 1992; 5. Atwood 1986; 6. U.S. Fish and Wildlife Service 1985; 7. Collins 1992; 8. Massey 1974; 9. Hothem and Powell 2000; 10. Atwood and Massey 1988; 11. Massey and Atwood 1981; 12. Howell and Engel 1993; 13. Schwarzbach and Adelsbach 2002.

# Black Skimmer *Rynchops niger*

## Status

**Federal: BCC** **State: CA-SC** **IUCN: None** **NAWCP: HC/HC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 3 | yes | 1-2 | ~23d | ~24d | May-Sep | surface scrape | tactile skimming | coastal |

## Distribution, Population Status, and Trends

Black Skimmers (BLSK) breed in the Americas, along both coasts, from southern CA to Ecuador (Pacific) and from Massachusetts to Brazil (Atlantic).[4] BLSK belong to their own subfamily (Rynchopidae) within the Laridae, and 3 subspecies are recognized; *R. n. niger* is the subspecies found in this Region, breeding along both Atlantic and Pacific coasts.[1,4] Pacific birds winter from southern CA south to Chile.[1,4] CA breeders are resident year-round (K. Molina, pers. comm.). At-sea distribution is close to shore and migration is along the coast, in flocks of dozens to hundreds.[1]

The estimated North American breeding population is between 65,000 and 70,000 individuals.[7] The first CA breeding record was in 1972, at the Salton Sea[11] and since then, their range has expanded. Currently, there are small, isolated colonies along the CA coast from San Francisco to San Diego. Breeding was first recorded at Bolsa Chica Ecological Reserve in 1985, San Francisco Bay in 1994, and nesting was attempted in Monterey County in 2000.[5,6,8,9] The San Diego colony contains 300-400 pairs, the Los Angeles Harbor had 100 nest attempts in both 1999 and 2000, and the number of nest attempts at Bolsa Chica was 295.[5,10] In 1995 the state total was estimated at 1,200 pairs.[5] Reproductive success at many of the southern CA colonies is poor.

## Ecology

BLSK breed territorially on beaches, islands, or in salt marshes, often with other terns, gulls, and plovers.[1] The colony at Los Angeles Harbor is on a dredged fill site that will be developed in the future. Re-laying can occur up to 3 times if the nest fails.[1] Chicks hatch asynchronously and fledglings depend on parents for food for at least 14 days after their first flight.[1] Most birds begin breeding at 3 years of age and can live up to 20 years.[2]

This unique bird uses tactile foraging, skimming the water surface in flight, with its laterally compressed

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bill.[1] Adult BLSK feed on small fish and possibly crustaceans[1,3] in the calm, shallow waters of bays, estuaries, harbors, ponds, and lagoons. In San Diego Bay, the diet studies in the mid 1990s found a diverse diet, with Pacific sardine, northern anchovy, California halfbeak, topsmelt, California grunion and California killifish the most abundant prey.[12] Ocean warming associated with El Niño and other events has a significant effect on prey abundance and diet. BLSK spend more time feeding during the night than during the day, although foraging is mainly during the day during chick rearing.[1]

## Conservation Concerns and Activities

Current threats are those common to all of the coastal terns nesting in southern CA: flooding of nest sites, predation, human disturbance, and potential loss of habitat due to development. The proximity of colonies to urban areas makes them especially vulnerable to disturbance by humans, pets, and feral animals that can disrupt breeding of these southern CA colonies and may have contributed to low reproductive success in the past.

## Recommended Actions

- Protect the breeding habitat from human disturbance, development, and non-native predators.
- Investigate the causes of low reproductive success in this Region.

## Regional Contacts

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***References:*** 1. Gochfeld and Burger 1994; 2. Clapp *et al.* 1982; 3. Leavitt 1957; 4. Harrison 1983; 5. Collins and Garrett 1996; 6. Layne *et al.* 1996; 7. Kushlan *et al.* 2002; 8. Roberson 2000; 9. Carter *et al.* 1992; 10. Patton 1999; 11. McCaskie *et al.* 1974.; 12. Horn and Dahdul 1998.

# Common Murre *Uria aalge*

## Status

**Federal: None** **State: WA-C** **IUCN: None** **NAWCP: MC/MC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | yes | 1 | ~32d | ~20d | Apr-Jul | surface, none | pursuit diving | coastal/pelagic |

## Distribution, Population Status and Trends

Common Murres (COMU) have a circumpolar distribution in the Northern hemisphere.[19] In the Pacific, the breeding range extends from Korea, through AK and south to central CA.[3,14] There are seven recognized subspecies; *U. a. californica* breeds from northern WA south to CA.[5] Year-round, COMU usually remain within 50 km of shore,[14] but are more pelagic in the winter and often form large rafts of up to 250,000 birds.[13]

The total Pacific breeding population is estimated at 4.3 million birds,[15] although these numbers are confounded due to range overlap with Thick-billed Murres.[3,5] The core of the COMU breeding population in this Region is in OR (712,000 breeders, 66% of total). CA has approximately 352,000 breeders (34%), and WA, 7,000 (<1%).[2,16] In recent decades, the central CA population was drastically reduced (by at least 50%) due to gillnet fisheries and oil spill mortality,[9,16] but has started to recover. In OR and northern CA, populations appeared relatively high and stable between 1979 - 1995.[16] Since 1995, disturbance by increasing numbers of Bald Eagles in OR has resulted in colony abandonment and redistribution at some colonies (D. Pitkin pers. comm.) Populations in WA suffered a major decline after the 1983 El Niño and a combination of anthropogenic and natural factors have contributed to a lack of recovery.[16,17]

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## Ecology

COMU are highly social and breed in extremely dense colonies on cliff ledges, flat low-lying islands and the tops of offshore stacks.[3,5] Birds exhibit high site and mate fidelity[1,5,6] and begin breeding at age 4-5 years.[1] Females lay a single egg on bare rock or soil, and both sexes incubate.[3] COMU are only capable of raising a single chick each year, but will lay one or more replacement clutches.[1,4,5] Egg laying dates are variable between years and colonies, with median lay date approximately 5 days later for every 1°C change in sea surface temperature.[3]

Chicks are cared for continuously until they depart for sea at 18-25 days.[1] Chicks are not able to fly when they leave the colony; they scramble to the sea, usually accompanied by the male parent.[1,3,5] Prior to winter dispersal, adult COMU are flightless during molt.[13] After chicks fledge, adults continue to feed the chicks for 1-2 months, while chicks learn to dive and feed themselves.[16] Reproductive success is fairly consistent, except during warm-water El Niño events when prey availability is reduced.[12,17,18]

COMU are wing-propelled pursuit divers capable of deep dives.[5] Adult COMU feed on pelagic zooplankton during the non-breeding season,[7] but feed their chicks whole fish or squid. Midwater schooling fishes such as herring, sandlance, smelt, anchovy, and juvenile rockfish, are important in the chick diet.[1,3,7]

## Conservation Concerns and Activities

While the widespread global distribution of COMU makes them less susceptible as a species, local populations can be significantly impacted by oil contamination, gillnet mortality, and disturbance. COMU are highly susceptible to oiling and are especially susceptible during the period from Jul - Oct, when chicks fledge and adults may be flightless. COMU are the most numerous species affected in many spills.[6,8] Populations in central CA, that declined due to gillnet and oil spill mortality, have started to recover since the adoption of tighter fishery restrictions and active restoration at colonies.[9,10,11] Social attraction has been a successful tool for restoring historic colonies in central CA.[9] Human disturbance (*e.g.,* boats and low flying aircraft) and natural disturbance (*e.g.*, Bald Eagles) can both cause serious consequences. Efforts to reduce human disturbance (*e.g.,* seasonal buffer zones to exclude boat traffic, outreach to military and civilian pilots) have benefitted nesting murres. The current population monitoring program for this important species is very expensive and labor intensive. New methods need to be developed.

## Recommended Actions

- Reduce disturbance around major colonies through the use of buffer zones, marine reserves, marine protected areas or other means. Reduce disturbance from aircraft overflights.
- Restore colonies decimated by disturbance, oil pollution, and fisheries bycatch.
- Support efforts to minimize the incidence of fuel spills near breeding and wintering areas.
- Work with state and federal agencies and fisheries councils minimize the negative impacts of fisheries interactions and review plans for emerging fisheries, to identify potential problems and solutions.
- Develop and implement an accurate and efficient population monitoring program.

## Regional Contacts

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***References*:** 1. Boekelheide *et al.* 1990a; 2. Carter *et al.* 1992; 3. Gaston and Jones 1998; 4. Harris and Wanless 1988; 5. Johnsgard 1987; 6. King and Sanger 1979; 7. Matthews 1983; 8. Page *et al.* 1990; 9. Parker *et al.* 1997; 10. Sydeman *et al.* 1997a; 11. Takekawa *et al.* 1990; 12. Sydeman *et al.* 2001; 13. Harrison 1983; 14. Briggs *et al.* 1987b; 15. Kushlan *et al.* 2002; 16. Manuwal *et al.* 2001; 17. Wilson 1991; 18. Hodder and Graybill 1985; 19. Ainley *et al.* 2002.

# Pigeon Guillemot *Cepphus columba*

## Status

**Federal: None** **State: None** **IUCN: None** **NAWCP: MC/MC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1-2 | yes | 1-2 | ~30d | ~35d | May-Aug | crevice | pursuit diving | coastal |

## Distribution, Population Status and Trends

Pigeon Guillemots (PIGU) are endemic to the north Pacific where they breed along rocky coasts and offshore rocks and islands from the Kurile Islands to southern CA.[5,7,8] There are five recognized subspecies, two of which breed in this Region: *C. c. adianta* (central Aleutians to WA) and *C. c. eureka* (OR and CA).[5,8] During the non-breeding season, PIGU are widely dispersed throughout sheltered, inshore waters, south to CA.[5,8,13] Migration is not well studied, but OR and WA birds do not appear to move great distances; CA PIGU migrate north after breeding and winter as far north as WA and British Columbia.[13,16] Foraging in all seasons is close to shore and birds are rarely encountered >5 km offshore.[13,16]

The global population estimate is 246,000 birds, with approximately 88,000 breeders in North America.[6,12,18,19] The Farallon Islands are one of the largest breeding concentrations in the eastern Pacific.[5,10] The breeding population in this Region is estimated at 38,000 birds, representing approximately 43% of the North American population: WA (18,000[15,18]), OR (4,500[19]), and CA (15,500 birds[2]). Overall population trends are unknown, hampered by differences in census methodology and access to colonies;[15] however, there has been growth and establishment of new colonies in the southern part of the range.[2] PIGU are extremely sensitive to changes in oceanographic conditions; breeding effort and reproductive success fluctuate greatly in response to warm and cold water events.[1,3,11,17]

## Ecology

PIGU typically nest in natural rock cavities[4,5] but they also nest in artificial cavities and nest boxes.[1,15] They are highly gregarious, in the water as well as on land.[5] PIGU are generally monogamous, with high mate retention.[4] Breeding begins in early May throughout most of the Region, although this is variable depending on latitude.[1,4] PIGU are capable of producing replacement clutches if the first one is lost and clutch size on the Farallons varied with oceanographic conditions.[1] Young are independent after fledging.[6]

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PIGU are shallow water, wing-propelled pursuit divers and feed close to the breeding colony on a wide variety of small benthic fish and invertebrates.[5] Both sexes contribute to the feeding of young, capturing a single fish to carry back to the chicks. There is considerable spatial and temporal variation in diet, depending on local availability. Rockfish and sculpin are important prey in CA,[1,2,11] and blennies, sculpin and flatfish (Bothidae) are important in British Columbia.[4,5,6] Diet of OR and WA birds is unknown.

## Conservation Concerns and Activities

PIGU's widespread distribution along the Pacific coast makes them less vulnerable as a species to threats from human disturbance and mortality from oil spills. Local and regional populations, however, can be significantly impacted by these threats.[8,14] Vulnerability to oil contamination is considered high, since PIGU form large rafts on the water.[9] Gillnet fisheries can cause significant local mortalities.[2] PIGU census techniques are not standardized between sites, making comparisons and trend analysis difficult.[2,5] Application of standardized protocols during a 5 year survey of Washington's inland waters resulted in a population estimate of almost 16,000 PIGU at 425 colonies[18] compared to 4,000 birds at 120 colonies documented previously.[15] The increase in numbers is most likely attributable to intensive standardized surveys rather than any change in PIGU abundance (D. Nysewander pers. comm.).

## Recommended Actions

- Protect breeding colonies from human disturbance and introduced mammals.
- Implement standardized survey protocols to assess population size and trends and research demographic parameters.
- Investigate the impacts of oil contamination and fishery related mortality.
- Determine important wintering areas.

## Regional Contacts

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***References*:** 1. Ainley and Boekelheide 1990; 2. Carter *et al.* 1992; 3. Carter *et al.* 1995c; 4. Drent 1965; 5. Ewins 1993; 6. Ewins *et al.* 1993; 7. Harrison 1983; 8. Johnsgard 1987; 9. King and Sanger 1979; 10. Warzybok *et al.* 2002; 11. Sydeman *et al.* 2001; 12. Kushlan *et al.* 2002; 13. Briggs *et al.* 1987b; 14. PRBO 1997; 15. Speich and Wahl 1989; 16. Briggs *et al.* 1992; 17. Hodder and Graybill 1985; 18. Evenson *et al.* 2002; 19. USFWS in prep.

# Marbled Murrelet *Brachyramphus marmoratus*

## Status

**Federal: T** **State: CA-E, OR-T, WA-T** **IUCN: VU** **NAWCP: HC/HI**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | rare | 1 | 30-40d | ~30d | Mar-Sep | tree, limb | pursuit diving | coastal |

## Distribution, Population Status and Trends

Marbled Murrelets (MAMU) breed in the northeastern Pacific Ocean, from the Aleutian Is., AK to central CA.[1,2] MAMU tend to remain near breeding sites year-round in most areas, though many MAMU breeding on the outer shores of Vancouver Is. appear to move into more sheltered waters in the fall and winter, and MAMU numbers are known to decrease during winter in southeast AK.[24] MAMU have been documented as far south as southern CA and northern MX.[1,3,6] MAMU tend to forage just beyond the surf zone, usually <5km offshore, and highest concentrations are in protected inshore waters.[6]

Most population estimates of MAMU have involved at-sea detection surveys,[6] though the power of these surveys to detect trends is low.[7] Rough estimates of the Region's population represent 3-7% of the North American population: 6,800 - 17,600 (ave. 9,800) in WA and 8,000 - 17,600 (ave. 12,800) in OR and CA.[1, 4, 19] Demographic modeling using MAMU and other alcid parameters indicated declining populations in WA, OR and CA.[11,20] MAMU are also thought to be declining in some areas of Alaska.[11]

## Ecology

This species, and the closely related Long-billed Murrelet, are unique among the Alcidae because they nest solitarily on the mossy limbs of mature trees in coastal forests.[6] They also nest on the ground in the northern portion of their range.[6] The farthest inland nests in OR were 50 km, although birds have been sighted in OR and WA as far as 129 km inland.[6] Incubation shifts are 24 hrs and egg neglect is common.[6] When chicks fledge, it is believed that they reach the water in a single flight.[6] Breeding ecology remains poorly known.[12]

MAMU are wing-propelled, pursuit divers, foraging both day and night.[6] In AK and British Columbia, primary diet items include sandlance, anchovy,

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herring, capelin, and smelt, among others.[1,6] Euphausiids, mysids, amphipods, and osmerids form a large proportion of adult diet in the non-breeding and pre-breeding periods.[6,9,10] Adults usually return to the nest with a single fish and chicks are fed 1-8 times a day.[6] MAMU feed close to shore in small groups or individually (larger groups in AK and BC), generally in shallow waters.[6]

## Conservation Concerns and Activities

The key conservation concern is past and current loss of breeding habitat from timber harvest and the loss of breeding habitat is most evident in the southern range.[1,4,6,12] Management actions to preserve habitat on federal lands are in place according to the Northwest Forest Plan. However, there is extensive vulnerable murrelet habitat on non-federal lands that need protection for population maintenance and recovery. Nest site predation by large raptors, corvids and small mammals reduces nesting success.[6] Forest fragmentation has been thought to increase levels of nest predation by the creation of forest edge.[6] Human activities in murrelet habitat also attracts predators.[11,13] Threats in the marine environment include oil pollution[15] and bycatch in gillnets.[16] Population trend data from at-sea surveys have low power and conventional mark-recapture and radio telemetry studies are costly and logistically difficult; however, radar monitoring has emerged as a powerful, relatively inexpensive new tool to monitor breeding populations.[17,18] As a federally (U.S. and Canada) and state-listed species, the MAMU has some degree of protection. For a more detailed discussion of threats and conservation actions, see the Recovery Plans.[14,23]

## Recommended Actions

- Complete landscape management strategies for each of the six Marbled Murrelet Conservation Zones. Identify and protect areas of terrestrial and marine habitat, on private and public land, essential for recovery.
- Many aspects of breeding ecology, habitat selection, and foraging ecology are still unknown. Expand research studies of MAMU demography and ecology to guide conservation decisions. Conduct standardized monitoring to determine abundance and trends.
- Monitor and protect central CA breeding populations and breeding habitat. This small population at the southern edge of the species' breeding range is likely limited by habitat availability and is thus the most vulnerable to localized extinction from lack of nesting sites.
- Reduce human activities near potential breeding habitat that might attract nest predators.

## Regional Contacts

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***References*:** 1. Gaston and Jones 1998; 2. Sowls *et al.* 1978; 3. Erickson *et al.* 1995; 4. Ralph *et al.* 1995; 5. Piatt and Naslund 1995; 6. Nelson 1997; 7. Jodice *et al.* 2001; 8. Cam *et al.* 2003; 9. Burkett 1995; 10. Becker 2001; 11. McShane *et al.* 2004; 12. Cooke 1999; 13. Marzluff *et al.* 2000; 14. Kaiser *et al.* 1994; 15. Carter and Kuletz 1995; 16. Carter *et al.* 1995a; 17. Burger 2001; 18. Cooper *et al.* 2001; 19. Kushlan *et al.* 2002; 20. U.S. Fish and Wildlife Service 1997.

# Xantus's Murrelet *Synthliboramphus hypoleucus*

## Status

**Federal: C, BCC** **State: CA-T** **IUCN: VU** **NAWCP: HC/HC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1-2 | yes | 1-2 | ~34d | 1-3d | Feb-Aug | crevice, shrub | pursuit diving | pelagic |

### Distribution, Population Status and Trends

Xantus's Murrelet (XAMU) breeding distribution is restricted to approximately 12 offshore islands of southern CA and Baja California, MX.[3,6] Two subspecies are currently recognized: *S. h. scrippsi*, nesting primarily in southern CA (Channel Islands), and *S. h. hypoleucus,* nesting on Guadalupe Is. and the San Benito Is., MX.[3] Limited information on non-breeding distribution indicates that individuals of both subspecies disperse offshore, moving northward from the breeding colonies as far as British Columbia.[3] During the fall, XAMU are more widely dispersed, although in some years they congregate.[13] XAMU forage in pairs or small groups over the continental slope and shelf[4,5] and recent studies during the breeding season found them foraging in cool, upwelled waters.[11]

XAMU's nocturnal habits, concealed nests, and the inaccessibility of much of their nesting habitat make estimation of population size difficult. There are likely fewer than 7,000 breeding birds, with 30-35% occurring in southern CA.[9,14] The majority nest on Santa Barbara Is. (approximately 60% of the CA population).[1,3] A population viability analysis indicated that the size of the population on Santa Barbara Is. declined by 30-50% between 1977 and 1991, and that a continuing decline of this magnitude will cause the population to reach a critically low level by the year 2019.[9,10] In addition, reproductive performance of this colony declined significantly between 1977-1985.[15]

Darrell Whitworth

### Ecology

XAMU begin returning to staging areas offshore of colonies and visiting nest sites in late winter or early spring. Nests are typically in rock crevices or under shrubs on steep slopes, although they will also nest in burrows created by other species and under artificial structures.[3,7] XAMU lay 2 eggs, approximately eight days apart. Both sexes incubate, with shifts of approximately 3 days beginning after the second egg is laid.[3,7] During May and Jun, chicks hatch synchronously and depart the island 1-3 nights after hatching, dispersing rapidly out to sea.[3,7] Both parents remain with the chicks after they leave the nest, although it is unknown how long they remain together at sea.[3] Annual estimates indicate that timing of breeding varies from year to year, probably reflecting food availability at the start of the breeding season.[4]

Limited information on diet indicates that XAMU rely primarily on larval anchovy, saury, and rockfish.[4,5] Reproductive success fluctuates annually due to a combination of predation on eggs and adults, and variation in food supply.[3,7,10] Changes in oceanographic conditions, including El Niño and regime shifts may affect XAMU food supply.[8,10]

### Conservation Concerns and Activities

The limited breeding distribution and small population make XAMU vulnerable to threats such as oil pollution, organochlorine contaminants, fishery bycatch, and bright lights.[1,9] In the colonies, native predators, such as Barn Owls and Peregrine Falcons, can have a substantial impact on the population.[2,12] Endemic deer mice prey on XAMU eggs, consuming an average of 46% of all eggs produced on Santa Barbara Is.[10] Non-native predators include feral cats and rats.[3] A liquid natural gas terminal is proposed off the Coronados

Is, MX.; light pollution, disturbance, potential fuel spills and predator introductions could all affect the murrelets nesting in this area. Bright lights associated with squid fishing operations could alter behavior and make XAMU more vulnerable to predation.

Feral cats have been removed from many of the Channel Islands, but they are still a problem at others.[3,6] Removal of black rats from Anacapa Is. was undertaken as part of the American Trader Oil Spill Restoration Plan. The NGO, Island Conservation and Ecology Group, and the American Trader Trustee Council have initiated the removal of introduced predators on islands in MX. Channel Islands NP initiated a long-term monitoring program on Santa Barbara Is. in 1985 that continues today, with periodic monitoring occurring on other islands.

## Recommended Actions

- Initiate U.S. and Mexico partnership to plan and implement joint protection, recovery, and education programs.
- Remove non-native predators from all active and potential nesting islands and protect islands from future introductions (*e.g.,* rats from San Miguel).
- Work with agencies and industry to determine the effects of bright lights (*e.g.*, lights associated with squid fishery) on murrelets and develop ways to reduce these effects.
- Restore/expand breeding populations on islands from which XAMU have been extirpated/ reduced.
- Develop and implement standardized protocols to assess and monitor populations.
- Investigate demographic parameters such as adult and juvenile survival, age at first breeding, frequency of breeding, reproductive success, etc.

## Regional Contacts

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***References*:** 1. Carter *et al.* 2000a; 2. Drost 1989; 3. Drost and Lewis 1995; 4. Hunt and Butler 1980; 5. Hunt *et al.* 1979; 6. Keitt 1999; 7. Murray *et al.* 1983; 8. Roth and Sydeman 2000; 9. Sydeman and Nur 1999; 10. Sydeman *et al.* 1998b; 11. Whitworth *et al.* 2000; 12. Wolf *et al.* 2000; 13. Briggs *et al.* 1987b; 14. Kushlan *et al.* 2002; 15. Sydeman *et al.* 2001.

# Ancient Murrelet *Synthliboramphus antiquus*

## Status

**Federal: None** **State: None** **IUCN: None** **NAWCP: HC/MC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 2 | no | 1-2 | ~30d | 1-3d | Mar-Aug | crevice/burrow | pursuit diving | pelagic |

## Distribution, Population Status and Trends

Ancient Murrelets (ANMU) breed along the northern Pacific Rim, from China to WA.[4] The southern extent of the eastern breeding range is a small colony in WA.[13,14] Two subspecies are currently recognized; *S. a. antiquus* is the subspecies found in this Region.[4] Post-breeding, ANMU move southward as far as southern CA.[1,4] Based on frequent observations of ANMU in protected waters of WA and adjacent Canadian waters, it appears that these areas are important wintering habitat for this species.[10,11] ANMU are also recorded in low numbers in OR and CA waters during winter and early spring.[12] Foraging is in small, scattered groups mostly over the continental shelf and shelf break.[9,15]

Population estimates are difficult to obtain for this species, but the world population is likely between 1-2 million birds, with the core of the population in British Columbia and AK.[4] The first documented breeding in this Region was in 1924, at Carroll Is., WA.[13] It is not known if ANMU currently nest in WA, but is considered probable based on early Apr observations of staging adults between Carroll Is. and Jagged Is.[14] (U. Wilson pers. comm.). Data indicate declines throughout the range primarily due to introduced mammalian predators on colony islands.[2,4]

## Ecology

ANMU begin returning to staging areas offshore of breeding colonies in Mar, approximately one month prior to egg-laying, and begin visiting nest sites 2-3 weeks prior to egg-laying.[4] ANMU are nocturnal at the breeding colonies and usually exhibit nest site fidelity and long-term pair bonds.[6,7] Nest sites are found on the steep slopes of densely forested or grass-covered islands [4,6] and can be up to 400 m from sea.[7] ANMU typically nest in burrows, but will nest in rock crevices or under human-made structures.[4] Egg-laying occurs from early Apr through mid-May, becoming progressively later at more northerly latitudes.[4] Incubation is shared equally by both

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sexes, and shifts of approximately 3 days begin after the second egg is laid, though a period of egg neglect prior to the onset of incubation is common.[4,6] Chicks hatch synchronously, and family groups leave the nests 1-3 nights after the chicks hatch.[4,6] The chicks remain with the parents for at least one month after leaving the colony.[4]

Diet data indicate ANMU feed primarily on euphausiids during the early part of the breeding season before shifting to a diet composed mainly of juvenile fish.[4,5,8] Data from birds collected off Vancouver Is., B.C. indicate they feed almost entirely on euphausiids during the non-breeding season.[4,5]

## Conservation Concerns and Activities

The colony at Carroll Is. is vulnerable given its small size and location at the southern extent of the range. However, these traits also limit the importance of this colony to the health of the total population. Given the post-breeding southern dispersal, at-sea threats are the highest concern for this Region. At sea, ANMU may be negatively impacted by oil pollution and interactions with fisheries.[3,4] An oil spill could be devastating if it occurred near a staging area during the breeding season or when chicks fledge and are flightless.[3,4] During the 1950s and 1960s mortality of ANMU was linked to salmon-fishing activities near Langara Is., B.C. due to attraction to vessel lights and drowning in gillnets.[16] Currently, it is unknown what the magnitude of the interaction is between ANMU and fisheries, which may be especially important in the foraging habitat in the inshore waters of WA.

## Recommended Actions

- Work with Canada to ensure recovery and protection of ANMU populations.
- Document current breeding status in WA.
- Evaluate the mortality of ANMU in commercial fisheries.

## Regional Contacts

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***References*:** 1. Briggs *et al.* 1987a; 2. Gaston 1990; 3. Gaston 1994a; 4. Gaston 1994b; 5. Gaston *et al.* 1993; 6. Sealy 1976; 7. Gaston and Jones 1998; 8. Sealy 1975; 9. Vermeer and Rankin 1984; 10. Wahl 1975; 11. Wahl *et al.* 1981; 12. Briggs *et al.* 1992; 13. Hoffman 1924; 14. Speich & Wahl 1989; 15. Vermeer *et al.* 1985; 16. Bertram 1995.

# Cassin's Auklet *Ptychoramphus aleuticus*

## Status

**Federal: BCC (32)** **State: WA-C, CA-SC** **IUCN: None** **NAWCP: MC/HC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | yes | 1 | ~40d | ~45d | Feb-Oct | burrow/crevice | pursuit diving | offshore |

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## Distribution, Population Status and Trends

Cassin's Auklets (CAAU) breed from the western Aleutians to central Baja California, MX.[7] Two subspecies have been recognized, *P. a. aleuticus*, distributed throughout most of the species' range, and *P. a. australe*, limited to central Baja California.[7,16] Post-nesting dispersal is variable, with southern populations mostly resident and northern populations (AK and British Columbia) migrating south.[10] A greater number of CAAU are seen in CA waters in the fall and winter than nest in CA, OR, and WA combined.[5] There are seasonal shifts in foraging locations, with post-breeding birds generally occurring farther offshore as dictated by variable distributions in prey resources.[18,19] During the breeding season, CAAU are concentrated near their colonies and forage mostly over the outer shelf.[19]

Current population size is estimated at 3.6 million breeding birds.[10,20] The core of the CAAU population is in British Columbia. The Pacific Region encompasses <5% of the global population: 63% in WA (87,600), 37% in CA (50,600), and <1% in OR (500).[6, 10, 22] The largest colonies in this Region are on Alexander Is., WA (54,600) and the Farallons (20,000).[10,15,22] The breeding population on the Farallons was estimated at 105,000 birds in 1971,[21] 38,274 in 1989,[6] and 20,000 currently.[22] The largest colony in the world is at Triangle Is., B.C., Canada with approximately 1.1 million breeding birds (548,000 breeding pairs), although this population is declining.[4] Populations of CAAU appear to be declining at several locations throughout the species' range and several historic colonies have disappeared, mainly due to introduced predators.[10] Reasons for the declines include predation[11] and changes in prey resources.[3,14,23,24]

## Ecology

CAAU visit some breeding colonies year-round, although they may be absent for months in the fall.[1,9] Nesting occurs in small and large colonies on coastal islands, and activity at the colonies is nocturnal.[1] CAAU breed in natural crevices or burrows, which they dig.[10] Mean age of first breeding at the Farallon Is. colony is 3 years with a range of 2-10 years.[14] The breeding season can be extended, with egg-laying occurring between Feb - Aug in CA. Production of two broods in a single breeding season can occur in CA and MX when the food supply is adequate;[1] but due to shorter breeding seasons does not occur in more northerly colonies. Both sexes participate in incubation.[9,10]

Chicks are fed euphausiids, crustaceans, amphipods, decapods, copepods, mysids, larval squid and fish,.[3,5,17] Longevity ranges up to 23 years (PRBO unpubl. data).

## Conservation Concerns and Activities

Annual survival of adults at Triangle Island, Canada and the Farallon Is. have been estimated at 67-70%, which is thought to be too low to sustain the population given other life-history parameters.[4,12] In conjunction with low adult survival at some of the main breeding colonies, CAAU face several threats, including entanglement in gillnets and other fishing gear[2] and effects of oil spills.[10,13] Predation by the introduced house mouse on eggs and small chicks may occur on the Farallons (K. Mills, unpubl. data). Predation of adults by Barn Owls occurs in the

Channel Islands and possibly the Farallons.[25] An indirect human effect is increased chick predation by gull populations that have been artificially inflated due to human practices.[11] A possible human-related effect relates to global warming and warming of the oceans, which appears to be correlated with declines in the prey resources of CAAU.[3,8,14]

## Recommended Actions

- Assess the impacts of contaminants and oil pollution.
- Investigate the effects of climate change on prey resources, CAAU diet and population dynamics.

## Regional Contacts

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***References***: 1. Ainley and Boekelheide 1990; 2. Ainley *et al.* 1981b; 3. Ainley *et al.* 1996; 4. Bertram *et al.* 2000; 5. Briggs *et al.* 1987a; 6. Carter *et al.* 1992; 7. Gaston and Jones 1998; 8. Kitaysky and Golubova 2000; 9. Manuwal 1974; 10. Manuwal and Thorenson 1993; 11. Nelson 1989; 12. Nur *et al.* 1998; 13. Page *et al.* 1990; 14. Pyle 2001; 15. Speich and Wahl 1989; 16. Van Rossem 1939; 17. Vermeer *et al.* 1985; 18. Harrison 1983; 19. Briggs *et al.* 1987b; 20. Kushlan *et al.* 2002; 21. Manuwal 1972; 22. Warzybok *et al.* 2002; 23. Sydeman *et al.*2001; 24. Abraham and Sydeman 2004; 25. McIver 2002.

# Rhinoceros Auklet *Cerorhinca monocerata*

## Status

**Federal: None** **State: CA-SC** **IUCN: None** **NAWCP: LC/HC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | yes | 1 | ~42d | ~49d | Apr-Aug | burrow/crevice | pursuit diving | coastal |

## Distribution, Population Status and Trends

Rhinoceros Auklets (RHAU) breed from Japan, along the Aleutian Islands, to southern CA.[5,8] RHAU are present in waters off WA, OR and CA throughout the year. However, birds move south in a post-breeding dispersal to important wintering areas off CA and numbers decline to low levels in the two northern states in winter (except the inland waters of WA).[18,20] There is also a shift from waters over the continental shelf and at the shelf break during breeding[7,18] to waters seaward of the shelf off CA in winter.[20]

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World population estimates are extremely rough at 1.5 million breeding birds, with approximately 1 million in the North American segment.[5] Most (>95%) of the North American population breeds on islands in southeast Alaska (12%), British Columbia (73%) and WA (13%), with most birds concentrated at 8 colonies.[5] Two of these key colonies are located in WA (~50,000 birds) at Protection and Destruction Islands.[16] Less than 1,000 individuals are estimated to breed in OR[19] and 2,000 in CA.[2] RHAU were extirpated from CA circa 1860, but over the past 30-40 years, population numbers have increased and birds have re-colonized the historic range.[5,6] Populations at Protection Is. increased from 6,000 - 8,000 in the 1950s[11] to 40,600 in 1983.[17] More recently, populations at this key WA colony appear to be declining[5] and the population at the Farallons has shown a diminishing reproductive performance since 1986, although this was not significant.[12]

## Ecology

Despite the name, RHAU are more closely related to puffins than to auklets. RHAU dig burrows, although when soil is limited they will nest in crevices. In WA, they nest predominantly on shrubby and grassy slopes that face the sea and to a lesser degree on cliffs and flat areas of islands.[16] At most colonies, RHAU are nocturnal or crepuscular, although they are also diurnal at some colonies. Birds return to breed at 3-5 years and pairs often remain together in successive years.[21] The breeding season is from Apr- Aug, and egg laying occurs earlier in CA than WA.[5]

RHAU are wing-propelled, pursuit divers and their diet consists mainly of schooling mid-water fishes and squid.[12] Prey composition is variable among colonies.[9,12,15] On Destruction Is. in 1974-1981 main prey included anchovy, night smelt, sandlance, and herring, although they switched to Pacific Saury in 1983.[16] On Año Nuevo Is. (ANI), between 1993-2000 main prey included anchovy, but they also switched to Pacific Saury in 1998. Saury are usually found farther offshore, and are lower in nutritional and energetic value than preferred prey items. In 2001-2002 RHAU chick diet on ANI consisted mostly of juvenile rockfish.

## Conservation Concerns and Activities

Documented and potential threats to the RHAU populations in this Region include predation, oil contamination, fisheries interactions, and habitat degradation. Historically, extirpations were caused, at least in part, by introduced mammalian predators. RHAU did not return to Southeast Farallon Is. until introduced rabbits were eradicated in 1972; they may have competed with RHAU for nesting space.[1] Mortality has been documented at breeding colonies from Peregrine Falcon, Bald Eagle, and other avian predators.[4,13,16] Disturbance and trampling of burrows by humans, pinnipeds, surface nesting or roosting birds, or introduced animals can cause nest loss and lowered reproductive success. RHAU was the second most common species killed in the *Apex Houston* oil spill off central CA.[10] Mortalities have been documented in the CA and WA gillnet fisheries[3,14] and declines observed since the 1980s at some WA colonies may be due to gillnet mortality.[5] Long-term foraging and population studies are currently maintained on Año Nuevo Is. and the Farallons (CA) and WA colonies.

## Recommended Actions

- Assess population size and document trends at colonies throughout the Region. Investigate causal relationships for declines.
- Investigate the relationship between RHAU demographics, forage fish resources, and commercial fisheries and evaluate possible impacts.
- Coordinate with Canada, NOAA Fisheries, the states, and Tribes to minimize fishery bycatch. Observer programs are needed to quantify mortality of RHAU in gillnets.

## Regional Contacts

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***References***: 1. Ainley and Boekelheide 1990; 2. Carter *et al.* 1992; 3. Forney *et al.* 2001; 4. Harfenist and Ydenberg 1995; 5. Gaston and Dechesne 1996; 6. Grinnell 1926; 7. Morgan *et al.* 1991; 8. McChesney *et al.* 1995; 9. Morejohn *et al.* 1978; 10. Page *et al.* 1990; 11. Speich and Wahl 1989; 12. Sydeman *et al.* 2001; 13. Thayer *et al.* 2000; 14. Thompson *et al.* 1998; 15. Wilson 1986 16. Wilson and Manuwal 1986; 17. Thompson *et al.* 1985; 18. Briggs *et al.* 1987b; 19. USFWS in prep; 20. Briggs *et al.* 1992; 21. Richardson 1961.

# Tufted Puffin *Fratercula cirrhata*

## Status

**Federal: None** **State: CA-SC, WA-C** **IUCN: None** **NAWCP: LC/MC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | yes | 1 | ~42d | ~40d | May-Sep | burrow/crevice | pursuit diving | coastal/pelagic |

## Distribution, Population Status and Trends

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Tufted Puffins (TUPU) are endemic to the North Pacific, breeding from Japan to CA, and as far north as the Chukchi Sea.[6,8] The southeastern extent of its range is now thought to be the Farallon Is. in central CA,[8] although historically it was documented breeding as far south as the Channel Islands.[5,8] Recent evidence suggests that TUPU may be re-colonizing this area.[10] Generally solitary at sea, TUPU disperse in offshore waters during the winter with a corresponding southerly expansion of their range[11] and are most common seaward of the continental slope up to 180 km offshore.[12] During the breeding season, TUPU are seen foraging in waters seaward of their colonies.[4,12]

The total TUPU breeding population has been estimated at just under 3 million breeders,[15] though accurate estimates are difficult, as in most crevice-nesting seabirds. Approximately 82% breed in North America and only 1% in this Region. During the 1980s, the largest breeding colonies in this Region were on Jagged Is. (7,800 birds), Alexander Is. (4,000 birds), and Carroll Is. (2,700 birds) in WA,[13] and Three Arch Rk. (4,600 birds) in OR.[5] However, based on data from numerous published and unpublished sources, declines of 3% - 21% per annum were estimated for CA, OR, and WA, over the past 15 years.[15] Overall, population trends appear to be increasing in the Gulf of AK and westward, and declining throughout southeast AK and south through CA.[15] It is hypothesized that these trends are in response to decadal changes in large scale ocean currents.[15]

## Ecology

TUPU return to their colonies in Apr-May and excavate burrows[5] though they also nest in rock crevices and nest boxes.[8] Burrows are generally found in steep, sea-facing slopes with sparse vegetative cover.[11] They will nest in less-steep terrain, where they do not overlap with Rhinoceros Auklets.[14] Pairs defend a territory that includes the burrow entrance, a path to the burrow and a landing area.[8] TUPU are generally monogamous and will stay together through several seasons, usually using the same nest site.[1,5,8] Egg-laying begins in early May,[1] but is delayed with an increase in latitude.[5] Females often lay replacement eggs if the first egg is lost early in the breeding season.[1] Chicks are brooded for the first 5-7 days, after which they are left alone during the day while the parents forage.[5]

TUPU are wing-propelled pursuit divers, capable of reaching depths of over 100 m.[1] They feed on fish, squid, crustaceans and polychaetes, although chicks are fed almost exclusively fish.[5,8] Adults can carry 12 fish or more, crosswise in their bills, when feeding chicks.[13] Rockfish and anchovies are important prey items off the coast of CA.[1] Parents range far from breeding colonies on foraging excursions[5,8] and return to feed chicks three times daily.[5,10]

## Conservation Concerns and Activities

TUPU are vulnerable to oil pollution,[9] entanglement in fishing gear,[2] and predation from introduced mammals.[5] Introduced species, such as rabbits, may compete for burrow space.[1,14] Populations may decline at some locations as a result of the re-establishment and recovery of Rhinoceros Auklets, where they compete with TUPU for available nesting habitat.[1] Competition with commercial fisheries[7] and high losses in gillnet fisheries [2] has also contributed to their decline in some areas. There is a general lack of information available for TUPU nesting in the Region, because of the inaccessibility of nests and small populations at many locations.[1,3]

## Recommended Actions

- Develop and implement standardized protocols for determining population status and trends.
- Protect breeding sites from human disturbance and introduced mammal predation.
- Encourage development of Observer Programs on commercial fishing vessels to quantify TUPU entanglement and mortality in nets. Work with regulating agencies and industry to minimize bycatch.
- Continue or initiate long-term monitoring at key colonies throughout the Region to track population trends, other demographic parameters, and diet to investigate the relationship between large-scale oceanographic/climate cycles, prey ecology, and TUPU trends.

## Regional Contacts

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***References*:** 1. Ainley and Boekelheide 1990; 2. Byrd and Douglas 1990; 3. Carter *et al.* 1992; 4. Briggs *et al.* 1992; 5. Gaston and Jones 1998; 6. Harrison 1983; 7. Hatch and Sanger 1992; 8. Johnsgard 1987; 9. King and Sanger 1979; 10. McChesney *et al.* 1995; 11. Vermeer 1979; 12. Briggs *et al.* 1987a; 13. Speich and Wahl 1989; 14. Leschner 1976; 15. Piatt and Kitaysky 2002.

# U.S. Pacific Island Species Profiles

# Short-tailed Albatross (Steller's Albatross) *Phoebastria albatrus*

## Status

**Federal: E** **State: HI-E** **IUCN: VU** **NAWCP: HC/HC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | no | 1 | 65d | 140d | Oct-Jun | scrape | surface dip | pelagic, near-shore |

## Distribution, Population Status and Trends

Short-tailed Albatross (STAL) once ranged throughout the North Pacific breeding on islands in Japan and Korea. Today they breed only on Torishima and Minami-kojima, Japan.[1,2] Birds regularly visit the NWHI and individual birds have laid eggs at Midway Atoll in various years since at least the 1990s, but historical accounts of successful nesting are unsubstantiated.[3] STAL disperse widely throughout the temperate and subarctic North Pacific from Japan through CA. Birds are concentrated along the edge of the continental shelf in the northern Gulf of Alaska, Bering Sea, and along the Aleutian Is.[5,6,7,8]

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STAL, once the most abundant North Pacific albatross, numbered in the millions until the late 19th century when the lucrative millinery trade developed.[9] By the 1930s, STAL had almost been wiped out. The last remaining breeding population on Torishima was considered extinct after World War II;[10] however, in 1950, a small number were found and the population began a slow recovery.[11,12,13] In 2002, the world population was estimated at approximately 1,700 individuals (including breeding and non-breeding birds), with 200-250 at Minami-kojima and 1,500 at Torishima.[14] The annual population growth is >6% per year.[15,16]

## Ecology

STAL, largest of the North Pacific albatrosses, breed on oceanic islands and atolls.[4] On Torishima, they nest on open ground on fairly steep volcanic ash slopes next to clumps of grass or shrub. On Minami-kojima, they nest on a rocky terrace of a steep cliff. At Midway and other NWHI, STAL occur amongst nesting Laysan and Black-footed Albatross. Egg laying occurs from late Oct - Nov and chicks fledge in Jun.[4,17] They are monogamous with high rates of mate retention and philopatry. As many as 25% of breeding age adults may not return to the colony at any given year.[3,16] STAL feed their young until the time of their departure from breeding grounds in Jun.[4] Juveniles are dark brown and gradually acquire the white body plumage and golden head over a period of 10-15 years, but there is considerable variation.[4] Immatures remain at sea for several years before returning to breed[4] and age at first breeding is 5-6 years on average.[3]
STAL are surface feeders and scavengers, and are frequently encountered around fishing vessels. They feed more inshore than the other North Pacific albatrosses, often in sight of land.[18] In Japan, their diet consists of shrimp, squid, and fish which include bonita, flyingfish, and sardines.[19,20] There are no published data on life span but it is probably similar to the other North Pacific albatrosses. Average survival rate is 96%.[3,16]

## Conservation Concerns and Activities

The primary STAL breeding colony at Torishima is located on an active volcano and there is significant threat of mortality and major habitat loss from volcanic eruptions. Within the last century, Torishima has experienced five eruption events over the past century with the most recent one occurring on Aug 11, 2002. Past eruptions have destroyed much of the original breeding site leaving sparsely vegetated steep slopes of loose volcanic soil. Without the protection provided by vegetation, eggs and chicks are at greater risk of mortality from monsoon rains, sand storms, and wind.[21] Current conservation activities in Japan are concentrated on habitat stabilization in the original colony on Torishima and efforts to entice breeding birds to alternate sites on Torishima that are less likely to be affected by lava flows, mud slides, or erosion.[3] Concentration of the entire breeding population at just two islands, Torishima and Minami-kojima, make STAL extremely vulnerable to catastrophic events. Midway Atoll has been identified as a possible site for establishment of a breeding colony.[3] Midway is a logical candidate because STAL regularly visit and have displayed reproductive capacity (*e.g.,* courtship dances and egg laying). Decoys and recorded colony sounds have been deployed at Midway but it is unknown if they will prove effective in attracting breeding birds or if STAL will thrive at this location.

Bycatch in commercial fisheries is another known threat. Federal agencies are actively coordinating with industry and others to minimize STAL bycatch and U.S. fishers are required to employ multiple seabird avoidance measures. At sea, marine pollution, plastics, and oil spills are also threats.[20] Oil development in contested areas may be a problem in the future. Minami-kojima is disputed territory of Japan and China and consequently little biological research or management is conducted at this breeding site.

A Recovery Team has been formed and a recovery plan is being developed.

## Recommended Actions

- Continue efforts to establish a breeding colony on Midway by using decoys and sound recordings or new techniques as they are developed.
- Support research and development of new gear types and/or fishing methods that reduce or eliminate bycatch and work with regulatory agencies and fishing industry to ensure compliance with regulations.
- Assist in the development of the recovery plan and support activities and actions outlined therein.

## Regional Contacts

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***References**:* 1. Hasegawa 1984; 2. King 1981; 3. USFWS 1999; 4. Tickell 2000; 5. Sanger 1972; 6. USFWS unpublished data. 7. McDermond and Morgan 1993; 8. Sherburne 1993; 9. Yamashina in Austin 1949; 10. Austin 1949; 11. Tickell 1973; 12. Tickell 1975; 13. Ono 1955; 14. H. Hasegawa, pers. comm 2002; 15. Hasegawa 1982; 16. Cochrane and Starfield 1999; 17. Hasegawa 1980; 18. Harrison 1990; 19. Hattori 1889; 20. Fujisawa 1967; 21. H. Hasegawa, pers. comm.1997.

# Black-footed Albatross (Black Albatross, Moli)
## *Phoebastria nigripes*

### Status

**Federal: BCC** **State: HI-T** **IUCN: EN** **NAWCP: HI/HC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | no | 1 | 65d | 140d | Nov-Jun | scrape | surface dip, scavenge | pelagic |

### Distribution, Population Status and Trends

Black-footed Albatross (BFAL) breeding distribution is almost entirely restricted to the Hawaiian Islands with the exception of small breeding colonies off Japan.[1,2,3,4] In Hawai`i, colonies occur on the NWHI and Kaula and Lehua.[1] BFAL recently recolonized Wake.[24] During the breeding season, adults range mostly to the north and east of the Hawai`i colonies. Adults brooding chicks forage closer to the colonies (100s km), but after brooding many birds transit to continental shelf areas off North America while feeding chicks.[15] Nonbreeding birds disperse throughout the north Pacific between 20º and 58º N.[5,6] Compared to Laysan Albatross, BFAL have a more easterly at-sea distribution and regularly occur in large numbers off the coast of Canada and the U.S.[6,7]

The breeding population was estimated at approximately 58,000 breeding pairs in 2003-2004.[6] Greater than 95% nested in Hawai`i; the majority of the population breed on Laysan (19,500 pairs) and Midway (20,400 pairs). Historically, breeding colonies existed on Johnston and the Northern Marianas.[1,8] The population rebounded from a drastic population decline at the turn of the 20th century but over the past decade breeding populations appear to have declined slightly at the largest Hawaiian colonies.[6,9,10]

### Ecology

Most BFAL nest on low coral and sand islands, on open sandy beaches or dunes, and sometimes among vegetation.[1,11] Egg laying occurs Nov - Dec and chicks fledge in mid-Jun.[12,13] Sexes are similar although males are slightly larger.[15] Pairs are highly philopatric and mate retention is high.[16,17] Birds do not breed every year.[5,14] Immature plumage is similar to adults, but first-year birds lack the white ring around the bill and white feathers at the base of the tail.[18] Age at first breeding probably averages 7-8 years.[19,20]

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BFAL are surface feeders, taking food by dipping and scavenging at the ocean's surface. They are also frequently encountered around fishing vessels and will scavenge ship offal.[21] Feeding aggregations of BFAL are common, but they rarely feed with other species.[22] In Hawai`i, the diet includes fish eggs, squid, deep-water crustaceans, fish, and zooplankton.[21] Flyingfish eggs are important, comprising >40% of the diet.[5,21] The oldest-known BFAL was at least 43 years old.[6]

### Conservation Concerns and Activities

Between 1990-94, it is estimated that >23,000 BFAL were incidentally killed on longline hooks set in the North Pacific swordfish fishery.[6] An estimated 1,831 birds were killed annually between 1994-98 in the HI longline fishery, alone.[6] In addition, birds were lost to demersal longline fisheries in AK. Both AK and HI instituted regulations requiring mandatory mitigation measures to minimize bycatch. The Hawaiian longline fishery for swordfish was closed in 2001 and estimates of BFAL bycatch decreased to less than 100 birds per year. However, most fishers affected by this closure, moved their base of operation to CA where they were not required to employ mitigation measures. BFAL were taken in the CA-based fishery but the magnitude of the kill is unknown. In 2004, mitigation measures were required in the CA-based fishery and a HI-based model swordfish fishery was opened with new restrictions to protect turtles.

In the 1950s and 1960s, albatross control programs conducted at Midway to protect aircraft resulted in the death of tens of thousands of albatross. Buildings, lights, antenna wires, and even introduced ironwood trees created obstacles that killed many BFAL at Midway each year.[5] Organochlorine levels in BFAL were higher than other albatross species and were high enough to increase the risk of eggshell thinning and subtle embryonic effects that decrease egg viability.[23] Ingestion of plastics is also a problem. BFAL nest close to the shoreline and sea level rise and storm tides associated with global warming pose a significant threat. In the past, introduced predators such as rats impacted populations on Kure and Midway, however, rats have been eradicated at all major breeding locations. Rats and cats occur at Wake and the Marianas and may hinder recolonization at these sites.

## Recommended Actions

- Design and implement a statistically rigorous population monitoring program, including estimation of age-specific survival rates.
- Compile, analyze and report USFWS data collected at the breeding colonies. Analyze and report demographic information from 50 years of banding data.
- Complete a status assessment.
- Support efforts to estimate mortality from all U.S. and foreign fisheries and determine effects of this mortality on BFAL populations.
- Support continued research and development of mitigation measures and practices to prevent mortality in fisheries.
- Eradicate introduced predators on USPI where BFAL historically bred (*i.e.*, Wake, Johnston, and the Marianas).

## Regional Contacts

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***References:*** 1. Whittow 1993a; 2. Harrison *et al.* 1984; 3. Hasegawa 1982; 4. Hasegawa 1984; 5. Harrison 1990; 6. Cousins and Cooper 2000; 7. Sanger 1974a; 8. McDermond and Morgan 1993; 9. Lewison and Crowder 2002; 10. E. Flint, USFWS, pers. comm. 11. Tickell 2000; 12. Woodward 1972; 13. Fisher 1969; 14. Rice and Kenyon 1962a; 15. Fernandez *et al.* 2001; 16. Bailey 1952; 17. Fisher 1971; 18. Bourne 1982; 19. Rice and Kenyon 1962b; 20. Robbins 1966; 21. Harrison *et al.* 1983; 22. USFWS 1983c; 23. Ludwig *et al.* 1998; 24. Rauzon *et al.* in prep.

# Laysan Albatross *Phoebastria immutabilis*

## Status

**Federal: BCC (67,68)** **State: None** **IUCN: VU** **NAWCP: HC/HC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | no | 1 | ~65d | 165d | Nov-Jul | scrape | surface dip | pelagic |

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## Distribution, Population Status and Trends

Laysan Albatross (LAAL) breeding range is centered in the Hawaiian Islands[1,2] with smaller colonies on the Bonin Is., Japan[2,18] and islands off west Mexico.[19,20,21] LAAL nest on all of the NWHI and on Kaua`i, Lehua, and O`ahu in the main islands. They have recolonized Wake and Johnston and one pair successfully bred on Wake in 2001.[23] Breeding adults forage primarily to the north and northwest of HI, to the Gulf of Alaska and the Aleutian Is.[3] During nonbreeding periods, adults disperse widely throughout the north Pacific tending more to the west than Black-footed Albatross.[2,4]

The 2003-2004 estimate was approximately 630,000 breeding pairs worldwide;[5] the largest colonies were at Midway and Laysan, with approximately 441,000 and 145,000 pairs, respectively.[17] There is concern that the population is declining, but the number of birds breeding each year can be quite variable and more rigorous demographic monitoring is needed to accurately track population trends. The breeding range is expanding with the small colonies off MX and birds recolonizing Johnston and Wake.

## Ecology

LAAL nest predominantly on low coral and sand islands. They tend to select nest sites closer to vegetation than Black-footed Albatross and typically nest on flat ground.[1,6] However, LAAL will nest in steep rocky areas (*e.g.*, Nihoa and Lehua).[7,22] Egg laying occurs Nov-Dec and chicks fledge in early-Jul.[1,7] Sexes are similar although males tend to be larger.[8] Pairs are philopatric and mate retention is high. About one-fifth of the experienced adults do not breed in a typical year.[2] Immature plumage is similar to that of adults.[1,8] Sexual maturity is reached at around 8-9 years (range 6-12 years).[9]

LAAL are surface feeders, taking food by dipping and scavenging at the ocean's surface.[1,7] They occasionally follow ships to scavenge refuse.[10] Feeding aggregations are common, but they almost never feed in association with other species.[11] In Hawai`i, the diet consists of squid, deep-water crustaceans, fish, and flyingfish eggs.[12] Squid constitute >50% of diet.[2,12] The oldest-known LAAL was 51 years.[13]

## Conservation Concerns and Activities

Thousands of albatross were killed annually in high seas drift net fisheries until an international ban on the fisheries in 1993.[14] In the 1990s, thousands of LAAL were killed each year by longline fisheries.[14,15] The estimated bycatch has been reduced substantially in the U.S. fisheries as a result of a suite of management measures ranging from fishing closures to required seabird deterrents. Regulations now require U.S. longline fisheries to implement mandatory mitigation measures to minimize bycatch in AK, HI, and CA.

Predation by cats, dogs, and rats are a threat to LAAL in many areas. At Kilauea Point, Kaua`i nesting birds are protected by fences and predators are controlled near the colony, but occasional problems persist. Predators are controlled by the state near the colony at Kaena Pt., O`ahu, but remain a problem. Rats have been eradicated on all NWHI. Between 1954-1964, control measures at Midway to reduce LAAL collisions with aircraft resulted in the death of tens of thousands of albatross.[16] LAAL nesting efforts are thwarted at Pacific Missile Range (Kaua`i), Dillingham Airfield (O`ahu) and Marine Corps Base Hawai`i (O`ahu) by egg collection and relocation of adults to ensure aircraft safety. At Midway, lead based paint has contaminated the soil around old military buildings and chicks ingesting the lead exhibit deformities or die. Buildings, lights, antenna wires, and even introduced ironwood trees have created obstacles that kill many LAAL on Midway.[2] Golden crown-beard, an invasive weed that is well established on Kure, Midway, and Pearl and Hermes may limit LAAL nesting densities, reduce productivity, and provide habitat for mosquitoes that spread avian pox. Over the past three decades, management of nesting habitat on Midway has led to an increase in LAAL numbers.

## Recommended Actions

- Design and implement a statistically rigorous population monitoring program, including estimation of age-specific survival rates.
- Compile, analyze and report USFWS data collected at the breeding colonies. Analyze and report demographic information from 50 years of banding data.
- Review population sampling design at Laysan Is. and design a sampling program to estimate breeding populations at Midway.
- Support efforts to estimate mortality from all U.S. and foreign fisheries and determine effects of this mortality on LAAL populations.
- Support continued research and development of mitigation measures and practices to prevent mortality in fisheries.
- Eradicate introduced predators on USPI where LAAL historically bred or are establishing new colonies (*e.g.*, Wake, Johnston, and Kaena Pt, O`ahu).
- Control exotic vegetation at Midway, Pearl and Hermes, and Kure Atoll that degrades nesting habitat (*e.g.*, golden crown-beard).
- Work with the DOD in Hawai`i to investigate the potential for albatross nesting areas on military lands where albatross would not interfere with or endanger airfield operations.
- Remove lead contaminated soil around old buildings and building sites at Midway or otherwise eliminate the availability of the lead to albatross.
- Eradicate mosquitos (introduced vectors for avian pox) from Midway Atoll.

## Regional Contacts

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***References**:* 1. Whittow 1993b; 2. Harrison 1990; 3. Fernandez *et al*. 2001; 4. Shuntov 1974; 5. E. Flint pers. comm. 6. Fisher 1972; 7. USFWS 1983c; 8. Tickell 2000; 9. Fisher 1975; 10. Sanger 1974b; 11. Gould 1971; 12. Harrison *et al*. 1983; 13. C. Robbins, pers. comm. 14. McDermond and Morgan 1993; 15. Cousins and Cooper 2000; 16. Harrison *et al*. 1984; 17. USFWS unpubl. data; 18. Sugimura *et al.* 2003; 19. Pitman 1988; 20. Dunlap 1988; 21 Howell and Webb 1992; 22. VanderWerf *et al.* 2004; 23. M. Rauzon *et al.* in prep.

# Hawaiian Petrel (Hawaiian Dark-rumped Petrel, \`Ua\`u)
# *Pterodroma sandwichensis*

## Status

**Federal: E** **State: HI-E** **IUCN: VU** **NAWCP: HI/HI**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | no | 1 | 55d | 110d | Apr-Dec | burrow | surface seizer | pelagic |

## Distribution, Population Status and Trends

Dark-rumped Petrel was recently split into two species based on genetic and morphological evidence, *Pterodroma sandwichensis* in Hawai\`i and *P. phaeopygia* in Galapagos.[1,2] Hawaiian Petrels (HAPE) range over the central tropical Pacific but nest only in Hawai\`i.[3] Fossil and archeological evidence indicate HAPE were common at all elevations on the main islands until humans arrived.[3,4] Today, there are small populations scattered widely on Maui, Kaua\`i, Hawai\`i, and probably Moloka\`i , Lāna\`i, Lehua, and sea stacks off Kaho\`olawe.[3,13,17] At sea, birds are more abundant near the islands during the breeding season and range up to 1,300 km from colonies.[11]

Based on pelagic observations, the total population including juveniles and subadults was estimated at 20,000 with a breeding population of 4,500-5,000 pairs.[8,11] Approximately 1,000 pairs nest in Haleakala National Park, Maui.[3] There is also a small colony on Mauna Loa, Hawai\`i.[18] Kaua\`i populations are difficult to assess but potentially a large portion of the population nest on that island.[8] Overall population trends are unknown. Numbers breeding on Maui appear stable[3] and have increased in areas of Haleakala NP with active predator management.[6] On Hawai\`i numbers may be declining due to predation by introduced predators.[3,16]

## Ecology

On Hawai\`i and Maui HAPE have been pushed to the limits of their habitat, nesting in the cold, xeric environment above 2,500 m primarily in national parks. On Kaua\`i there is evidence that HAPE nest at lower elevations in densely vegetated rainy environments.[8] HAPE are colonial and nest in burrows, crevices in lava, or under ferns. Burrows are 1-9 m deep.[3] HAPE are monogamous and show a high degree of mate and nest-site fidelity.[3] Birds are nocturnal at the colony and appear to stage on the


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water nearshore prior to flying in to the nests.[8] Both sexes incubate and the 55 day incubation period is usually broken into 4-5 incubation shifts.[3] The single chick is brooded for 1-6 days and then fed every 2-3 days on average.[3,4] Age at first breeding is unknown but likely 5-6 years. Simons[4] found that 89% of the adult population breeds each year.

Prey is taken by dipping, surface-seizing, pattering and scavenging often in association with tuna or other subsurface predators.[7,14] HAPE have been observed feeding during the day but their diet indicates they may also feed at night.[4,14] Squid dominates the diet followed by fish (goatfish and lantern fish most common) and crustaceans.[3,4]

## Conservation Concerns and Activities

The most serious threat to adult survival and reproductive success is predation by introduced predators at nesting colonies. The Haleakala colony is raided by mongooses, cats and rats which have caused breeding failure rates >70%.[3] Feral cats and mongooses are now controlled in accessible areas and reproductive success is significantly higher in fenced areas with active predator management.[6] Feral goats also cause mortality by trampling burrows. Boundary fences at Haleakala NP provide a barrier to goats, pigs and dogs but they are also cause direct mortality; modification of the fences has reduced this mortality.[6] Axis deer numbers are increasing on Maui and they pose a new threat since they can jump over the existing fences but increasing the height of the fences would likely increase petrel mortality.[6] Research on the Mauna Loa colony suggests feral cats are a key predator.[16] The remoteness of these nesting sites make predator control difficult and as a result this colony is extremely vulnerable. Bright lights in the flight corridor to the ocean can disorient fledglings, leading to fallout and mortality; shielding of lights on Kaua`i has helped reduce this threat.[10,12,15] Collisions with powerlines also cause mortality.[9]

## Recommended Actions

- Work with NPS, the state of Hawai`i and other land managers to control introduced predators and ungulates in the area of important colonies.
- Work with Kaua`i Electric to develop solutions to mortality caused by powerlines (*e.g.*, different spatial array, strategic tree planting, visual deterrents).
- Survey Lāna`i and Kaho`olawe to determine if HAPE are nesting. Locate and determine the size of Kau`ai colonies. Outline and implement a population monitoring program.
- Maintain a program to shield lights to reduce their effects on petrels and continue recovery efforts for grounded fledglings.
- Determine status on offshore islands such as Lehua, that could be made predator-free.

## Regional Contacts

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***References:*** 1. Browne *et al.* 1997; 2. Tomkins and Milne 1991; 3. Simons and Hodges 1998; 4. Simons 1985; 5. Howell and Pyle 1997; 6. Hodges and Nagata 2001; 7. Pitman 1986; 8. Ainley *et al.* 1997b; 9. Cooper and Day 1998; 10. Planning Solutions 2003; 11. Spear *et al.* 1995; 12. Telfer *et al.* 1987; 13. Day *et al.* 2003; 14 Pitman and Ballance 1997; 15. Reed *et al.* 1985; 16. Hu *et al.* 2001; 17. E. VanderWerf pers. obs.

# Herald Petrel *Pterodroma arminjoniana*

## Status

**Federal: BCC 68** **State: None** **IUCN: None** **NAWCP: HC/HC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | no | 1 | 60?d | 100?d | May-? | surface | surface seizing | pelagic |

## Distribution, Population Status and Trends

Several polymorphic populations of Herald Petrels (HEPE) occur in the tropical and subtropical Atlantic, Indian and Pacific Oceans.[1] In the tropical Pacific, *P. a. heraldica* breeds on Raine Is. (off Australia), Tonga, Samoa, Cook, Marquesas, Tuamotu, Gambier and Pitcairn island groups and Easter Is.[1] There are three distinct color morphs and the birds at American Samoa are light morph.[6,7] Several authors have proposed full species status for the Pacific HEPE: *P. heraldica*.[4]

In the USPI, HEPE breed on Mt. Lata in the Ta`u Unit of the American Samoa National Park.[2,3,6] The only specimen of HEPE known from Samoa was collected on 6 May 1988.[6] Birds were observed on several occasions in the days leading up to this collection and 30-40 were counted calling and displaying over the densely forested ridgeline.[6] Lack of sightings since 1988 suggests this population is decreasing or is now extirpated on Ta`u.[3] World-wide population trend is unknown.

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## Ecology

HEPE nest on cliff ledges, slopes or ridges.[1] On the north side of Ta`u, the HEPE colony was in the nearly impenetrable vine thickets found above 670 m.[5,6] Nests were on the surface and birds visited the nesting colony during the day.[1,4] Phenology on Ta'u is difficult to assess given the limited data but birds appeared to breed in the austral winter, which coincides with breeding on other islands in the Pacific.[6] Birds were courting in May and their behavior in Jul indicated they were incubating eggs or feeding chicks.[6] Prospecting birds were also observed in Aug 1989 and this could indicate a protracted or year-round breeding season.[6] At other locations birds visit the colony throughout the year.[7]

The diet consists of squid, fish, crustaceans and other invertebrates such as sea striders.[8] Prey is taken by dipping or surface-seizing.

## Conservation Concerns and Activities

Introduced mammalian predators are the greatest threat on breeding islands. In Jul 2001, Norway rats were discovered on the summit of Ta`u.[3] Rats may have arrived with construction materials to repair hurricane damage in the 1980s and 1990s. The last observation of HEPE in American Samoa was in 1989. None were seen during several visits between 1999-2002, suggesting that the colony may have been extirpated by rats.[3] However given that many species are aseasonal breeders in the tropics, this species may still be extant on the island.

## Recommended Actions

- Work with NPS and the Government of American Samoa to implement rat control in the vicinity of existing and historical petrel and shearwater colonies at Ta`u.
- Continue surveys at Ta`u to verify HEPE presence/absence.

## Regional Contacts

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Peter Pyle - PRBO Conservation Science

***References:*** 1. Carboneras 1992a; 2. Engbring and Ramsey 1989; 3. M. Rauzon pers. comm.; 4. Pratt *et al*. 1987; 5. Pyle 1988; 6. Pyle *et al*. 1990; 7. Harrison 1983; 8. Imber *et al.* 1995.

# Tahiti Petrel *Pterodroma (Pseudobulweria) rostrata*

## Status

**Federal: BCC** **State: None** **IUCN: LR/nt** **NAWCP: HC/HC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | no | 1 | 60?d | 100?d | Nov-Jun | cavity | surface seizing | pelagic |

## Distribution, Population Status and Trends

Tahiti Petrels (TAPE) are endemic to the eastern and subtropical south Pacific, ranging from Mexico to Taiwan. Three subspecies are recognized.[8] They breed in the Society, Samoa, Fiji, and Marquesas islands and New Caledonia; possibly Tonga. In the USPI, TAPE breed in American Samoa on the islands of Ta`u, Tutuila, and possibly Olosega: on Mt. Lata, American Samoa National Park, Ta`u Unit;[5] and, on Ta`u Mountain in the Tafuna plain, Tutuila.[3] They have been reported from Olosega but no evidence of a colony was found in 1999, however, colonies could exist in inaccessible cliff areas.

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A live bird was collected on Guam in March 1986.[6] At sea, birds are most abundant in the vicinity of the breeding islands. During the austral winter, small numbers are recorded north of the equator in the central Pacific, but the main wintering range is presumed to be west of the breeding islands towards Australia.[9]

Some experts speculate that Ta`u birds may be a separate species. Feathers were collected for DNA analysis and submitted to the Smithsonian Institute, and sound recordings have been archived in the Cornell Library of Sounds. Recent work also indicates that TAPE are a distinct species from Beck's Petrel and should be in the genus *Pseudobulweria*.

Seabird surveys of Ta`u in 2001 indicate about five miles of summit rim habitat that TAPE likely use in addition to surrounding cliffs. Based on the estimated density of birds and potential nesting habitat, perhaps 1,000 pairs may breed over the island summit areas of this island.[7] Population trend is likely decreasing since Norway rats have reached the summit of Ta`u.

## Ecology

TAPE breed on forested mountain slopes, and rims and craters of volcanic islands, at altitudes from 200-2,000 m.[2] Birds nest in loose colonies that can be up to 12 km inland.[2] A partially diurnal species in the Society Islands, TAPE are seen flying along mountain ridges in late afternoon.[7] Birds are normally nocturnal on land, coming and going at dusk and dawn.[1] Nests are in burrows or cavities and the rainforest nesting habitat is characterized by large tree root systems, with open chambers under trees and vines that were made by generations of TAPE diggings. On Ta`u, TAPE are austral summer breeders and lay their single egg in Dec. Chicks fledge in Jun.

Diet is unknown, but probably consists of fish and squid. Pratt *et al.*[1] labels TAPE as solitary birds of the open ocean that will follow ships, but birds have been observed in mixed-species feeding flocks in the Central Pacific, where small fish and squid are the typical diet.[9]

## Conservation Concerns and Activities

Feral cats and rats affect TAPE populations throughout range. A newly discovered Norway rat infestation at the Ta`u colony is a major threat to the island population and NPS is considering a control program.[7] Bright lights affect TAPE in the Society Is. and the recovery of downed birds on American Samoa, indicates that lights or obstacles are a problem on these islands also.

## Recommended Actions

- Work with NPS and Government of American Samoa to implement rat control at Ta`u colonies.
- Determine location and extent of American Samoa colonies and document population size. Develop a program to monitor trends.
- Determine taxonomic status of the Samoan population (e.g, DNA, morphometrics) and the Pacific distribution.
- Conduct research to collect basic life history information for USPI populations.
- Determine the magnitude of the problem bright lights and obstacles pose for this species.

## Regional Contacts

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***References*:** 1. Pratt *et al.* 1987; 2. Carboneras 1992a; 3. Muse and Muse 1982; 4. Baker 1952; 5. Pyle *et al.* 1990; 6. Wiles *et al.* 1987; 7. O'Connor and Rauzon 2004; 8. Clements 2000; 9. King 1967.

# Phoenix Petrel *Pterodroma alba*

## Status

**Federal: BCC** **State: None** **IUCN: EN** **NAWCP: HI/HI**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | yes? | 1 | 60?d | 100?d | year-round | scrape | dipping? | pelagic |

## Distribution, Population Status and Trends

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Phoenix Petrel (PHPE) is endemic to the tropical Pacific and breeds in the Line, Phoenix, Marquesas, Tonga, Tuamotu, and Pitcairn islands.[3,4] Efforts to confirm their presence in recent years has been unsuccessful in the Marquesas, Tuamotus, and Tonga. Currently PHPE are thought to nest at only 10 locations.[11] U.S. islands in the Line and Phoenix groups do not currently host this species but decades of infestation by rats and cats may have extirpated populations or prevented colonization. At sea they are present in small numbers in the central Pacific, north to the Hawaiian Islands.[5]

The population center appears to be at Kiritimati, Kiribati in the Line Archipelago (Christmas Is.).[11] In 1980-82, this colony, estimated at 20,000-25,000 birds, was believed to be the largest in the world.[1,2] Phoenix Is., Kiribati, may host significant numbers, but this is unconfirmed. Globally the range is contracting, populations are declining, and all colonies are threatened.

## Ecology

PHPE nest on the ground on low coral or sand islands. Breeding occurs throughout the year , but two distinct peaks exist: roughly Nov-Feb and Apr-Jul.[6,7] PHPE is a diurnal species, which helps determine presence/absence, since it more conspicuous than other nocturnal petrels. Birds nest on the surface but eggs at Kiritimati were often laid in sheltered locations.[6]

The diet consists primarily of squid, and other invertebrates (*e.g.,* water striders) and fish.[6]

## Conservation Concerns and Activities

The world status of PHPE is extremely precarious; it is threatened by feral cats, rats, rabbits, human encroachment and poaching, El Niño flooding, and sea level rise expected with global warming. The Polynesian rat is depleting the Kiritimati populations, and the recent arrival of black rats there has serious implications.[8] Rat control efforts have begun there, and the Polynesian rat was eradicated from Motu Upua in 2002.[9] Predator-free islets (Motu Tabu and Motu Upua) in the main lagoon and land-locked Isles Lagoon area are critical, but an atoll-wide plan for PHPE conservation and rat eradication remains unfunded.[8] Feral cats prevent the species from nesting on the main island and sporadic cat control on Kiritimati has failed to limit predation. Rats appear to have been eradicated from Oeno and perhaps Ducie Is. in the Pitcairn Group in 1997, allowing some reproductive success.

Rats and cats were eradicated from Howland, Baker and Jarvis and in 2001 an acoustic play back recorder designed to attract PHPE was installed at Jarvis (322 km from Kiritimati).[10] To date there is no evidence of PHPE at the island.

## Recommended Actions

- Work with other nations in Oceania and especially Kiribati to enact conservation measures for PHPE.
- Expand efforts to assess the suitability of U.S. islands to support PHPE and if suitable work with international partners to attract or

translocate PHPE to U.S. islands within the historic range where exotic predators have been eradicated.

- Support Kiribati in efforts to eradicate rats and other predators from their islands, monitor for new introductions (*e.g.*, black rats), educate school children about PHPE, and support the nomination of Kiritimati as a World Heritage Site.

## Regional Contacts

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***References:*** 1. Jones 2000; 2. Garnett 1984; 3. Bell and Bell 1998; 4. Carboneras 1992a; 5. King 1967; 6. Ashmole and Ashmole 1967; 7. Flint 2002; 8. Everett *et al.* 2002; 9. L. Jones, pers. comm.; 10. E. Flint, pers. comm.; 11. BirdLife International 2000.

# Bonin Petrel *Pterodroma hypoleuca*

## Status

**Federal: None** **State: None** **IUCN: None** **NAWCP: MC/MC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | no | 1 | 49d | 82d | Dec-Jun | burrow | surface, dip | pelagic |

## Distribution, Population Status and Trends

Bonin petrels (BOPE) range throughout the central Pacific with breeding colonies in Hawai`i and Japan (Bonin and Volcano islands).[2] During the breeding season birds are rarely seen at-sea south of 20°N.[8] During the non-breeding season a few stay in the vicinity of Hawai`i but most disperse widely over the subtropical north Pacific, north and west of Hawai`i towards Japan.[2,5]

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In Hawai`i, BOPE nest on the NWHI from French Frigate Shoals to Kure; the main breeding colonies are at Lisianski (150,000-250,000 pairs)[9], Laysan (50,000-75,000 pairs)[9] and Midway (70,000 pairs)[13]. The population at Midway has increased since the removal of rats in 1997, from an estimated 2,500-5,000 pairs in 1979 to 70,000 pairs in 1999.[9,13] In the 1930s, Midway Atoll supported one of the largest colonies in the world with an estimated 250,000 pairs but populations were decimated by rats introduced in 1943.[3,4,6] Historically BOPE also bred on the main islands but colonies there are now extirpated.[7] Global population trends are unknown but trends in Hawai`i are increasing as birds recolonize Midway and Kure atolls following the removal of rats.

## Ecology

BOPE are nocturnal on the NWHI colonies where they excavate burrows in the sandy soil.[1] They are monogamous and exhibit high rates of mate retention.[1] BOPE are winter breeders, returning to the colonies in Aug. Prior to egg-laying there is an exodus of up to 24 days.[1] The first eggs are laid in mid-Jan and both parents share in incubation; shifts at Midway averaged 6-8 days.[1] Chicks are fed a rich oil by both parents every 2 days on average.[11] Chicks fledge at approximately 82 days and their plumage is almost indistinguishable from that of adults. Late fledging chicks may be killed or forcibly ejected from burrows by Wedge-tailed Shearwaters returning to breed.[2] Chicks are assumed to be independent of adults after fledging and preliminary data indicate they return to the natal island at 1 year.[2]

BOPE are fairly unique among Pterodroma petrels in having a diet that consists mainly of fish (rather than squid), especially lanternfish and hatchetfish; they also eat squid.[4,9] BOPE are believed to feed at night since most of their diet consists of deepwater species that migrate to the surface at night.[9] Usually solitary at sea, they sometimes occur in mixed species flocks.[10]

## Conservation Concerns and Activities

Historically, BOPE have suffered from mammalian introductions to breeding islands. Introduced rabbits devegetated Lisianski and Laysan in the early 1900s resulting in population declines for many seabird species, due to soil erosion, destabilization of burrows, and sand storms that filled burrow entrances.[12] Rabbits were eradicated in 1923.[12] Rats were introduced to Midway and Kure in the 1940s in conjunction with military activities and over a 40 year period BOPE populations at Midway declined from ~500,000 to 5,000. Rats (black and Polynesian) were eradicated from both islands in the 1990s and populations of all small ground nesting seabirds are rebounding. BOPE are nocturnal at the colonies and easily disoriented by artificial lighting, causing fatal collisions; the Service has removed or modified artificial lights and overhead wires at Midway to address this problem. Introduced plants such as golden crown-beard and sandbur degrade nesting habitat: the shallow root system provides poor soil stabilization and the dense thickets of crown-beard reduce access. Introduced ants at Kure may attack nestlings but more important they facilitate destruction of native vegetation by introduced scale insects.

## Recommended Actions

- Eradicate golden crown-beard at Midway, Kure and Pearl and Hermes and prevent introductions elsewhere. Eradicate sandbur from Laysan.
- Develop and implement a monitoring program. Monitor population recovery at Midway and Kure post rat eradication.
- Conduct long-term demographic studies to document population trends, survival rates, reproductive success, and to acquire accurate estimates of the breeding populations.
- Investigate the ecology and effects of introduced ants and scale insects, including direct and indirect impacts on BOPE survival, reproductive behavior and reproductive performance. Investigate means to control or eradicate ants and scale without damaging the native/endemic fauna.

## Regional Contacts

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***References:*** 1. Grant, *et al*. 1983; 2. Seto and O'Daniel 1999; 3. Woodby 1988; 4. Harrison 1990; 5. Harrison 1983; 6. Hadden 1941; 7. Olson and James 1984; 8. King 1967; 9. Harrison *et al.* 1983; 10. Fefer *et al.* 1984; 11. Pettit *et al.* 1982; 12. Ely and Clapp 1973; 13. Small 1999.

# Bulwer's Petrel (`Ou) *Bulweria bulwerii*

## Status

**Federal: None** **State: None** **IUCN: None** **NAWCP: MC/MC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | no | 1 | 44d | 62d | May-Sep | crevice | surface seizing | pelagic |

## Distribution, Population Status and Trends

Bulwer's Petrel (BUPE) is a pantropical, highly pelagic species.[2] In the Pacific Ocean, BUPE breed on the Phoenix, Marquesas, Bonin, Volcano, and Hawaiian island groups, and probably in the Marshalls.[3,5] At sea distribution is not well documented but Hawaiian birds appear to disperse to the southeast of Hawai`i after the breeding season, probably to winter in the central and eastern Pacific.[6]

The global population size is unknown but the Pacific population exceeds 100,000 pairs. The largest colony is at Nihoa (75,000-100,000 pairs) where approximately 97% of the Hawaiian population and a large percentage of the Pacific population nest.[1] During the last century, BUPE nested on all of the NWHI except Kure, islets off the main Hawaiian Islands and a few remote sites on the main islands. BUPE were "abundant" at Midway before rats were introduced in 1943; they no longer breed at Midway.[4] At Johnston Atoll, a growing colony supports 60-80 pairs.[7] Population trends globally and in the USPI are unknown.

## Ecology *(from Megyesi and O'Daniel 1997 unless otherwise noted)*

BUPE nest under cover in crevices, caves, rock and coral rubble, under vegetation or debris, and in man-made structures. Breeding is highly colonial. Most birds arrive at the Hawaiian colonies in Apr, egg laying occurs from mid May to mid Jun, and most young are fledged by early Oct.[8] Pairs are monogamous, with high mate and site fidelity. Both sexes share in incubation; shifts at Laysan averaged 9.5 days[8] and at Johnston males averaged 10.2 and females 5.8 days. At Layson, young are brooded for <5 days after which at least one adult returned to the nest almost every night.[8] Chicks fledge after two months, but before flight feathers are fully developed. Birds return to the colonies at 2 years of age but most do not nest until 6 years. The oldest known bird was 24 years.

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BUPE are solitary foragers. They migrate to areas of upwelling, feeding mainly on fish (lanternfishes and hatchetfishes) and squid, but also crustaceans and sea-striders.[4] Most of their prey are bioluminescent and migrate from deep water to the surface at night where they are caught by surface-seizing.[4]

## Conservation Concerns and Activities

Predation by rats and cats occurs throughout the BUPE range. Rats eliminated BUPE from Sand Is., Midway. However, rat eradication has been accomplished at Midway and Kure, and BUPE are expected to reestablish breeding populations. The effects of house mice are unknown. Introduced ants have been observed entering and killing pipping eggs at colonies on Maui and Molokini.[9] In the NWHI and Johnston, storm tides can cause loss of chicks or eggs.[3] The extreme concentration of a large proportion of the Pacific population at one island renders this species vulnerable to catastrophic events at this location.

## Recommended Actions

- Control or eradicate feral cats and rats from islets off the main Hawaiian Islands and at main

island sites such as Marine Corps Base Hawai`i, Kaneohe Bay, and Pyramid Beach.
- Eradicate mice from Midway and Johnston NWRs.
- Baseline population ecology studies are needed for this poorly known species.

## Regional Contacts

Beth Flint - USFWS, Pacific Remote Islands NWR Complex, Honolulu, HI
David Smith - Hawai`i Division of Forestry and Wildlife, Honolulu, HI

***References:*** 1. Harrison *et al.* 1984; 2. Carboneras 1992a; 3. Megyesi and O'Daniel 1997; 4. Harrison 1990; 5.King 1967; 6. King 1970 in Megyesi and O'Daniel 1997; 7. USFWS unpubl. data.; 8. USFWS 1983c; 9. Fern Duvall, Hawaii DOFAW, pers. comm.

# Wedge-tailed Shearwater (`Ua`u kani) *Puffinus pacificus*

## Status

**Federal: None** **State: None** **IUCN: None** **NAWCP: LC/LC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | no? | 1 | 54d | 100d | Jun-Dec | burrow | contact dipping | pelagic |

## Distribution, Population Status and Trends

Wedge-tailed Shearwaters (WTSH) are widespread throughout the tropical and subtropical Indian and Pacific Oceans.[1] In the Pacific they breed from the Bonin Is. off Japan to the Revilla Gigedos off Mexico. At sea birds are most abundant near the colonies during the breeding season.[9] After the breeding season, Hawaiian birds probably migrate south to the Equatorial Countercurrent and east.[9] There are two color phases: light and dark. Light phase birds predominate at all breeding colonies north of 10°N except the Marianas where only dark phase birds occur.[9]

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WTSH are abundant, with a worldwide population greater than one million pairs.[1] In the USPI, most birds breed in the Hawaiian Islands with smaller colonies on Johnston and the Marianas. Approximately 270,000 pairs breed in Hawai`i and <2,000 pairs on the other islands of the USPI.[2,4,6,7] The largest colonies in the USPI are at Laysan (125,000-175,000 pairs), Nihoa (30,000-40,000) and Lisianski (10,000-30,000).[2] WTSH also nest in the main Hawaiian islands (40,000-60,000 pairs), including Lehua (23,000 pairs)[16], Kaula (1,500-2,500 pairs) and offshore islets such as Manana and Moku Lua off O`ahu (10,000-20,000 pairs each). Smaller colonies occur at Moku Manu, Moku`auia and Kapapa (O`ahu), and Molokini and other islets off Maui.[2] Although abundant and widespread, global populations are far below historical levels due primarily to human harvest, introduced predators, habitat degradation by introduced herbivores, and possibly competition with commercial fisheries.[1] However, eradication of cats and rats at Midway, Kure, Johnston and islands off the main Hawaiian Islands resulted in population increases as these sites.[4] In the USPI, most of the colonies have not been surveyed for 20-25 years, so trends cannot be assessed.

## Ecology

WTSH excavate burrows or nest in rock crevices; nesting habitat is typically flat ground, plateaus, slopes or cliff tops. Pairs are monogamous and mate retention is strongly influenced by a pair's success the previous season.[12] Breeding generally occurs during the local summers in the subtropics but breeding cycles are less seasonal at equatorial colonies.[9] In Hawai`i nesting is very synchronous. Birds return to the colonies in Mar-Apr and most eggs are laid in Jun. Both parents incubate and shift length at Manana ranged from 4-12 days.[10] Most chicks hatch from Jul-Aug and most young fledge in Nov.[2,10] Birds return to breed at four years.[3]
°

Most sightings of WTSH at sea are of single birds or small groups but foraging birds are most often seen in large multi-species flocks associated with predatory fish, that drive prey to the surface.[9] In Hawai`i, the diet consists largely of larval goatfish, flyingfish, squirrelfish and flying squid.[11] WTSH often follow trawlers and other fishing boats discharging offal.

## Conservation Concerns and Activities

Introduced predators are the greatest threat to WTSH in the USPI. Rats and cats have been eradicated from the NWHI and most of the remote USPI but they still exist on the main Hawaiian Islands, Wake and the Marianas. Feral cats are known to kill large numbers of adult WTSH at colonies in the main Hawaiian

Islands[8,17] Predator control in the main Hawaiian Islands has helped colonies become established and maintain themselves (*e.g.,* Mokapu Peninsula and Kaena Point, O`ahu; Kilauea Pt., Kaua`i). WTSH are recolonizing Baker and Wake after predator control.[5] At the two largest colonies (Laysan and Nihoa) endemic finches readily predate eggs that are left unattended (*e.g.,* due to researcher disturbance). Introduced Common Mynas were significant egg predators at Kilauea Pt., Kaua`i,[13] but placing chicken eggs treated with bird repellant throughout the colony, significantly lowered predation rates.[14] Artificial lights disorient fledglings, which collide with power lines and vehicles on the main Hawaiian Islands. Human trespass at colonies can cause burrow collapse. Contaminants (including mercury, lead and organochlorines) have been detected in Hawaiian birds and experimentally applied oil reduced breeding success.[15] Avian pox-like lesions have been observed since 1996 at Maui and Molokini.[8] Because shearwaters associate with the tuna schools, by-catch and overfishing may pose significant threats.

## Recommended Actions

- Eradicate cats and rats at Wake. Eradicate all introduced predators and herbivores on Lehua and islets off the main Hawaiian Islands. Control introduced animals at colonies on the main Hawaiian Islands (*e.g.*, Black Pt., Kaena Pt., Malaekahana, and Mokapu, O`ahu; Ho`okipa, Maui; Kilauea Pt., Kaua`i).
- Investigate and monitor the levels and effects of contaminants.
- Investigate the cause and effects of the pox-like lesions on WTSH breeding at Maui and Molokini.
- Research into the ecology of seabirds, their prey, and schooling predatory fish that drive prey to the surface. Model the system to predict the effects of overfishing on seabirds.

## Regional Contacts

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David Smith - Hawai`i Division of Forestry and Wildlife, Honolulu, HI
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Larry Spear and David Ainley - H. T. Harvey & Associates, Alviso, CA
Robert Shallenberger - The Nature Conservancy, Hawai`i, HI

***References:*** 1. Carboneras 1992a; 2. Harrison 1990; 3. Whittow 1997; 4. USFWS unpubl. data; 5. Rauzon in prep.; 6. Stinson 1995; 7 Reichel 1991; 8. F. Duvall unpubl. data; 9. King 1974; 10. Shallenberger 1973; 11. Harrison *et al.* 1983; 12. Fry *et al.* 1986; 13. Byrd *et al.* 1983; 14 Byrd and Moriarty 1980; 15. Fry *et al.* 1983; 16. VanderWerf *et al.* 2004; 17. Smith *et al.* 2002.

# Christmas Shearwater (black shearwater) *Puffinus nativitatis*

## Status

**Federal: BCC 67,68** **State: None** **IUCN: None** **NAWCP: HC/HC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | no | 1 | 52d | 100d | Mar-Oct | under vegetation | pursuit plunge | pelagic |

## Distribution, Population Status and Trends

Maura Naughton, USFWS

Christmas Shearwaters (CHSH) range throughout the tropical and subtropical central Pacific. They breed on small, remote islands in the Hawaiian, Line, Phoenix, Samoan, Marquesas, Marshall, Pitcairn, Tuamotu, and Austral islands; and islands off Chile and Easter Is. in the eastern Pacific.[2,3] Extirpated from the Bonins (Ogasawara), Minami Torishima (Marcus) and Wake.[2] At sea they are most abundant offshore of the breeding islands.[6] It is assumed that juveniles, non-breeders and most adults disperse after breeding to tropical and subtropical waters, although some breeding adults in the tropics may be sedentary.

Global population size is not known but probably numbers in the several tens of thousands pairs.[7] In the USPI they breed on the Hawaiian Islands from Lehua to Kure (a few pair also nest on islets off the main Hawaiian Islands), and at Johnston, Jarvis and American Samoa. In Hawai`i, the total population is probably <3,000 pairs; the largest colonies are on Laysan (1,500-2,000) and Lisianski (400-600).[2] Global population trends are unknown but several known colonies are declining. For example, Christmas Is. supported large colonies numbering about 6,000 pairs in the 1980s but populations in 2002 were probably less than 3,000.[5] In USPI, populations suffered historic declines due to introduced predators but appear to be stable to increasing because of active predator eradication programs on remote islands (*e.g.*, Kure, Midway, and Jarvis).

## Ecology

CHSH nest under vegetation or in rock crevices. Birds return to the colony at night and are most active in early evening and early morning.[8] CHSH are monogamous but mates are not always retained in subsequent years.[2] Breeding birds return to the colonies in Feb and a single egg is laid in Mar-Jun (slightly earlier phenology at Johnston).[2] Both parents participate in incubation with shifts lasting ~5days.[9] One or both parents returned almost every night to feed chicks at Laysan in 1979.[9] Fledglings are almost indistinguishable from adults at fledging and are probably independent of parents once they depart the colony; adults continue to visit the nest site after chicks have left.[9]

CHSH feed far offshore, in mixed species flocks over predatory fish that drive prey to the surface.[4,10] The diet of CHSH in Hawai`i is split almost equally between fish and squid, caught by pursuit-plunging, pursuit-diving and occasionally surface-seizing.[4] Goatfish, flyingfish and scad were the most common fish in the diet.[4]

## Conservation Concerns and Activities

Worldwide, populations at many island groups are declining due to feral cats and rats (*e.g.,* Kiritimati).[1] In the USPI, colonies at Midway, Kure, Jarvis, and Johnston all suffered significant declines after predators were introduced but are now rebounding.[11,12] The colony at Wake was extirpated but one individual was observed after cat control was initiated.[13] Invasive plants and invertebrates degrade nesting habitat in the Hawaiian Islands (*e.g.*, golden crown-beard and scale insects).

## Recommended Actions

- Control exotic vegetation and invertebrates at Pearl and Hermes, Midway and Kure and restore native vegetation.
- Eradicate predators and herbivores from Lehua and work with DOD and other partners to eradicate rats and cats from Wake.
- Support Kiribati in efforts to control/eradicate cats at Kiritimati.

## Regional Contacts

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***References:*** 1. Haley 1984; 2. Seto 2001; 3. Amerson *et al.* 1982; 4. Harrison *et al*. 1983; 5. M. Rauzon, pers. comm. 6. King 1967; 7. Carboneras 1992a; 8. Harrison 1990; 9. USFWS 1983c; 10. Ballance and Pitman 1999; 11.USFWS unpubl. data; 12. Rauzon *et al.*2002; 13. Rauzon *et al*. in prep.

# Newell's Shearwater (`A`O) *Puffinus auricularis* Newell

## Status

**Federal: T** **State: HI-T** **IUCN: CR** **NAWCP:HI/HI**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | no | 1 | 62d | 92d | Jun-Nov | burrow | pursuit plunge | pelagic |

## Distribution, Population Status and Trends

Newell's Shearwater (NESH), a subspecies of Townsend's Shearwater, is endemic to the Hawaiian Islands. The largest colonies are on Kaua`i,[1] the only island without introduced mongoose. Smaller colonies exist on Hawai`i and Moloka`i; recent reports of nesting on O`ahu, Maui and Lāna`i are unconfirmed. NESH were discovered nesting on Lehua (an islet near Ni`ihau) in 2003.[13] Their marine range extends principally south and east of the Hawaiian Islands to the eastern tropical Pacific, especially near the Equatorial Counter Current and the Inter-tropical Convergence Zone.[4] During the breeding season, some birds forage west and north of the Hawaiian Islands and the central part of their marine range moves northward.[1] During the nonbreeding season they are absent from the waters within several hundred kilometers of the Hawaiian Islands.[5]

NESH have experienced significant population declines. Apparently abundant at the time of Polynesian colonization, the species was thought to be extinct by 1908.[1] Subsistence hunting by Polynesians and predation by introduced rats, pigs and dogs were the likely causes of decline. They were rediscovered at sea in 1947 and confirmed breeding on Kaua`i in 1967.[5] They began to make a comeback, but since then the species has suffered continual declines. Recent demographic models estimated a population of 84,000 birds (range 57,000-115,000) in the late 1980s and early 1990s.[2] Hurricane Iniki in Sep 1992 caused considerable damage to the forests on Kaua`i and occurred when chicks were near fledging. Ornithological radar data from 1993 and 2001 indicated a 62% decline.[11] The Save Our Shearwaters Program (SOS), which has operated since 1978, may also provide an index of population size and fecundity.[7] Numbers of birds recovered by SOS have declined steadily since reaching a peak in 1987; numbers in 2000 were 21% of what they were in 1987.[7]

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## Ecology

*(from Ainley et al. 1997 unless otherwise noted)*
Highly pelagic, year-round. Most NESH on Kaua`i are thought to nest high (160-1200m) on steep, densely vegetated mountain slopes but substantial numbers of birds also nest on dry sparsely vegetated cliffs on the Na Pali cost of Kaua`i and on Lehua.[10,13] A smaller breeding population also occurs on forested cinder cones in the Puna District, Hawai`i.[6] Radar studies indicate that significant numbers may nest in other parts of Hawai`i Islands with the largest concentration in Waipio Valley. In Apr, adults return to renovate or dig new burrows. Egg laying is very synchronous in early Jun. NESH lay a single white egg that is incubated by both parents. The chick is fed a diet of regurgitated squid and fish by parents that forage hundreds of kilometers offshore, returning in darkness to the colony. Feeding NESH are often associated with tuna. Young fledge in the fall and fledglings visually orient by following river valleys to the sea, where they spend three years at sea before returning to land. Fledglings are independent of parents.

## Conservation Concerns and Activities

Street and resort lights concentrated near the coast disorient or blind fledglings, which then fall to the ground and are unable to regain flight.[3,11,12] Each year, thousands of fledglings are grounded and many are killed by cars, cats and dogs.[8] Others succumb to starvation and dehydration. Rapidly expanding coastal development has changed the Kaua`i skyline significantly since the 1980s. The conservation project Save Our Shearwaters began recovering and releasing downed shearwaters in 1978.[8,9] Since then, nearly 30,000 shearwaters have been recovered and released. Efforts to reduce fallout by shading lamps at resorts were effective.[3,12] In the early 1980s, Kaua`i Electric Co. began installing hoods on streetlights in areas with heavy fallout and recently a project was completed to convert all public street light on Kaua`i to shielded designs. Adults do not appear to be as vulnerable to lights as fledglings, but they do collide with utility wires that intersect their flight paths to the sea. The proposed construction of a Kaua`i Electric powerplant and associated lines in a known NESH "flight corridor" poses a potential additional threat and the Service is working with Kaua`i Electric to reduce this threat.

Over the past 150 years, >75% of the forests on Kaua`i have been lost. Large tracts of remaining forest are protected but habitat degradation by introduced plants and herbivores are a threat. Habitat in colonies at the privately owned Pu`ulena and Heiheiahulu colonies in Puna on the island of Hawai`i is lost to cinder mining. Introduced predators are a major concern; Kaua`i is the only main island without mongooses, but there are periodic unconfirmed sightings of this predator. Rats, cats, pigs and other introduced mammals are serious threats. Lehua could potentially provide important nesting habitat if rabbits and predators were removed. Hurricanes, fishery interactions and disease may also play a role in population decline and recovery.

## Recommended Actions

- Evaluate colonies for conservation measures. Compile a GIS database of NESH locational data (*e.g.*, colony, flyway) and conduct a structured ranking for restoration projects based on estimated probability of increasing productivity and survival.
- Initiate or maintain predator control and habitat conservation measures (*e.g.*, trapping, toxicants, fencing) at key colonies on Kaua`i, Hawai`i and Lehua. Research/monitoring to evaluate the effects of control.
- Refine and expand radar studies to monitor population trends, locate colonies, and investigate behavior. Evaluate and standardize an island-wide monitoring program.
- Work with Kaua`i Electric to minimize the effects of powerlines (*e.g.*, burial, different spatial arrangement, strategic tree planting).
- Reduce fallout of fledglings due to bright lights. Work with partners to shield lights and reduce light output especially during critical periods. Identify fallout areas on other islands where light shielding may be needed.
- Research into light attraction (*e.g.*, colors, flashing patterns) to minimize this threat.
- Continue Save Our Shearwater program.
- Develop partnerships with private landowners focused on NESH conservation.

## Regional Contacts

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***References:*** 1. Ainley *et al.* 1997a; 2. Ainley *et al.* 2001; 3. Day *et al.* 2003b; 4. Harrison 1990; 5. King and Gould 1967; 6. Reynolds and Ritchotte 1997. 7. Day and Cooper 2001; 8. T. Telfer, pers. comm.; 9. J. Sincock, pers. comm.; 1984; 10. E. Flint, pers. comm.; 11. USFWS 1983a; 12. Reed *et al.* 1985; 13. VanderWerf *et al.* 2004.

# Audubon's Shearwater *Puffinus lherminieri*

## Status

**Federal: None** **State: None** **IUCN: None** **NAWCP: HI/HC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | no | 1 | 50d | 62-75d | Jul- | burrow | pursuit diving | pelagic |

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## Distribution, Population Status and Trends

Widespread and abundant, Audubon's Shearwaters (AUSH) are pantropical breeders found throughout the Atlantic, Indian and Pacific Oceans. Several (9-10) subspecies are recognized; *P. l. dichrous* breed in the central Pacific.[2,5] Detailed genetic analysis of *P. lherminieri/assimilis* may show that the taxonomy of this group requires revision. In USPI, AUSH breed in the Line Islands and American Samoa. At sea, birds are usually within 160 km (100 mi) of breeding islands and migration is not known to occur.[6]

The global population may be several tens of thousands of breeding pairs.[2] Although this species is widespread and locally abundant, populations have declined from historical levels, including extirpation from many breeding sites. Colonies in American Samoa are located on Ta`u and Tutuila; estimates for Ta`u were 100 pairs[8] and the size of the Tutuila population is unknown.[4] Numbers are increasing at Jarvis (approximately 100 pairs) in response to cat eradication;[9] elsewhere in the Line Is. populations are decreasing at Kiritimati (possibly 2,000 pairs) where the long-term future is not secure.[3,4]

## Ecology

AUSH nest in a variety of habitats. In American Samoa they nest on steep cliffs and at Jarvis in sandy loam under *Sesuvium*.[4] Very little is known of the life history of this species from the USPI. Elsewhere they are colonial, nesting in rock crevices or burrows.[2] Incubation is 49-51 days with individual shifts of 2-10 days.[2] Chicks are brooded for 3-7 days and fledged in 62-75 days.[2] In the Galapagos sexual maturity is attained at 8 years.[2,3]

AUSH have been recorded diving 6-35 m deep at the Seychelles, contradicting the hypothesis that tropical shearwaters do not specialize in underwater foraging.[1] Birds off Samoa typically feed on the surface but they will dive for prey; they are usually seen feeding in mixed-species flocks.[7] Diet consists of fish, squid and crustaceans.[2] They sometimes forage near fishing boats.

## Conservation Concerns and Activities

Historically, Samoans hunted AUSH.[7] Pigs, dogs, rats and cats on nesting islands threaten the survival and reproductive success of these small birds. Many colonies vulnerable to extinction. Norway rats likely limit birds at Ta`u, American Samoa. The establishment of a colony on Jarvis in 1995 was only possible through cat removal.[4]

## Recommended Actions

- Monitor growth of the colony at Jarvis.
- Conduct systematic surveys to identify location and size of colonies in American Samoa.
- Work with NPS and the Government of American Samoa to implement predator control at Samoan colonies.
- Support international efforts in Kiribati to implement predator control (*e.g.*, cats and rats at Central Lagoon, Kiritmati).

## Regional Contacts

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***References:*** 1. Burger 2001; 2. Carboneras 1992a; 3. Jones 2000; 4. M. Rauzon, pers. comm; 5. Clements 2000; 6. King 1967; 7. Muse and Muse 1982; 8. Amerson *et al.* 1982; 9. Rauzon *et al.* 2002.

# Band-rumped Storm-Petrel (`ake`ake, Harcourt's and Madeiran Storm-Petrel) *Oceanodroma castro*

## Status

**Federal: C, BCC** **State: HI-E** **IUCN: None** **NAWCP: HI/HI**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | ? | 1 | 42d | 64-73d | Apr-Oct | crevice | pattering | pelagic |

## Distribution, Population Status and Trends

Band-rumped Storm-Petrels (BANP) are a widespread species with breeding sites in the Atlantic and Pacific Oceans. They breed in three archipelagoes in the Pacific: Japan, Galapagos and Hawai`i.[1] Colonies in Japan and Galapagos may consist of many thousands of birds[2] but the size of the Hawaiian population is unknown.[3] Highly pelagic, BANP are regularly observed at sea off Kaua`i and Hawai`i in the breeding season and their marine range extends from the main islands through the NWHI and tropical Pacific, especially near the Equatorial Counter Current. There is little mixing of Pacific breeding populations.[3] Birds are highly pelagic during the non-breeding season but some individuals at other colonies are sedentary, visiting colonies irregularly throughout the year.[1]

Historically, BANP were abundant and widespread in Hawai`i judging from numbers in midden sites and lava tubes on O`ahu, Hawai`i and Moloka`i.[7] The Hawaiian population is now a tiny remnant judging from the paucity of recent encounters.[2] BANP are known from 12 sites on Kaua`i at elevations around 610 m, and from Hawai`i and Maui at elevations >1,200 m, and from Lehua.[4,6,10] Population size and trend are unknown but suspected to be critically low. The breeding population on Kaua`i was estimated at 171-221 pairs in 2002,[6] but observations at sea suggest larger populations.[2,8]

## Ecology

Very little is known about BANP in Hawai`i and most of the data presented here are from other populations. BANP remains the only Hawaiian breeding bird whose nest is undescribed. Nesting habitat includes the very steep hanging valleys of Kaua`i vegetated with shrubs and grasses and the barren lava flows high on the volcanos of Maui and Hawai`i.[4,6] (Confirmation of nesting on Kaua`i


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was made in 2001-2001 during visits to the hanging valley of Pohakuao.[6]) Birds excavate burrows or nest in natural cavities.[4] Recovery of downed fledglings in Oct indicates that eggs are laid in May-Jun, chicks hatch in Aug and fledge in Oct.[4] BANP are long-lived (15-20 years) and probably do not breed until 3-7 years.[1,2,5]

Diet information is not available for Hawaiian birds but elsewhere they eat small fish and squid and some crustaceans.[4] Solitary feeders, BANP are most frequently observed alone or in the company of other BANP. Foraging in the Atlantic is often associated with upwellings.[9]

## Conservation Concerns and Activities

BANP need predator-free environments to survive. Introduced rats, mice, cats, mongoose, pigs and owls are all potential predators. Predator control at Haleakala National Park and Mauna Loa in Hawai`i Volcano National Park should reduce predation pressure. Eradication of rats from Lehua could provide an important predator-free site that will allow that population to increase.[10] Power lines at high elevations are suspected to cause some mortality.[4] Street lights concentrated near the coastlines disorient fledglings, which fall to the ground and are unable to regain flight. Colonies require protection and possibly management. Assessment of BANP status in Hawai`i is needed. The Hawaiian population is potentially isolated from other breeding populations and recolonization, if island populations are extirpated, may be difficult.

## Recommended Actions

- Control predators in nesting areas, particularly Lehua.
- Determine size, status, and distribution of Hawaiian BANP population.
- Locate and describe nests and conduct basic life history investigations to assess needs and conservation status.
- Identify factors limiting populations, determine the impacts of predation and formulate conservation and recovery actions.

## Regional Contacts

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***References:*** 1. Carboneras 1992a; 2. Harris 1969; 3. Harrison *et al*. 1990; 4. Slotterback 2002; 5. Ainley 1984; 6. Wood *et al*. 2002; 7. Olson and James 1982; 8. L. Spear, pers. comm.; 9. Haney in Slotterback 2002; 10. VanderWerf *et al.* 2004.

# Tristram's Storm-Petrel (Sooty Storm-Petrel) *Oceanodroma tristrami*

## Status

**Federal: BCC** **State: None** **IUCN: NT** **NAWCP: MC/HC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | no | 1 | 40-45d | 85-90d | Dec-May | burrow | pattering | pelagic |

## Distribution, Population Status and Trends

Tristram's Storm-Petrels (TRSP) nest on islands in Hawai`i and Japan.[1] In Japan they nest on the Volcano, Izu and possibly Bonin island groups; in Hawai`i they nest in the NWHI.[1] No colonies are located in the main Hawaiian Islands and their bones have not been found in archeological excavations on the main islands.[4,2,7] TRSP are rarely seen south of Hawai`i away from breeding islands. They range across the subtropical central and western Pacific into waters off Japan.

The Hawaiian population was estimated at <10,000 pairs with the largest colonies located at Nihoa (2,000-3,000 pairs), Laysan (500-2,500 pairs) and Pearl and Hermes Reef (1,000-2,000 pairs).[4,9] Smaller colonies exist at Necker, French Frigate Shoals and possibly Lisianski.[5] Historically colonies existed on Midway and Kure but were probably extirpated by rats; individuals have been recorded on these islands and TRSP may recolonize now that rats have been eradicated from both atolls.[2,4] TRSP populations are likely below historic levels with the extirpation of colonies at Midway and Kure, but more recent population trends are unknown.[2]

## Ecology

TRSP are winter breeders and are nocturnal at the colonies. Nest sites are colonial, in recesses in rock scree, under piles of mined guano, or burrows that they excavate under vegetation.[2,4] Information on breeding phenology is limited but birds return to the colonies in Nov, eggs are laid between Dec-Feb and both sexes incubate the egg.[4,2] Egg neglect is probably minimal at most of the large colonies where finches would quickly find and eat unattended eggs. The chick is fed by regurgitation until May and most adults and young are gone by Jun.[2,4] There is no information on age at first breeding but storm-petrels often begin breeding at 3-5 years.[3] TRSP may live approximately 15-20 years.[1]

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Diet information is limited. In Hawai`i they eat mainly small fish and squid and occasionally planktonic insects and crustaceans.[6] Prey is caught by pattering and snatching from the surface. TRSP rarely approach land except to breed and typically feed alone or with conspecifics.[8]

## Conservation Concerns and Activities

Because they are small ground nesters, the introduction of cats or rats results in high levels of mortality and rapid extirpation of colonies. Rats are responsible for a population decline on the Torishima and Izu Is., Japan. Black rats probably caused the extirpation of TRSP from Midway and Polynesian rats their extirpation from Kure. Recently TRSP have been caught in mist nets on Sand Is., Midway and have responded to audio recordings but nesting has not been documented. TRSP habitat on Pearl and Hermes Reef and Kure may become limited if golden crown-beard continues to expand uncontrollably.[5] The effects of house mice are unknown. Introduced ants have been noted on dead chicks but it is unknown if they had any role in the mortality.

## Recommended Actions

- Eradicate mice from Midway and establish attraction programs if TRSP do not recolonize naturally.
- Determine population size, status and trends of TRSP in Hawai`i. Design and implement reliable population monitoring program.
- Eradicate golden crown-beard at Pearl and Hermes Reef, Midway, and Kure.
- Determine the effects of introduced ants.
- Research into basic life history traits, demography, and limiting factors.

## Regional Contacts

Beth Flint - USFWS, Pacific Remote Islands NWR Complex, Honolulu, HI

***References:*** 1. Carboneras 1992a; 2. Slotterback 2002; 3. Ainley 1984; 4. Rauzon *et al.* 1985; 5. E. Flint, USFWS, pers. comm.; 6. Harrison *et al.* 1983; 7. Olson and James 1982; 8. Crossin 1974; 9. Harrison *et al.* 1984.

# Polynesian Storm-Petrel (White-throated Storm-Petrel) *Nesofregetta fuliginosa*

## Status

**Federal: BCC68** **State: None** **IUCN: VU** **NAWCP: HI/HI**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | no | 1 | ? | ?d | year-round | crevice | dip, patter | pelagic |

## Distribution, Population Status and Trends

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Polynesian Storm-Petrels (POSP) have a fairly limited distribution confined to the central Pacific. They breed in the Line, Phoenix, Austral, Society, Gambier and Marquesas island groups; historically they bred, and may still breed, in Samoa, Vanuatu, and Fiji.[1] POSP is one of the largest storm-petrels in the Pacific.[9] The genus is monotypic but several color morphs have been described. An all dark morph was described from Samoa[4] and is often referred to as the Samoan Storm-Petrel. At sea POSP are widely distributed along the equator with the majority of birds between 10$^{O}$N and 10$^{O}$S.[9] Most abundant south of the equator to about 8$^{O}$ S along the northern edge of the South Equatorial Current and east to the Marquesas.[3] Concentrations occur around the breeding islands (*e.g.*, the Line and Phoenix islands).[2]

POSP historically nested on all of the islands of American Samoa and were most abundant on the Manua Islands, but the population may now be extirpated.[5] Twenty years ago fairly large flocks were still observed at sea between Western and American Samoa and occasionally a bird is still seen flying over the islands, so they may still breed there in very low numbers.[9] Although they nest in the Line and Phoenix groups, nesting has not been recorded for the U.S. islands in these groups (although a single bird was recorded on Howland in the 1960s). However, 3 birds were seen on Jarvis in 2000 following rat and cat eradication.[8] The world population is very small and declining at many locations. POSP may recolonize and flourish on Howland, Baker and Jarvis now that these islands are free of introduced predators.

## Ecology

POSP nest in the shade of coral rock and under vegetation on atolls and islands. They also nest in burrows, rock crevices on island cliffs in Samoa, and under the trunks of trees, but they do not excavate their own burrows.[2,5] In the Line and Phoenix islands they nest in vegetated areas with an abundance of loose rocks.[2] Breeding occurs year-round with a peak of nesting that varies between islands. Even on a single island the peak of nesting activity can vary quite significantly between years.[2] Little is known about the life history of this species. Birds are generally nocturnal on the colony with the greatest activity occurring around dusk.[2] However, birds have been observed flying into the island in the middle of the day to feed a chick.[2]

POSP are usually solitary or associated with their own species; typically they do not occur in mixed-species feeding flocks.[2] POSP exhibit a unique flight behavior at sea, wherein birds “kick off” a wave, glide, and then “kick off” again.[2] Diet is poorly known but likely includes small squid, fish and crustaceans.[7] A strong upwelling occurs around Jarvis and this may promote availability of planktonic food resources attractive to POSP.[6]

## Conservation Concerns and Activities

Historically, Samoans hunted POSP with dogs.[5] Human consumption and introduced predators are probably the reason POSP no longer breed here. POSP could still occur on remote cliffs in American Samoa. Norway rats have been recorded at the summit of Mt. Lata, Ta`u, but the vertical cliffs may provide a refuge, like the Waimea Canyon cliffs on Kaua`i do for Band-rumped Storm-Petrel.[6] Prospecting birds have been observed at Jarvis following cat and rat eradication and colonies may flourish at these locations. The effects of introduced house mice are unknown but they could limit colonization at Jarvis.

## Recommended Actions

- Eradicate mice from Jarvis and support efforts by NPS and the Government of American Samoa to control predators in historical nesting sites.
- Conduct systematic surveys of all potential and former nesting islands to determine current status and abundance.
- Coordinate with and support international conservation efforts, especially at Kiribati and Gambiers.

## Regional Contacts

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***References:*** 1. Carboneras 1992a; 2. Crossin 1974; 3. L. Spear, pers. comm.; 4. Pratt, *et al.* 1987; 5. Amerson 1982; 6. M. Rauzon, pers. comm.; 7. BirdLife 2000; 8. USFWS unpubl. data; 9. Muse and Muse 1982.

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*Mt. Lata, Ta'u, American Samoa offers potential habitat for storm-petrels on the 2000' cliff face that may be more secure from Norway rats than the summit where Tahiti petrels nests.*

# Masked Booby (Blue-faced Booby, `A) *Sula dactylatra*

## Status

**Federal: None** **State: None** **IUCN: None** **NAWCP: HC/MC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 2 | yes | 1 | 44d | 120d | aseasonal | scrape | plunge dive | pelagic |

## Distribution, Population Status and Trends

Masked Boobies (MABO) have a pantropical distribution.[1,2] There are four subspecies; *S. d. personata* breeds on islands in the central and western Pacific.[3] Within the USPI, the largest colonies are on Howland, Baker and Jarvis, but a significant portion of the population nests on the NWHI. Birds forage in offshore and pelagic waters.[4] They are most abundant in the vicinity of breeding islands, but they can be encountered far out at sea.[4] During nonbreeding periods, adults may visit sites 1,000-2,000 km from breeding colonies.[2,6,8]


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The world population is widely distributed, and therefore difficult to estimate but is thought to be several hundred thousand birds.[1] Within the USPI, there are approximately 8,300 breeding pairs with 1,200 pairs on Jarvis and over 1,500 pairs each on Howland and Baker.[9] Approximately 2,500 pairs nest in the Hawaiian Islands, most in the NWHI.[10] In the Marianas, approximately 600 pairs breed on Farallon de Medinilla (FDM), Maug, Uracas, and Guguan.[11,12] Small colonies also occur in American Samoa and Palmyra[2,4,5] and Wake was recently recolonized by bird banded at Johnston.[14] Population trends in the USPI appear stable with increasing numbers on Wake, Howland and Baker.[13,14]

## Ecology

MABO breed on oceanic islands and atolls. They tend to nest on open ground often near a cliff edge or on low sandy beaches or rocky ground.[1,15] They also form "clubs" or aggregations of non-breeding birds on the fringe of breeding colonies.[2] Breeding is fairly synchronous but timing varies depending on locality.[15] MABO are sexually dimorphic; females weigh slightly more than males and the bill of males is a richer, brighter yellow than that of females during breeding.[1,15] Sexes are most easily distinguished by voice, with males producing a thin whistle and females a loud honk.[1,2] MABO are monogamous and at least 45% of pairs on Kure retained their mates through a second breeding season.[16] Two eggs are laid but broods are typically reduced to one chick by siblicide.[1] Adults continue to feed young after they fledge, up to six months in extreme cases.[15] Juveniles remain in immature plumage until full adult plumage develops at 20 months.[2] Sexual maturity begins around 3-4 years and most birds return to their natal colony to breed.[1,7,16] Adults sometimes skip a year between breeding attempts.[2,15]

MABO feed by plunge-diving and can be found feeding more than 150 km from land.[15] They forage singly or in mixed-species flocks associated with schooling tuna.[4,10] In Hawai`i, fish constituted >97% of the diet and squid <3%; flyingfish and jacks were the most important prey.[17] The oldest-known bird was 25 years. On Kure, annual adult mortality was <8.6%; mortality between independence and age four was 72%.[17]

## Conservation Concerns and Activities

Habitat destruction, invasive weeds, disturbance, and introduced predators limit populations. MABO breed on a few islands with human populations but they are vulnerable to human disturbance.[1] Introduced predators such as rats and cats have negatively impacted populations.[15] Eradication of feral cats from Howland and Baker resulted in the rebound of populations.[14] Invasive weeds such as golden crown-beard have displaced populations and limited nesting habitat.[17] Navy bombing operations have undoubtedly killed MABO on Farallon de Medinilla but the creation of open habitat may have allowed populations to increase.[12] Overfishing of tuna could potentially have an impact on the availability of prey.[15] Commercial-size mackerel scad were important in the diet of MABO at some locations, and potential effects of commercial fisheries are unknown.[15] El Niño-Southern Oscillation conditions can cause breeding failure in the Central Pacific.[18]

## Recommended Actions

- Eradicate golden crown-beard at Midway, Kure, Pearl and Hermes and elsewhere in the NWHI.
- Eradicate cats and rats on Wake and Palmyra and elsewhere in USPI where MABO occur.
- Limit human disturbance to colonies.

## Regional Contacts

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Beth Flint - USFWS, Pacific Remote Islands NWR Complex, Honolulu, HI

***References:*** 1. Anderson 1993; 2. Woodward 1972; 3. Clements 2000; 4. King 1967; 5. Anderson *et al.* 1982; 6. Clapp and Wirtz 1975; 7. Nelson 1978; 8. O'Brien and Davies 1990; 9. Forsell 2002; 10. Harrison *et al*. 1984; 11. Reichel 1991; 12. Lusk *et al*. 2000; 13. Rauzon *et al*. in prep.; 14. Rauzon *et al.* 2002; 15. Harrison 1990; 16. Kepler 1969; 17. Harrison *et al.* 1983; 18. Schreiber and Schreiber 1984.

# Brown Booby (`A) *Sula leucogaster*

## Status

**Federal: None** **State: None** **IUCN: None** **NAWCP: HC/MC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 2 | yes | 1-2 | 43d | 85-105d | aseasonal | surface | plunge dive | nearshore |

## Distribution, Population Status and Trends

Brown Boobies (BRBO) have a pantropical distribution.[1] There are four subspecies; *S. l. plotus* breeds on islands in the central and western Pacific.[2] In the USPI, BRBO occur in the greatest numbers in the Hawaiian Islands. Breeding adults are mostly sedentary and immatures disperse throughout the tropical seas.[4,5] At-sea they occur more nearshore than Masked or Red-footed Boobies and they are rarely seen >80 km from the nearest land.[3] Little is known of movements during nonbreeding periods but adults have been found up to 2,900 km from breeding sites.[1]

USFWS

Worldwide, the number of BRBO is estimated at 221,000 - 275,000 pairs; 50,000 - 70,000 pairs of *S. l. plotus*.[1] About 3,700 pairs nest in the USPI: approximately 1,400 in Hawaii[12,13], 750 in the Marianas[14,15] and 700 in American Samoa[9]. (The largest colony in Hawai`i was just recently documented at Lehua.[13]) Smaller colonies exist on Palmyra, Howland, Baker, Jarvis, Wake and Johnston.[11] The world population has declined dramatically over the past 200 years and possibly only 1-10% of historic populations remain.[1] Currently, the USPI population appears stable with populations on Wake, Howland and Baker gradually rebounding following eradication or control of feral cats.

## Ecology

BRBO breeding range overlaps with that of Masked and Red-footed Boobies on oceanic islands and atolls.[4,5] Nesting occurs on flat ground, often on cliff ledges, but they will also nest on sandy islands and bare coral atolls.[1] Nests vary from a scrape in the sand to a fairly well-formed pile of twigs and grasses. Breeding is synchronous but timing varies depending on locality and occurs throughout the year.[1] Sexes are dimorphic; females are significantly larger than males and skin color around the eye is blue-gray in males and yellow-green in females.[1,4] Sexes are also distinguishable by voice; males produce a high-pitched whistle and females a low honk.[1] BRBO are monogamous but maintenance of long-term pair bonds varies by location.[1] Pairs lay 2 (very rarely 3) eggs but brood is often reduced to 1 chick as a result of siblicide.[1] Post-fledgling care varies considerably from a little over a month, up to 37 weeks.[1,6] Juveniles remain in immature plumage for 2 years. Age of first breeding is typically 4-5 years.[1,5]

BRBO feed by plunge-diving and feeding is often solitary, but they may be found in feeding flocks with other species.[1,5] They forage in nearshore waters, ranging from 8-70 km from land, and feed mostly on flyingfish, squid, mackerel scad, juvenile goatfish, and anchovy.[5,7] The oldest-known bird was 26 years, but they probably live to at least 30 years.[1,8] Adult survivorship was 93.2% at Kure.[10] On Johnston, survival from fledging to breeding ranged from 30-40% in an 18-year study.[1]

## Conservation Concerns and Activities

Habitat destruction, disturbance, introduced predators and feral ungulates limit populations. A major threat to BRBO has been the loss of habitat to development and human disturbance; newer pairs are especially vulnerable at the beginning of the breeding season.[1] Introduced predators such as feral cats and rats have negatively impacted populations.[5]

The recent eradication of feral cats on Baker, Howland, and Jarvis will hopefully result in long-term increases. Birds are subjected to live bombing exercises conducted by the military on Farallon de Medinilla, CNMI.[15] At Johnston, birds were killed in the recreational troll fisheries during the period of military occupation but this ended in 2004. In American Samoa, hunting pressure on BRBO was high during historic times and this may still occur.[9] El Niño-Southern Oscillation events can cause breeding failure in the Pacific.[1]

## Recommended Actions

- Eradicate feral cats and rats on Wake, Palmyra and elsewhere in the USPI.
- Limit human disturbance to colonies.

## Regional Contacts

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***References:*** 1. Schreiber and Norton 2002; 2. Clements 2000; 3. King 1967; 4. Carboneras 1992b; 5. Harrison 1990; 6. Nelson 1978; 7. Harrison *et al*. 1983; 8. Simmons 1967; 9. Amerson *et al*. 1982; 10. Tershy 1998; 11. Rauzon *et al.* 2002; 12. Harrison *et al.* 1984; 13 VanderWerf *et al.* 2004; 14. Reichel 1991; 15. Lusk *et al.* 2000.

# Red-footed Booby (White Booby, `A) *Sula sula*

## Status

**Federal: None** **State: None** **IUCN: None** **NAWCP: HC/MC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | yes | 1 | 45d | 100-140d | aseasonal | stick | plunge | pelagic |

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## Distribution, Population Status and Trends

Red-footed Boobies (RFBO) have a pantropical distribution that overlaps Masked and Brown Boobies.[1,2] There are three subspecies; *S. s. rubripes* breeds in the central and western Pacific.[3] RFBO nest throughout the USPI. At-sea distribution is pelagic; feeding flocks occur hundreds of kilometers from land.[4] Breeding adults are mostly sedentary but immatures roost near colonies on islands other than their natal island.[1,4] Little is known about adult movements outside of the nesting season.[1]

The world population was estimated at <300,000 pairs in 1996.[1] In the USPI, there are approximately 19,000 pairs. The largest colonies occur on Palmyra (6,250 pairs) and the Hawaiian Islands (>7,000 pairs).[5,21] A large colony of >1,200 pairs was recently documented at Lehua.[21] Approximately 2,500 and 2,000 pairs nest in the Marianas and American Samoa, respectively.[6,7] Smaller colonies exist on Howland, Baker, Jarvis, Johnston and Wake.[8,18] The world population has been severely reduced over the last two centuries.[1] The USPI population appears relatively stable with an increasing trend for Hawai`i. Numbers have decreased in the Marianas, particularly on Farallon de Medinilla.[14,15]

## Ecology

RFBO, the smallest booby species, breeds on oceanic islands and atolls.[1,2] Unlike Masked and Brown Boobies, they roost and nest on shrubs and trees but they will utilize bare ground or low piles of vegetation.[1,2,4] Nests are made of twigs, grass and other vegetation. Breeding is fairly synchronous but occurs throughout the year and timing varies by locality.[1,4] Several color phases exist, ranging from all brown to all white.[1,11] In the Hawaiian Islands, RFBO are almost exclusively white morphs. On other islands in the USPI, they are also mostly white morphs although intermediate plumages do occur.[4,11] RFBO are sexually dimorphic; females tend to be larger than males and males have a lime green or bluish patch near the eyes prior to breeding. They are monogamous and generally retain their mates throughout subsequent breeding seasons.[1] They lay 1 egg and continue to feed the young 1-2 months after fledging.[1,2] Sexual maturity begins around 3-4 years and most birds return to their natal colony to breed.[1,4] Adults usually breed every year but sometimes take a “rest” year.[1,4]

In Hawai`i, RFBO feed mainly on flyingfish and squid, taking a larger proportion of squid than other boobies.[9] Other prey items include mackerel scads, saury, and anchovies.[4] RFBO often depart the colony to feed well before daylight but most return to roost on the colony at night.[2,4] RFBO feed by plunge-diving and may feed solitarily or in mixed-species foraging flocks.[10] They forage further from land than other boobies except possibly the Masked Booby.[11] Annual adult survival was estimated at 90% in a 2-year study at French Frigate Shoals.[12] On Johnston, survival of chicks to breeding ranged from 27-52% depending on year.[1] The oldest-known bird was 22 years.[13]

## Conservation Concerns and Activities

Habitat destruction, disturbance, introduced predators and feral ungulates limit populations. Introduced predators such as the mongoose, cats and rats have negatively impacted populations.[1,2,4]

A major factor affecting populations is habitat loss and disturbance due to development and introduced species (*e.g.,* ungulates). The large areas of mangrove forests destroyed in the Marianas and American Samoa may have once been important habitat for RFBO. Military bombing of Farallon de Medinilla, CNMI has killed birds and contributed to the destruction of nesting habitat.[14,15] On Maug, CNMI, the exotic woodrose vine is overwhelming nest sites.[16] Introduced scale insects at Rose and Palmyra are destroying the Pisonia forests. Research will be initiated in 2004 at Palmyra to look at potential mechanisms for control or eradication. On the main Hawaiian Islands, habitat has been restored and protected at several locations and RFBO numbers are increasing. Eradication of rats and feral rabbits from Lehua is expected to reduce predation and enhance nesting habitat.[21] At Marine Corps Base Hawai`i (Kaneohe, O`ahu) populations have increased but nesting sites are subject to wild fires fueled by invasive vegetation.[17] Human predation on adults, chicks and eggs occurs in the Marianas and American Samoa.[16,7] El Niño-Southern Oscillation conditions can cause total or partial breeding failure in some locations.[19,20]

## Recommended Actions

- Eradicate or control feral cats, dogs, rats and other introduced predators at or near colonies. Control feral ungulates where they destroy RFBO habitat. Eradicate rabbits and predators from Lehua, Hawai`i.
- Investigate techniques to eradicate or control invasive species that affect RFBO habitat (*e.g.*, woodrose vine, scale insects and ants, grasshoppers, etc).
- Protect colonies from disturbance.

## Regional Contacts

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Robert Pitman - NOAA-Fisheries, Southwest Fisheries Center, San Diego

***References:*** 1. Schreiber *et al*. 1996; 2. Carboneras 1992b; 3. Clements 2000; 4. Harrison 1990; 5. Harrison *et al*. 1984; 6. Reichel 1991; 7. Amerson *et al*. 1982; 8. Forsell 2002; 9. Harrison *et al*. 1983; 10. Au and Pitman 1986; 11. Nelson 1978; 12. Hu 1991; 13. Clapp *et al*. 1982; 14. Whistler 1996; 15. Lusk *et al*. 2000; 16. Pratt 1985; 17. Rauzon and Drigot 1999; 18. Rauzon *et al*. in prep.; 19. Schreiber and Schreiber 1989; 20. Schreiber 1994; 21 VanderWerf *et al.* 2004.

# Great Frigatebird (`Iwa, Man o' War Bird) *Fregata minor*

## Status

**Federal: None** **State: None** **IUCN: None** **NAWCP: MC/MC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | yes | 1 | 55d | 168d | aseasonal | stick | surface dipping | pelagic |

## Distribution, Population Status and Trends

Great Frigatebirds (GRFR) have a pantropical distribution that overlaps with Lesser Frigatebirds.[1] There are five subspecies; *F.m. palmerstoni* breed on isolated islands in the western and central Pacific.[2] GRFR nest throughout the USPI and the largest colonies are located in Hawai`i. At sea, birds can be found any distance from land but they are most abundant within 80 km of breeding and roosting sites.[3] Adults are mostly sedentary but immatures and nonbreeders disperse widely throughout the tropical seas.[9]

The world population is estimated at 500,000-1,000,000 birds.[1] Approximately 20,000 birds nest in Hawai`i, with the largest colonies on Nihoa (3,500-4,500 pairs) and Laysan (2,000-2,500).[4] Substantial numbers roost on islands off the main Hawaiian Islands (*e.g.*, Moku Manu and Lehua) but no evidence of nesting has been found.[14,15] Smaller colonies exist on the other USPI islands including two small colonies in the Marianas on Maug and Farallon de Medinilla.[5,6] On Howland, Baker and Jarvis, populations rebounded after the eradication of feral cats.[7]

## Ecology

GRFR breed on small remote islands building stick platform nests in bushes, mangroves, or on low vegetation.[1] They nest on the ground at Howland, Baker and Jarvis. Breeding occurs throughout the year depending on locality with egg laying primarily in the dry season.[1] GRFR are sexually dimorphic; females tend to be 25% heavier than males and males have a scarlet gular pouch that they inflate during courtship displays.[1] GRFR are monogamous but it is extremely rare for pairs to remain together for subsequent breeding attempts.[1] Females breed biannually, sometimes every 3-4 years.[1] Post-fledging care, which continues for 5-18 months, is provided by females. Sexual maturity begins around 8-10 years and most birds return to the natal colony to breed.[1]

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Frigatebirds are highly specialized for aerial existence; their tiny feet and reduced legs are useless for walking or swimming.[3] They have extremely low wing-loading and are extremely maneuverable in flight.[10] They do not rest on the water or plunge in pursuit of prey but they can spend extended periods "on the wing".[1,10] They usually feed in mixed-species flocks over tuna schools.[1,3] Their diet consists mostly of flyingfish and squid which they capture at or above the water's surface.[11] Frigatebirds are notorious for kleptoparasitism, but most of their food is obtained by fishing.[11]

## Conservation Concerns and Activities

Habitat destruction, disturbance and introduced predators limit populations.[12] Introduced predators such as rats and feral cats can have devastating effects.[9] In the past, Polynesian rats have caused total nest failures on Kure[9] but rats have since been eradicated from Kure and Midway. The eradication of feral cats from Howland, Baker and Jarvis resulted in a rebound of both GRFR and LEFR populations.[7] GRFR were extirpated as a breeding species from Wake by feral cats but if efforts to eradicate cats are successful they may return as a breeding species.[8] Frigatebirds, mostly females and immatures, have been documented roosting on the island since 1996.[8] Rats and feral rabbits negatively impact populations on Lehua and eradication of rabbits and all introduced predators is expected to decrease predation and enhance nesting habitat, and may encourage GRFR to begin nesting.[14] The small colony on Farallon de Medinilla has been negatively impacted by live bombing conducted by the U.S. military.[13] Over-fishing of tuna could potentially have an impact on the availability of prey.[12]

## Recommended Actions

- Eradicate cats and rats from all current and potential nesting islands (*e.g.*, Wake and Lehua).

## Regional Contact

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***References:*** 1. Orta 1992a; 2. Clements 2000; 3. King 1967; 4. Harrison *et al*. 1984; 5. Stinson 1995; 6. Lusk *et al*. 2000; 7. Rauzon *et al.* 2002 8. Rauzon *et al.* in prep.; 9. Harrison 1990; 10. Weimerskirch *et al.* 2003; 11. Harrison *et al.* 1983; 12. Metz and Schreiber 2002; 13. T. deCruz pers comm.; 14. VanderWerf *et al.* 2004; 15. VanderWerf *et al.* pers comm.

# Lesser Frigatebird *Fregata ariel*

## Status

**Federal: BCC 68** **State: None** **IUCN: None** **NAWCP: HC/HC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | yes | 1 | 45d | 140d | aseasonal | stick | surface dipping | pelagic |

## Distribution, Population Status and Trends

Lesser Frigatebirds (LEFR) have a pantropical distribution that coincides with, but is smaller than, that of Great Frigatebirds (GRFR).[1,2] LEFR comprise three subspecies; *F. a. ariel* breed in the western and central Pacific. Within the USPI, the largest colonies occur on Baker and Howland.[3] At sea, birds are most abundant within 80 km of breeding and roosting islands although they can be found any distance from land.[4] Immatures and non-breeders disperse throughout tropical seas.[5]

The world population is estimated at several hundred thousand birds.[1] Within the USPI, there are at least 10,000 pairs with the largest colonies on Howland (~2,000 pairs) and Baker (~8,000 pairs).[3] Smaller colonies exist at Jarvis and American Samoa.[6] LEFR are absent as a breeding subspecies from the Marianas, Johnston and Wake. Nonbreeding birds have been recorded as rare visitors in Hawai`i[7]; they do not breed there except for a bird that hybridized with a GRFR at Tern Is. Within the USPI, LEFR populations declined significantly on islands after the introduction of cats, but post eradication, populations have been increasing.[3]

## Ecology

Breeding takes place on small remote tropical islands. Nests are stick platforms on trees and bushes but when suitable vegetation is not available birds nest on bare ground.[1] LEFR are sexually dimorphic; females tend to be heavier than males and males have a scarlet gular pouch that is inflated during courtship displays.[1] They are monogamous but it is unlikely that pairs remain together for future breeding attempts.[1] If successful, females can only breed successfully every 2-3 years since post-fledging care is provided by the female and can last 4-6+ months.[1] Age to sexual maturity is unknown[1] but probably similar to GRFR at 8-10 years.

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Frigatebirds are highly specialized for aerial existence, with low wing-loading that enables them to be among the nimblest of fliers.[1,8] Their legs and feet are tiny and useless for walking or swimming.[4] They do not rest on the water or plunge in pursuit of prey but can spend long periods "on the wing".[8,9] They feed in pelagic waters, usually in mixed-species flocks over tuna schools.[1,4] Their diet consists primarily of flyingfish and squid that they capture at or above the water's surface.[9] Frigatebirds are notorious for kleptoparasitism but obtain most of their food by direct capture.[9] El Niño-Southern Oscillation conditions can cause partial or total breeding failure.[1]

## Conservation Concerns and Activities

Feral cats decimated LEFR breeding populations on Howland and Baker and cat eradication programs implemented by the Service have resulted in the recovery of frigatebird populations on these islands. Cats and rats remain on Wake and the presence of roosting LEFR indicates that they would likely breed if predators were removed.[10] Over-fishing of tuna could potentially have an impact on the availability of prey.[1]

## Recommended Actions

- Eradicate cats and rats on USPI where LEFR occur or could potentially breed *e.g.*, Wake and Palmyra.

## Regional Contacts

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Beth Flint - USFWS, Pacific Remote Islands NWR Complex, Honolulu, HI

***References:*** 1. Orta 1992c; 2. Clements 2000; 3. USFWS unpubl. data (Forsell 2002); 4. King 1967; 5. Harrison 1990; 6. Amerson *et al.* 1982; 7. Pratt *et al.* 1987; 8. Weimerskirch *et al.* 2003; 9. Nelson 1976; 10. Rauzon *et al.* in prep.

# Red-tailed Tropicbird (Silver Bo'sunbird, Koa`e ula)
## *Phaethon rubricauda*

### Status

**Federal: None** **State: None** **IUCN: None** **NAWCP: MC/MC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | yes | 1 | 42-46d | 67-91d | year-round | scrape | plunge dive | pelagic |

### Distribution, Population Status and Trends

Red-tailed Tropicbirds (RTTR) have an Indo-Pacific distribution that coincides with, but is smaller than that of White-tailed Tropicbirds, ranging between 35º N and 30º S.[1,2,3] There are four subspecies; *P. r. melanorhynchos* breed in the central and western Pacific.[4] Breeding adults are mostly sedentary; however, they avoid land when not breeding and are among the most pelagic and solitary of seabirds.[1,5,6] At sea, RTTR are evenly distributed throughout their range.[1,7] Little is known about their movements outside the breeding season.


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The world population is estimated at 17,000-21,00 pairs; with an estimated 12,000-14,000 pairs in the Pacific.[1,3] The largest USPI breeding colonies occur in the Hawaiian Islands, primarily in the NWHI.[5] Approximately 9,000-12,000 pairs nest in Hawai`i with large concentrations on Midway and Laysan.[5] There are approximately 1,900 pairs on Johnston.[8] Smaller colonies exist in American Samoa, Palmyra, Wake, Jarvis, Howland, Baker, the Marianas and the main Hawaiian Islands. The world population seems stable in many areas and may be increasing in some areas, but there is a lack of information on past population estimates so comparisons are difficult.[1] Within the USPI, RTTR populations appear stable overall with increasing populations on Johnston and possibly Midway.

### Ecology

RTTR breed mainly on oceanic islands and coral atolls. They nest on the ground under vegetation in the understory of trees and less commonly in cavities of cliff faces.[1,2] Nests are scrapes that vary from a shallow depression in the sand to more elaborate structures consisting of twigs and leaves.[1,5,9] Breeding occurs annually, but timing varies depending on locality.[1,5] RTTR are monomorphic, but males tend to be slightly larger than females.[1,6] They are monogamous and pairs stay together for years, especially if they breed successfully.[5] RTTR lay a single egg.[1,2] Chicks are semi-altricial (unique among Pelecaniformes) and covered with down when they first hatch.[1,10] Adult feeding of chicks usually takes place midday between 1000 and 1400; none occur between dusk and dawn.[1] There is no post-fledgling care. Juveniles remain in immature plumage (white with black bars and spots except on the throat and belly) until two years old.[1] First breeding usually occurs around 2-4 years.[1,5] The oldest-known living bird was 23 years.[11]

RTTR feed by plunge-diving. They feed singly most of the time but are occasionally seen with flocks of Sooty Terns or shearwaters.[3,5] RTTR are attracted to ships, presumably because flyingfish, their main prey, are scattered by ships.[6] In Hawai`i, other prey include squid, mackerel scad, dolphinfish, truncated sunfish and balloonfish.[5,6] El Niño-Southern Oscillation conditions can cause breeding failure in the Pacific.[14]

### Conservation Concerns and Activities

Habitat destruction, introduced predators, and feral ungulates limit populations. Introduced predators such as rats have severely impacted populations throughout USPI. Most RTTR that bred along the coast of Kaua`i have been eliminated, except for those that nest on cliffs that are inaccessible to rats.[5] On Kure and Midway rats preyed upon RTTR and destroyed native vegetation that provided nesting habitat.[12] Rats were eradicated from both islands and restoration efforts on Midway to improve habitat for RTTR include removing invasive vegetation and restoring native vegetation. On Howland, Baker and Jarvis cats were eradicated and local RTTR populations are expected to increase. Cat eradication on Wake is nearing completion.[15] In the Marianas, feral ungulates such as pigs uproot vegetation and have contributed to the reduction of nesting habitat for RTTR and other ground-nesting seabirds.[13]

## Recommended Actions

- Eradicate or control introduced predators on USPI where RTTR occur (*e.g.*, Wake, Palmyra, Lehua, and NWRs on the main Hawaiian Islands.)
- Limit feral ungulate disturbance to colonies.

## Regional Contacts

Breck Tyler - University of California, Santa Cruz, CA

Elizabeth Schreiber - National Museum of Natural History, Smithsonian Institution.

***References:*** 1. Schreiber and Schreiber 1993; 2. Orta 1992a; 3. Gould *et al.* 1974; 4. Clements 2000; 5. Harrison 1990; 6. Harrison *et al.* 1983; 7. King 1970; 8. Hayes, pers. comm.; 9. Fleet 1974; 10. Baicich and Harrison 1997; 11. Klimkiewicz and Futcher 1989; 12. Tyler 1991; 13. Reichel 1991; 14. Schreiber and Schreiber 1989; 15. Rauzon *et al.* in prep.

# White-tailed Tropicbird (Bo'sunbird, Koa`e kea) *Phaethon lepturus*

## Status

**Federal: None** **State: None** **IUCN: None** **NAWCP: HC/MC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | yes | 1 | 41d | 77d | year-round | tree, cliff | plunge dive | pelagic, near-shore |

## Distribution, Population Status and Trends

White-tailed Tropicbirds (WTTR) have a pan-tropical distribution but are absent from the eastern Pacific and northeastern Atlantic.[1,2] There are six subspecies; *P. l. dorothea* breed in the central and western Pacific.[3] Breeding adults are mostly sedentary and forage widely over the pelagic seas, often at distances up to 120 km from nesting sites. Nonbreeding adults are rarely found on land and tend to disperse widely but distances and direction of dispersal are largely unknown.[1,4]

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The world population is difficult to estimate because of the remoteness of many nesting islands, but probably is less than 200,000 breeding pairs.[4] The largest USPI breeding colonies occur on American Samoa and the Hawaiian Islands. Most Hawaiian birds (~1,800 pairs) breed in the main islands; a few pairs nest annually on Midway.[2] Approximately 1,900 pairs breed in American Samoa.[9] Smaller colonies exist on Palmyra, Wake and the Marianas. The world population is considered generally stable or slightly declining.[4] Population trends in the USPI are unknown.

## Ecology

WTTR breed on oceanic islands and offshore islets.[1,2,4] They prefer to nest in inaccessible spots on cliffs, but they also nest in caves and tree hollows.[4] Nests have little to no material. Breeding occurs annually but timing varies depending on locality.[4] WTTR are monomorphic. They are monogamous and partners stay together for years, especially if they breed successfully.[2,4] Clutch size is one egg; chicks are semi-altricial (unique among Pelecaniformes) and covered with down when they hatch.[1,5] There is no post-fledgling care. Juveniles remain in immature plumage (yellow bill and head- and body-feathers primarily white with black barring) until the third year.[1,6] Few data are available on age of first breeding but may occur at four years old.[2] Their life span is unknown, but probably similar to the closely related Red-tailed Tropicbird at approximately 23 years.[4,7]

WTTR feed primarily by plunge-diving but sometimes catch prey "on the wing".[2,4] They are highly pelagic and solitary feeders but they sometimes congregate in small feeding groups.[4] WTTR tend to follow ships in pursuit of flyingfish, their main prey item, that are scattered by ships. Diet of WTTR in the USPI is poorly known but is probably similar to that of Red-tailed Tropicbirds.[2]

## Conservation Concerns and Activities

The main threats to WTTR are introduced predators and possibly disease. Introduced predators such as rats have severely impacted populations throughout the USPI and the availability of predator-free nest sites appears to be the single most important factor regulating WTTR populations.[4] On Guam, populations were probably extirpated due to predation by the brown tree snake.[8] Disease may be the cause of a dramatic population decline on O`ahu, however, more research is needed to confirm this.[2] WTTR nesting in Kilauea Crater on Hawai`i are sometimes overcome by fumes during eruptions and fall into the molten lava.[2] Because WTTR primarily nest on inaccessible cliffs, monitoring and research of this species is difficult.

## Recommended Actions

- Eradicate or control rats and other introduced predators where WTTR currently or potentially could nest.
- Develop and implement survey protocols to assess population status and monitor trends.

## Regional Contacts

None known.

***References:*** 1. Orta 1992a; 2. Harrison 1990; 3. Clements 2000; 4. Lee and Walsh-McGehee 1998; 5. Baicich and Harrison 1997; 6. Plath 1913; 7. Klimkiewicz and Futcher 1989; 8. G. Wiles, pers. comm.; 9. Amerson *et al.* 1982.

# Sooty Tern (`Ewa `ewa) *Sterna fuscata*

## Status

**Federal: None** **State: None** **IUCN: None** **NAWCP: MC/MC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | yes | 1 | 30d | 50d | aseasonal | scrape | surface dipping | pelagic |


USFWS

### Distribution, Population Status and Trends

Sooty Terns (SOTE) have a pantropical distribution.[1,2,3] There are eight subspecies; *S. f. oahuensis* breed in the central and south Pacific.[1,2] Breeding adults remain relatively close to colonies and forage up to 500 km from breeding islands.[5,6] During nonbreeding periods, they are highly pelagic and tend to avoid regions with cold-water upwelling.[1,3] Immatures disperse widely after fledging and remain at sea, sometimes not touching land for several years.[3]

The worldwide population is estimated to range from 60-80 million birds with 18-23 million pairs breeding each year.[3] In the USPI, there are approximately 3.2 million pairs. The largest colonies are at Baker (~800,000 pairs); and Jarvis, Laysan and Lisianski, with approximately half a million pairs each.[8,13] Other large colonies (≥100,000 pairs each) are found on Rose (American Samoa), Johnston and Uracas (CNMI).[14,15,16] Trends in Hawai`i appear relatively stable.

### Ecology

SOTE nest on oceanic islands and atolls in large dense colonies.[1,3] A colony usually consists of several subcolonies and each subcolony breeds very synchronously. SOTE nest on the ground in sandy substrate with sparse vegetation.[3] Clutch size is one egg and if the egg is lost early in the breeding season they will renest.[3] Both adults incubate the egg and feed the chick.[3] SOTE continue to feed their young at least 2 weeks after fledging.[3,6] Immature plumage is dark and immatures probably do not acquire adult plumage until their fourth year.[3] Sexual maturity begins around 4-10 years.[3,9] The oldest-known bird was 32 years.[4]

SOTE, the most pelagic of the tropical terns,[10] feed mainly by aerial-dipping, contact-dipping and aerial capture, although occasionally they will plunge-dive.[1,3,4] They rarely settle on water because their plumage quickly becomes waterlogged.[3] SOTE tend to feed in large flocks with other species in association with predatory fishes, such as yellowfin and skipjack tunas.[3,4,7] In Hawai`i, they feed mainly on squid, goatfish, flyingfish and mackerel scad.[11] El Niño-Southern Oscillation conditions can cause breeding failure in the Pacific.[12]

### Conservation Concerns and Activities

Introduced predators such as rats and cats have negatively impacted populations.[4] The eradication of cats and rats from Midway, Kure, Jarvis, Howland and Baker should result in population increases at these locations. At French Frigate Shoals and Midway, Cattle Egrets take chicks.[7,16] Native predators such as Great Frigatebirds, Black-crowned Night Herons, Ruddy Turnstones and Laysan Finches take chicks and eggs.[3,4] SOTE is vulnerable to oil pollution from tankers and spills. Over-fishing of tuna could potentially have an impact on the availability of prey.[3]

## Recommended Actions

- Eradicate introduced rats, mice and cats on USPI (*e.g.,* Palmyra, Wake and islets off the main Hawaiian Islands).

## Regional Contacts

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Elizabeth Schreiber - National Museum of Natural History, Smithsonian Institution

***References:*** 1. Gochfeld and Burger 1996; 2. Clements 2000; 3. Schreiber *et al.* 2002; 4. Harrison 1990; 5. Flint 1991; 6. Gould 1974; 7. USFWS 1983c; 8. Harrison *et al.* 1984; 9. Harrington 1974; 10. King 1967; 11. Harrison *et al.* 1983; 12. Schreiber and Schreiber 1989; 13. Forsell 2002; 14. Amerson *et al.* 1982; 15. Reichel 1991; 16. USFWS unpubl. data.

# Gray-backed Tern (Spectacled Tern, Pakalakala) *Sterna lunata*

## Status

**Federal: None** **State: None** **IUCN: None** **NAWCP: MC/MC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | yes | 1 | 30d | 50d | aseasonal | scrape | hover dipping | pelagic |

## Distribution, Population Status and Trends

Gray-backed Terns (GRAT) are endemic to the tropical and subtropical Pacific but are most common in the central Pacific.[1,2] Breeding adults are mostly sedentary and forage up to 370 km from land.[2,3] During nonbreeding periods, they are highly pelagic and occur far from breeding colonies, but their range is unknown.[1] At sea, GRAT are found in highly saline waters.[4] There is limited data on movements but immatures travel great distances after leaving the natal colony.[1]

The world population size is unknown but possibly on the order of 70,000 pairs.[1] Lack of adequate information on breeding phenology in many areas complicates estimates.[1] In the USPI there are approximately 48,000 pairs, with 44,000 in Hawai`i (largest colonies on Lisianski, Nihoa and Laysan).[12] Colonies with approximately 1,000 pairs each occur in the Marianas, Howland and Baker[8,13] Smaller colonies occur on Johnston, Wake and Jarvis.[8,14] A new colony on Tutuila represents a range expansion.[16] The global population trend is difficult to assess, but probably has declined since some colonies have been extirpated.[1] In the USPI, the population appears stable or increasing, but historical declines occurred at Howland, Baker, Jarvis, Wake and Midway due to introduced predators. Trends in the USPI may be increasing with the removal of predators from many islands.

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## Ecology

GRAT breed on remote islands and atolls, on rocky ledges or sandy beaches often along vegetated edges bordering open areas.[5,6] On Midway and Kure, GRAT also nest along airport runways.[7] Their nests are shallow depressions in sand or gravel. Breeding occurs throughout the year.[8] The clutch is 1 egg and chicks are semi-precocial when hatched.[1] Both birds incubate and feed the chick and parental feeding of fledged young continues for an unknown period of time.[1] Fledglings may remain at the colony up to 6 weeks after first flight.[2] Juveniles resemble adults but have a mostly gray dorsal surface, white underparts and forehead, and they often appear "scaly" because of light fringes on their gray feathers.[1] The oldest-known GRAT was 25 years.[1]

GRAT feed mainly by plunge-diving or contact/hover-dipping. They are described as an inshore, offshore, or pelagic feeder due to the geographical and seasonal differences in foraging habitat.[1] In Hawai`i, their main prey is fish: five-horned cowfish, juvenile flyingfish, goatfish, herring, and dolphinfish.[2] GRAT also eat squid, crustaceans, mollusks, and marine and terrestrial insects.[2] GRAT can be found foraging in mixed-species flocks, especially with Sooty Terns and sometimes with Wedge-tailed Shearwaters.[9]

## Conservation Concerns and Activities

Habitat destruction, disturbance and introduced predators limit populations. In the USPI, their gravest threat is predation by introduced mammals such as rats and cats.[2,7,10] Populations are recovering on Howland, Baker, Jarvis and Midway after the eradication of rats and cats.[8,15] GRAT are sensitive to disturbance, leaving their eggs when humans approach.[2] Unattended eggs and chicks are vulnerable to predators such as Great Frigatebirds, Ruddy Turnstones, Bristle-thighed Curlews, Laysan and Nihoa Finches.[1] GRAT tend to nest near the surf zone and nests are often lost to storm tides.[1,2] Collisions with antenna guy wires caused mortality at Kure and Johnston in the past[11] but these obstacles are being removed.

## Recommended Actions

- Eradicate introduced rats, mice and cats on USPI (*e.g.*, Palmyra, Wake, and islets off main Hawaiian Islands).
- Protect colonies from human disturbance.

## Regional Contacts

Beth Flint - USFWS, Pacific Remote Islands NWR Complex, Honolulu, HI

***References:*** 1. Mostello *et al.* 2000; 2. Harrison 1990; 3. Dixon and Starrett 1952; 4. Ainley and Boekelheide 1983; 5. Amerson 1971; 6. Ely and Clapp 1973; 7. Woodward 1972; 8. USFWS, unplubl. data 9. Gould 1971; 10. Harrison *et al.* 1983; 11. Udvardy and Warner 1964; 12. Harrison *et al.* 1984; 13. Reichel 1991; 14. Rauzon *et al.* in prep.; 15. Rauzon *et al.* 2002; 16. M. Rauzon pers. comm..

# Black Noddy (Hawaiian Noddy, Noio) *Anous minutus*

## Status

**Federal: None** **State: None** **IUCN: None** **NAWCP: MC/MC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | yes | 1 | 30d | 60d | aseasonal | tree | surface dipping | nearshore |

## Distribution, Population Status and Trends

Black Noddies (BLNO) have a pantropical distribution.[1,2] There are seven recognized subspecies and at least three breed in the USPI: *A. m. melanogenys* in the main Hawaiian Islands; *A. m. marcusi* in the NWHI, Wake, and throughout Micronesia; and *A.m. minutus* in Samoa.[1,3] There is some debate whether the birds nesting in the NWHI are *melanogenys* or *marcusi*.[1] Breeding adults are mostly sedentary remaining at colonies year-round and foraging within approximately 80 km of nesting islands.[1,4,5] Immatures probably remain at breeding colonies or travel to nearby roosting sites.[1] In Hawai`i, adults and immatures exhibit inter-island movement, but it is unknown what proportion of the population is involved and whether birds return to their natal colony.[1]

The world population is estimated to be 1-1.5 million pairs.[1] In the USPI, there are approximately 22,400 pairs. An estimated 12,000 pairs nest in the Hawaiian Islands; the largest colonies are at Midway (6,000 pairs) and Nihoa (5,000 pairs).[11] Smaller colonies exist in American Samoa, Palmyra, Johnston, Wake and the Marianas. Worldwide population trends are unknown.

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## Ecology

BLNO nest on oceanic and offshore islands.[1] In the main Hawaiian Islands they nest on sea cliffs and in caves; at other locations they nest on trees and bushes.[6,7] Breeding is asynchronous and aseasonal; in Hawai`i, egg laying occurs year-round, is synchronous in some years and asynchronous in others, and the peak(s) of egg laying can occur in different seasons in different years.[13] Birds are monogamous, mate retention is high, and pairs retain their territory from year to year, often reusing the same nest.[1,8] BLNO are capable of producing more than one brood per year and some lay a second egg while still tending the first chick.[1,9] BLNO feed their young up to 17 weeks after fledging.[1] Juvenile plumage is similar to adult plumage but the white cap is more sharply demarcated.[1] Age at which adult plumage is attained is unknown. Sexual maturity begins around 2-3 years.[1] The oldest-known bird was 25 years.[1]

BLNO feed by hover-dipping and contact-dipping, and typically forage in multi-species flocks over schools of predatory fish, especially tunas and jacks.[4] They feed mainly inshore (<10 km from shore) and sometimes within a few meters of the shoreline.[7,1] BLNO eat fish almost exclusively and very small amounts of squid and crustaceans.[1] In Hawai`i, they are opportunistic and juvenile and larval goatfish, lizardfish, herring, flyingfish and gobies are important components of the diet.[7] Elsewhere in the central Pacific flyingfish, blennies, mackerel and anchovies are important.[1]

## Conservation Concerns and Activities

Predation by introduced mammals limits populations and commercial fisheries exploiting coastal predatory species such as skipjacks and tuna may reduce BLNO foraging opportunities.[1] Zodiac/kayak tours of sea caves in the main Hawaiian Islands flush nesting BLNO. Removal of exotic ironwood trees at Midway could reduce nesting habitat for BLNO. The maturing ironwood forest on Wake is probably aiding recolonization.[13] Nesting populations have increased on Tern and Kure since the mid-1990s, probably because of increased shrub and tree nesting habitat and decreased human disturbance.[1] Introduced scale insects at Kure are threatening the native shrubs at this island and golden crown-beard (an unsuitable structure for nesting) is invading. Because of their tendency to concentrate nearshore, BLNO could potentially be more affected than other seabirds by oil spills and oceanic dumping of waste.[11] There have been repeated sightings of BLNO contaminated with oil in the NWHI.[12]

## Recommended Actions

- Eradicate or control scale insects and golden crown-beard at nesting islands.
- Eradicate or control introduced predators on all current or potential nesting islands.
- Determine the source of oil affecting BLNO in the NWHI.
- Determine the significance of disturbance from recreational activities (*e.g.*, kayaking and cave exploration) on the main Hawaiian Islands and examine approaches to minimize this disturbance if deemed necessary.

## Regional Contacts

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***References:*** 1. Gauger 1999; 2. Clements 2000; 3. Gochfeld and Burger 1996; 4. Ashmole and Ashmole 1967; 5. King 1967; 6. Howard and Moore 1984; 7. Harrison 1990; 8. Schreiber and Ashmole 1970; 9. USFWS unpubl. data; 10. Diamond 1978; 11. Harrison *et al.* 1984; 12. Fefer *et al.* 1984; 13. Rauzon *et al.* in prep.

# Brown Noddy (Common Noddy, Noio koha) *Anous stolidus*

## Status

**Federal: None** **State: None** **IUCN: None** **NAWCP: NCR/NCR**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | yes | 1 | 35d | 60d | aseasonal | scrape | surface dipping | pelagic |

## Distribution, Population Status and Trends

Brown Noddies (BRNO) have a pantropical distribution.[1] There are five subspecies; *A.s. pileatus* breed in the central and western Pacific.[2] Within the USPI, a significant portion of the population occurs in the Hawaiian Islands. Breeding adults remain within sight of the colony, foraging in waters several tens-of-kilometers from the colony.[3,4] During nonbreeding periods, BRNO generally stay within 100 km of colonies.[5,6] Little is known of the movements of immatures.[1]

The world population is estimated at 500,000-1,000,000 pairs.[1] Within the USPI, there are about 135,000 pairs, which includes 112,000 pairs distributed throughout the Hawaiian Islands.[9] The largest colonies are on Nihoa and Kaula with 35,000 and 20,000 pairs, respectively.[9] Approximately 9,000-11,000 pairs (each) nest in American Samoa, the Marianas and Johnston.[10,11,12] Smaller colonies exist on Howland, Baker, Jarvis and Wake.[12,13] Population trend is probably stable, but increasing at islands where predators were removed (*e.g.,* Midway, Kure).[1]

## Ecology

BRNO nest on the ground, often on open slopes or under vegetation but they also nest on cliffs and in trees, especially where introduced mammalian predators are present.[6,7] In the Hawaiian Islands, breeding is fairly synchronous with peaks occurring in both spring and summer.[6] Sexes are similar in appearance, but males are larger in size than females.[1] BRNO pairs stay together throughout the year, but there is little information on mate retention in subsequent years.[1] Adults continue to feed their chicks for several weeks after they fledge, up to 3 months in some cases.[6] Juvenile plumage is similar to that of adults except the white caps are smaller.[6] Sexual maturity begins around 3-7 years and it is unknown whether birds return to their natal colony to breed.[1,6] The oldest- known bird was 25 years.[1]

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BRNO feed by hover and contact-dipping in near-shore and off-shore waters.[8] They often feed in association with tuna schools and can be found in mixed-species feeding flocks. In Hawai`i, two-thirds of the diet is fish (goatfish, lizardfish, mackerel scad and flyingfish) and one-third is squid.[8]

## Conservation Concerns and Activities

The greatest threat is introduced predators, and where there are predators, BRNO often nest in trees (*e.g.,* Midway, Wake, American Samoa).[1,9] BRNO formerly nested on Lehua but were extirpated due to predation by introduced Barn Owls and Polynesian rats.[14] Disturbance of the colonies can lead to increased predation by native predators: unprotected eggs are taken by Laysan and Nihoa finches and Great Frigatebirds take BRNO chicks.

## Recommended Actions

- Eradicate introduced predators from current and potential colony sites (*e.g.,*Palmyra, Wake, Lehua).

## Regional Contacts

Beth Flint - USFWS, Pacific Remote Islands NWR Complex, Honolulu, HI

William Brown - Bishop Museum, Honolulu, HI

***References:*** 1. Chardine and Morris 1996; 2. Harrison and Stoneburner 1981; 3. Morris and Chardine 1992; 4. Clements 2000; 5. Clapp *et al.* 1983; 6. Harrison 1990; 7. USFWS 1983c; 8. Harrison *et al.* 1983; 9. Harrison *et al.* 1984; 10. Amerson *et al.* 1982; 11. Reichel 1991; 12. USFWS unpubl. data; 13. Rauzon *et al*. in prep.; 14. VanderWerf *et al*. 2004.

# Blue-gray Noddy (Blue Noddy, Necker Island Tern)
# *Procelsterna cerulea*

## Status

**Federal: BCC 67, 68** **State: None** **IUCN: None** **NAWCP: HC/HC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | yes | 1 | 35d | 50d | Dec-Jun | crevice | surface dipping | nearshore |

## Distribution, Population Status and Trends

Blue-gray Noddies (BGNO) are widely distributed throughout the Pacific.[1,2,3,4] Once considered conspecific with Gray Noddies, there are five subspecies of "Blue Noddies" and two occur in the USPI: *P. c. saxatilis* in the north Pacific and *P. c. nebouxi* in the south Pacific.[1] Within the USPI, most BGNO nest in the NWHI, with the largest colonies on Necker and Nihoa.[15] Breeding adults are mostly sedentary and seldom encountered far at sea.[5,6] In Hawai`i, adults are year-round residents but may exhibit inter-island movement.[6] Little is known of movements of immatures.

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The world population is approximately 100,000 breeding pairs, although it is difficult to get an accurate count because BGNO nest on inaccessible sea cliffs.[7] In the USPI, there are about 3,600 pairs with approximately 3,500 pairs on Necker and Nihoa, combined.[15] Elsewhere in the NWHI, La Perouse Pinnacle, French Frigate Shoals and Gardner Pinnacles have very small colonies. Colonies also occur on the high islands in American Samoa[16] and birds have recolonized Howland, Baker and Jarvis.[17] Birds once nested on Kaula[8] and there is some evidence that they once nested on Rota (CNMI).[9] Worldwide population trends are unknown.

## Ecology

BGNO, the smallest of the world's terns, occur on remote islands and atolls.[6] They nest on exposed sea cliffs, sea stacks, rocky outcrops, or sometimes in vegetation.[6] In Hawai`i, BGNO avoid isolated cavities and instead form loose nesting aggregations among clustered cavities within ancient lava flows.[6] At Nihoa, breeding takes place from early Dec-Mar but occasionally extends into summer during years of inclement weather.[10] At La Perouse, French Frigate Shoals BGNO breeds from Mar-Jun.[11] Little is known of breeding behavior. The oldest-known bird was 11 years but BGNO probably have greater longevity.[6]

BGNO feed by hover-dipping and surface-dipping and sometimes will forage with mixed flocks.[10] They are an inshore feeder.[10] They capture the smallest prey of any Hawaiian seabird, mainly larval lizardfishes, flounders, goatfishes and flyingfish; they also take squid and crustaceans.[12] Depending on the season, their diet may consist of significant amounts of insects (*e.g.,* sea striders).[10,12,13] BGNO were observed feeding off Jarvis in association with a rich upwelling of the Equatorial Undercurrent.[18]

## Conservation Concerns and Activities

Introduced predators such as cats and rats have negatively impacted populations.[7] The recent eradication of feral cats on Baker, Howland, and Jarvis (cat eradication at Wake is underway) will hopefully lead to long-term population increases. The Jarvis population was estimated at >500 birds in 2004, up from "a few birds" prior to rat and cat eradication.[18] The effect of mouse predation on this diminutive species is unknown. Native predators such as Nihoa and Laysan Finches can cause considerable egg loss.[14] The colony on Kaula was possibly eliminated when the island was used as a bombing range by the U.S. military; breeding has not been confirmed there for fifty years.[3,6]

## Recommended Actions

- Eradicate introduced predators at active and historic BGNO colony sites (*e.g.*,Rota, Palmyra, Kaula and Baker).
- Develop and implement standardized survey protocols to determine current population size and status.
- Monitor the recovery of this species post predator eradication.

## Regional Contacts

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# White Tern (Fairy Tern, Manu-o-Ku) *Gygis alba*

## Status

**Federal: None** **State: T** **IUCN: None** **NAWCP: MC/MC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | yes | 1 | 36d | 49-75d | year-round | none | surface diving | nearshore |

## Distribution, Population Status and Trends

White Terns (WHTE) have a pantropical distribution.[1,2] There are four subspecies; *G. a. alba* breed in the central and western Pacific.[2,3] Breeding adults remain close to colonies, foraging primarily inshore in shoals and banks but sometimes in offshore waters.[1] During nonbreeding periods they disperse from breeding grounds to sea but their range is unknown.[1] Some adults are year-round residents on the colony.[4] Little is known of immature movements.

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World population is unknown but probably exceeds 100,000 pairs.[2] In the USPI, there are about 17,000 pairs with a large portion in the NWHI. In the main Hawaiian Islands WHTE occur only on O`ahu where the population has exhibited remarkable growth from 1 pair to >250 pairs from 1961-2002.[9] Populations in the NWHI total approximately 15,000 pairs.[6] The largest colonies at Nihoa and Midway have 5,000 and 7,500 pairs, respectively.[6] Large colonies exist in American Samoa (3,900 pairs)[10] and the Marianas (1,250 pairs)[11], and small colonies occur at Johnston, Wake and Howland.[12] World and USPI population trends are unknown, however, populations appear stable within the NWHI.[1,2]

## Ecology

WHTE nest on volcanic pinnacles, cliffs, rocky slopes, in large bushes or trees, or on artificial substrates.[1,5] WHTE do not build nests but lay a single egg wherever they find a suitable depression.[4] In Hawai`i, they breed year-round but most eggs are laid from Feb-Jun.[1,6,9,14] WHTE are monomorphic, monogamous, and partners remain together for several seasons, often returning to the same nest site.[1,4] Clutch size is one and some breeding pairs may successfully raise two or even three broods within a nesting season.[1,9,13] Post-fledging care can last up to 2 months.[7] Immature plumage is similar to that of adults, except body- and wing- feathers are fringed with varying amounts of brown, the base of the bill is black, and fledglings may have a dark spot behind the eye.[1] There is no information on the age adult plumage is attained. At Tern Is., age at first breeding was 5 years.[1] The oldest-known bird was 42 years.[1]

WHTE feed primarily by dipping- and surface-diving.[1] They often occur in mixed feeding flocks and usually in association with predatory fish.[1,4] In Hawai`i, WHTE eat mainly juvenile goatfish and flyingfish.[8] Other prey items include squid, needlefishes, halfbeaks, dolphinfishes and blennies.[1,8]

## Conservation Concerns and Activities

Although WHTE exhibit lower vulnerability to introduced predators than most seabirds because of their ability to utilize remote (*e.g.,* sheer cliffs) nesting sites, introduced predators such as rats and cats have been the primary factor affecting populations.[1] On O`ahu the population has increased despite the abundance of introduced predators.[9] On Midway, introduced ants have been recorded attacking pipped eggs and incubating birds.[1,4] Scale insects have been introduced to Kure, Rose and Palmyra where they attack native vegetation and on Rose and Palmyra they are decimating the native forest; the effects on WHTE nesting populations are not known. Overfishing of large predatory fish stocks that drive prey to the surface may reduce foraging opportunities for WHTE.[1,2]

## Recommended Actions

- Investigate the impacts of introduced invertebrates on nesting habitat and WHTE populations and support research to control and eradicate these invasive species.
- Eradicate introduced predators where WHTE occur.
- Determine current size and trends of the American Samoan population.

## Regional Contacts

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***References:*** 1. Niethammer and Patrick 1998; 2. Gochfeld and Burger 1996; 3. Clements 2000; 4. Harrison 1990; 5. Rauzon and Kenyon 1984; 6. Harrison *et al.* 1984; 7. Howell 1978; 8. Harrison *et al.* 1983; 9. VanderWerf 2003; 10. Amerson *et al*. 1982; 11. Reichel 1991; 12. USFWS unpubl. data; 13. Miles 1985; 14. Miles 1986.

# Little Tern *Sterna albifrons*

## Status

**Federal: None** **State: None** **IUCN: None** **NAWCP: HC/LC**

| Egg | Relay | Young | Inc | Fledge | Breed | Nest | Feeding Behav | Marine Habitat |
|---|---|---|---|---|---|---|---|---|
| 1 | yes | 2-3 | 65d | 140d | spring | scrape | plunge dive | inshore |

## Distribution, Population Status and Trends

Little Terns (LITE) have a pantropical distribution.[1,2] There are six subspecies; *S. a. sinensis* breed throughout the Pacific.[1,2] LITE recently expanded their range into the USPI and are present in small numbers on islands in Hawai`i and the Marianas.[3,4,5] Breeding adults remain close to colonies and forage within 3 km of the colony.[2] During nonbreeding periods LITE may frequent tidal creeks, coastal lagoons and are sometimes found far out to sea.[2] Movement patterns by adults and immatures are not fully understood.

The world populations is estimated to be 70,000-100,000 pairs.[2] Recently, they were found nesting in small numbers at Pearl and Hermes and Midway (<10 pairs each).[3] LITE were documented migrants in the Marianas and were found breeding on Saipan in 1988.[4] Worldwide population trend is unknown.[2]

## Ecology

LITE occur in coastal areas and oceanic islands.[2] They tend to breed on sparsely vegetated sandy, rocky or barren ground, but they also nest on spits in estuaries and lakes, salt-marshes, rivers, and on reefs.[2] LITE breed synchronously during the spring. Clutch size is 2-3 eggs. Adults are similar and juveniles resemble adults but have paler wings and black chevrons on mantle.[2] Age at first breeding is 3 years.[2] The oldest-known bird was 21 years.[2]

They feed by plunge-diving in shallow water, usually at the edge of advancing tides.[2] LITE sometimes feed in groups, synchronously diving into the water to capture prey.[2] Diet consists of small fish, crustaceans, insects, annelids, and molluscs.[2]

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## Conservation Concerns and Activities

Worldwide LITE face many threats, especially habitat loss and disturbance.[2] LITE are sensitive to human disturbance, including birdwatchers, which can cause nest failures.

## Recommended Actions

- Monitor changes in distribution and abundance associated with range expansion.

## Regional Contacts

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***References:*** 1. Clements 2000; 2. Gochfeld and Burger 1996; 3. Conant *et al.* 1991; 4. Reichel *et al.* 1989; 5. Wiles *et al.* 1987.

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