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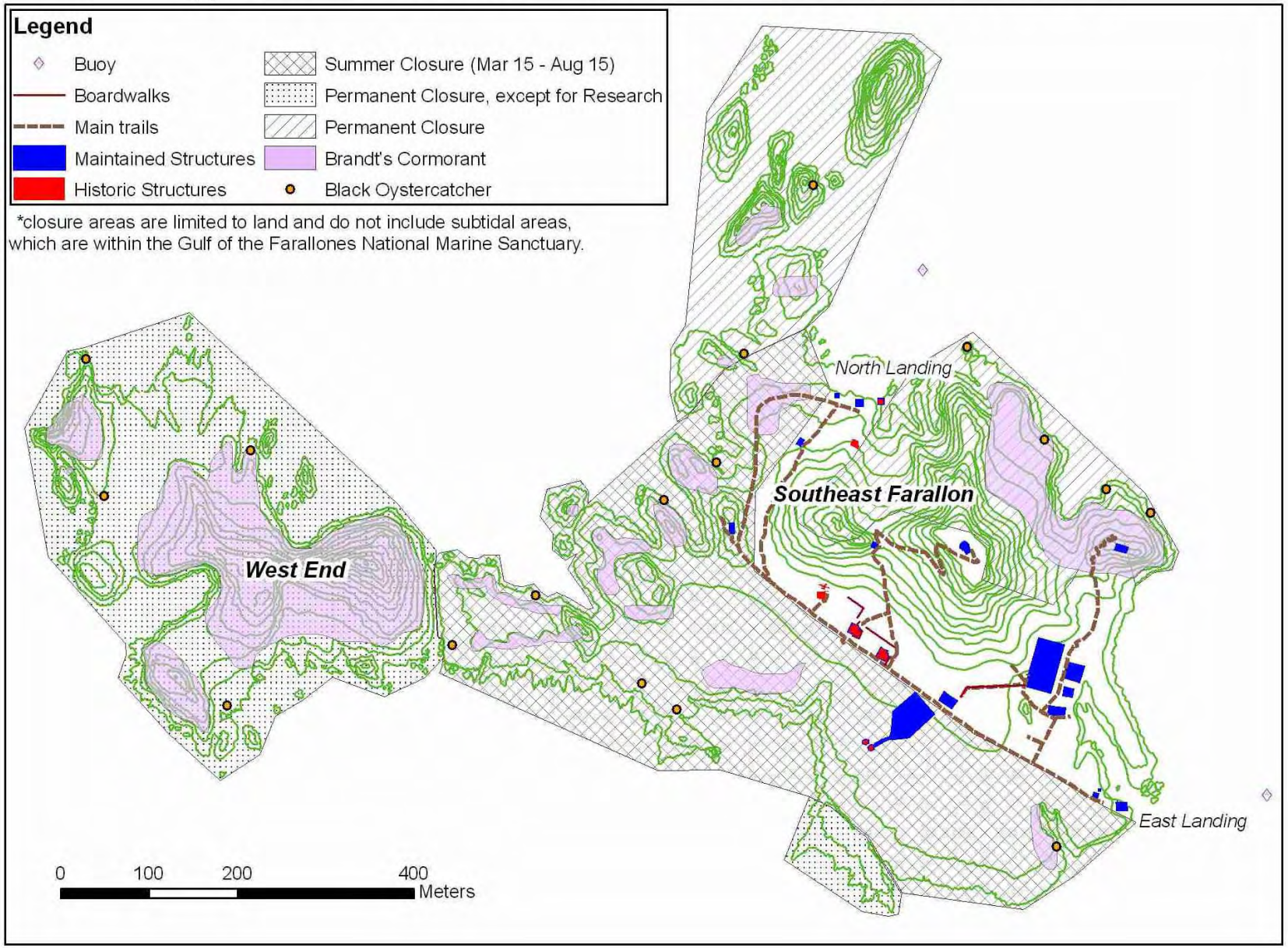
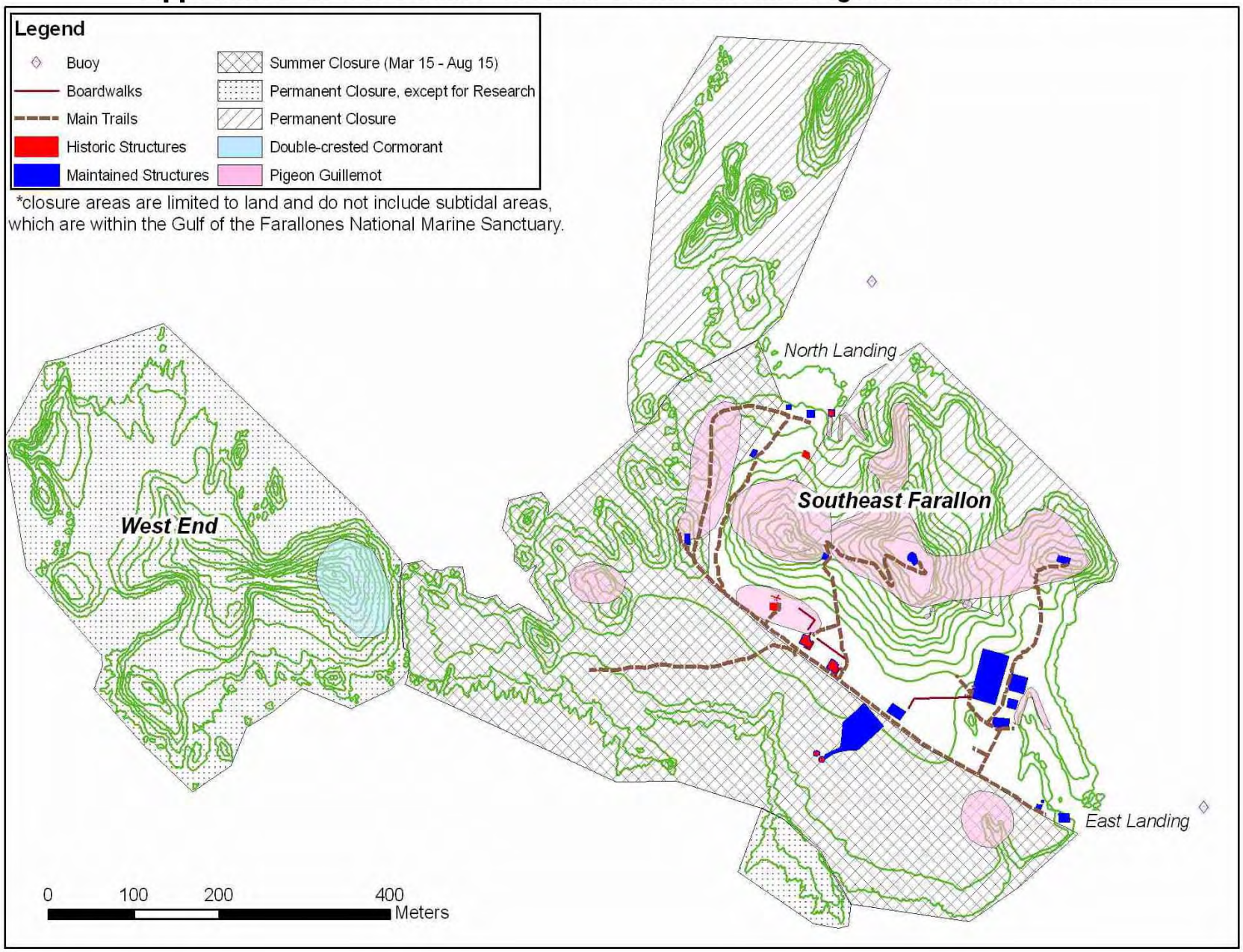
Appendix B. Maps of Wildlife Sites

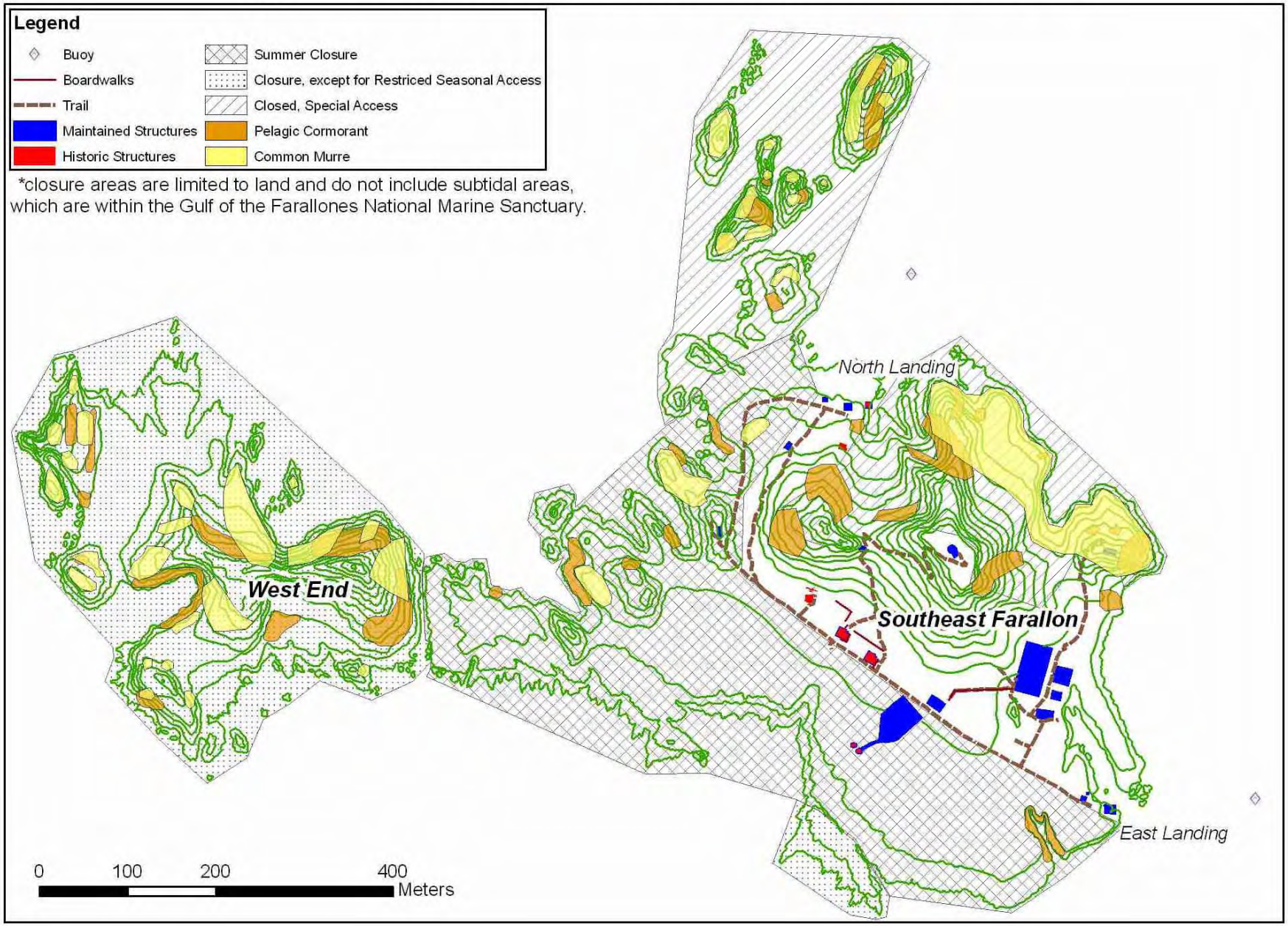
Appendix B-1. SFI Brandt's Cormorant and Black Oystercatcher Sites



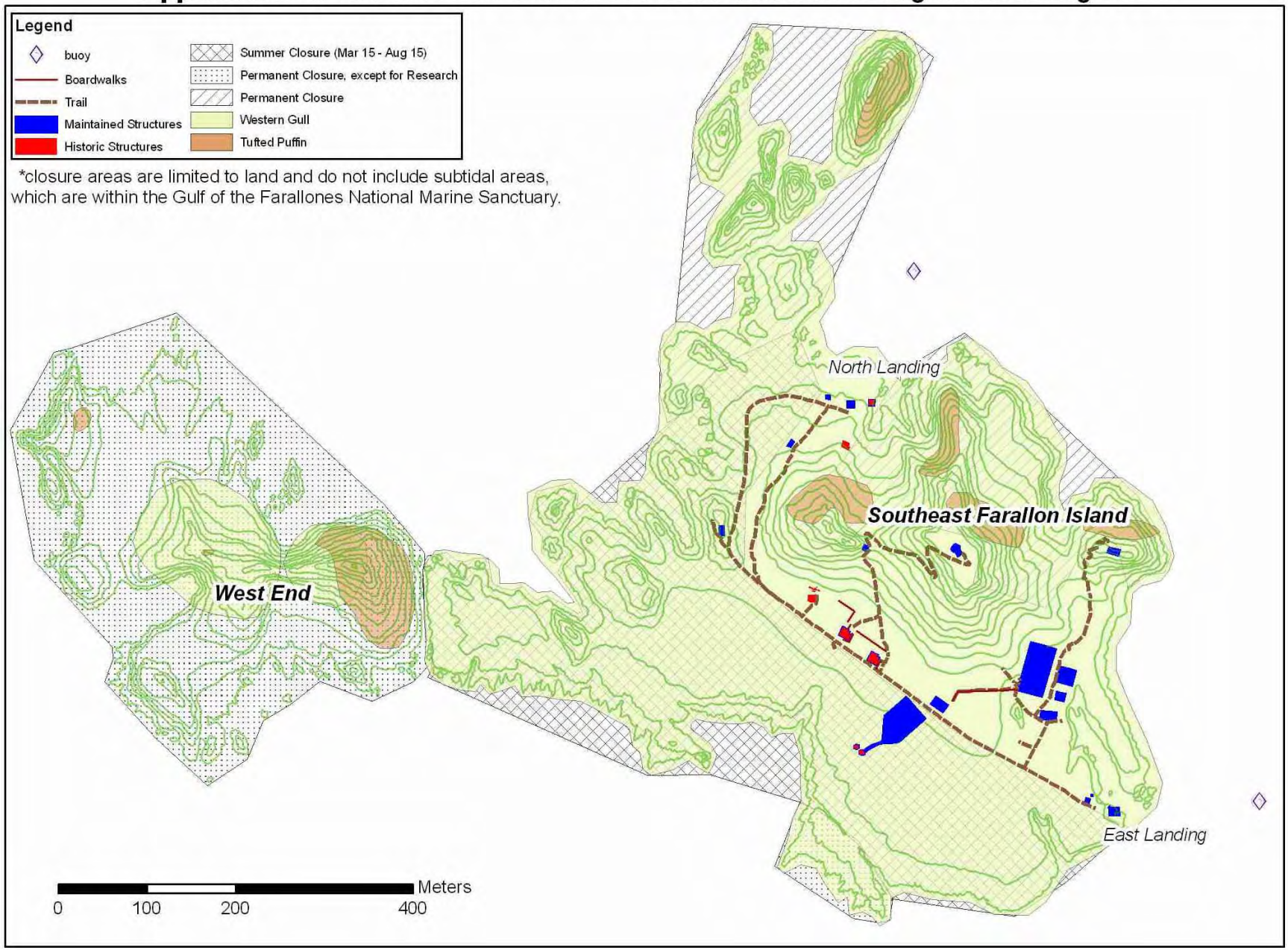
Appendix B-2. SFI Double-crested Cormorant and Pigeon Guillemot Sites



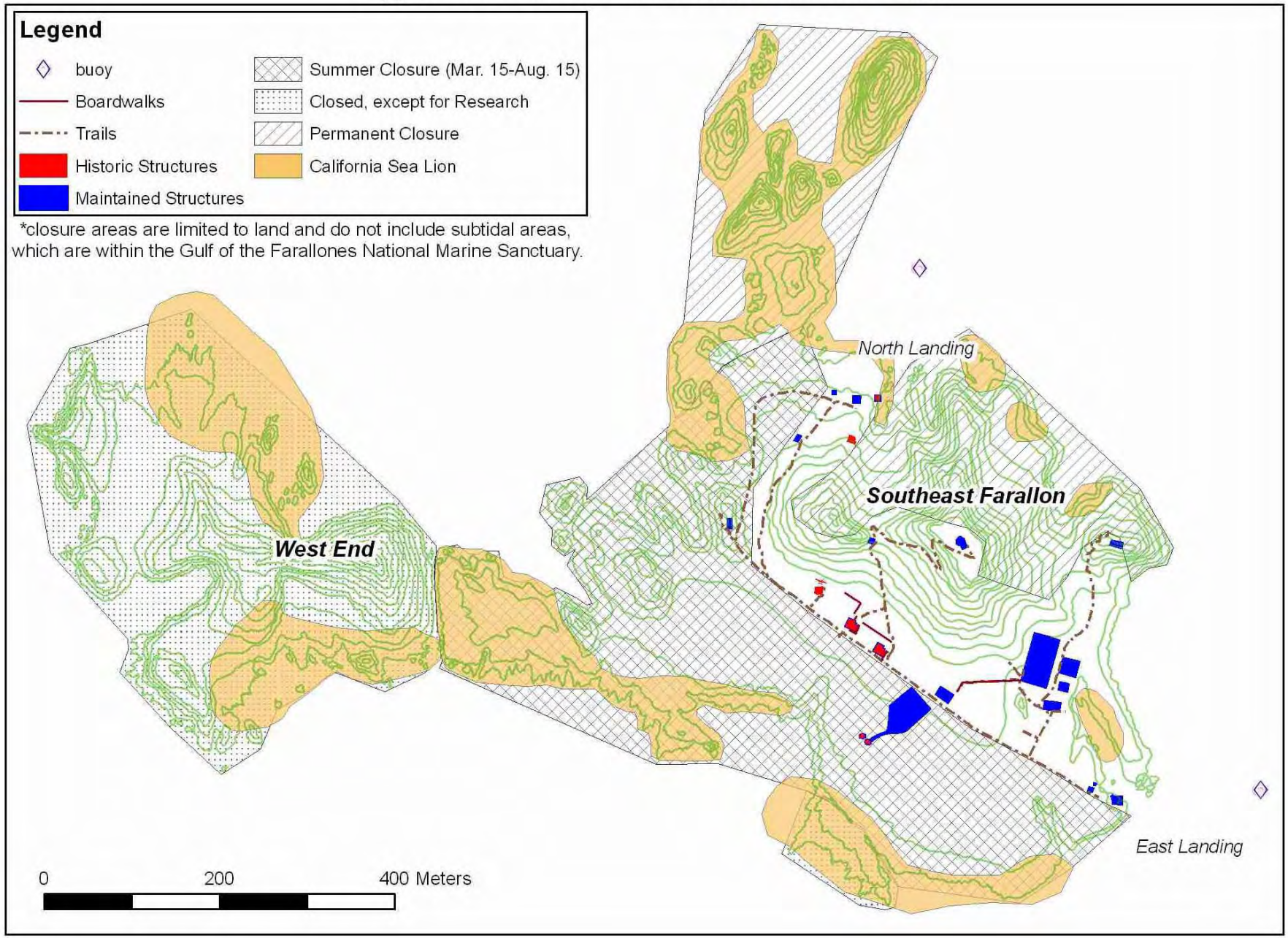
Appendix B-3. SFI Pelagic Cormorant and Common Murre sites



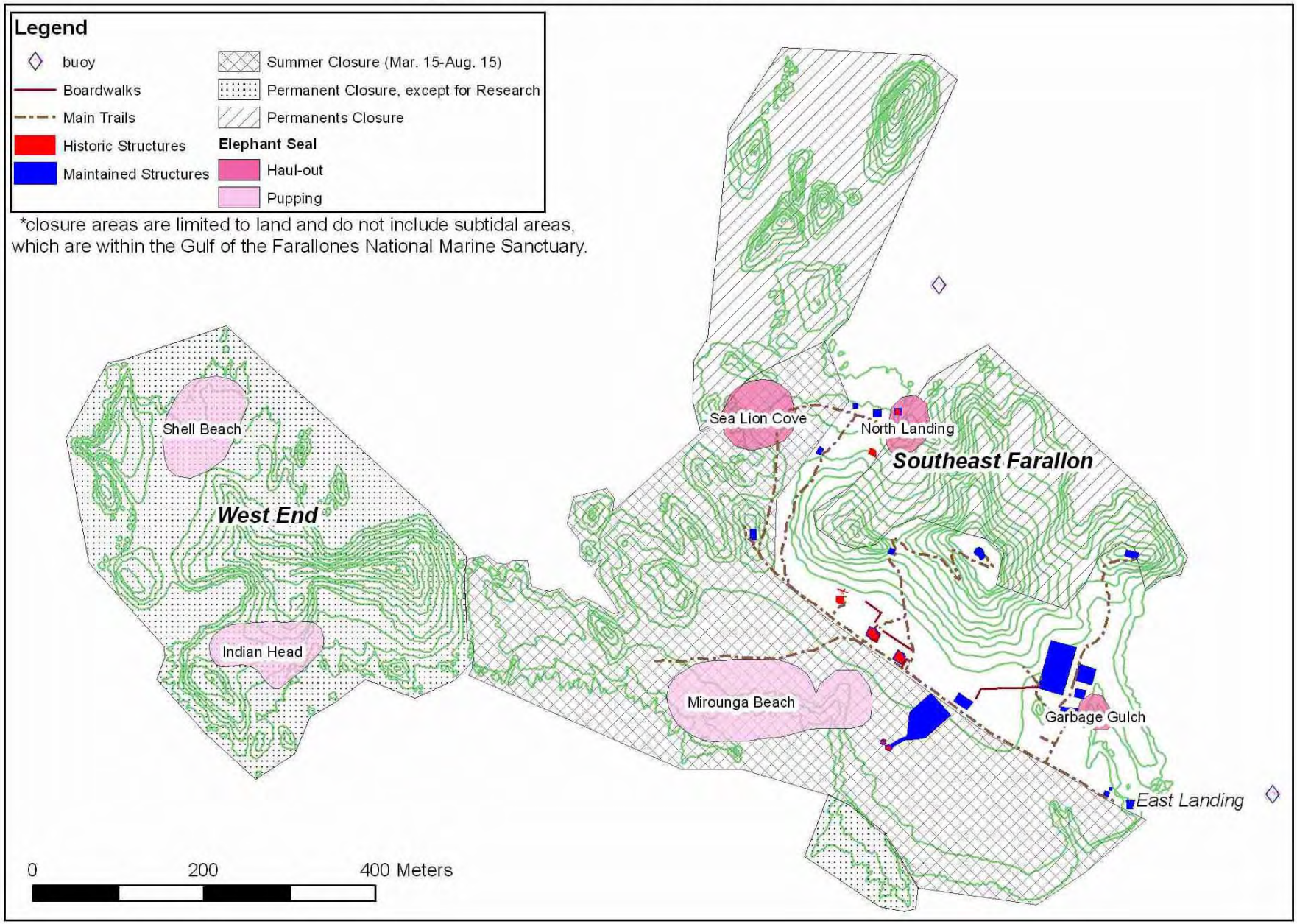
Appendix B-4. SFI Western Gull and Tufted Puffins Roosting and Nesting Sites



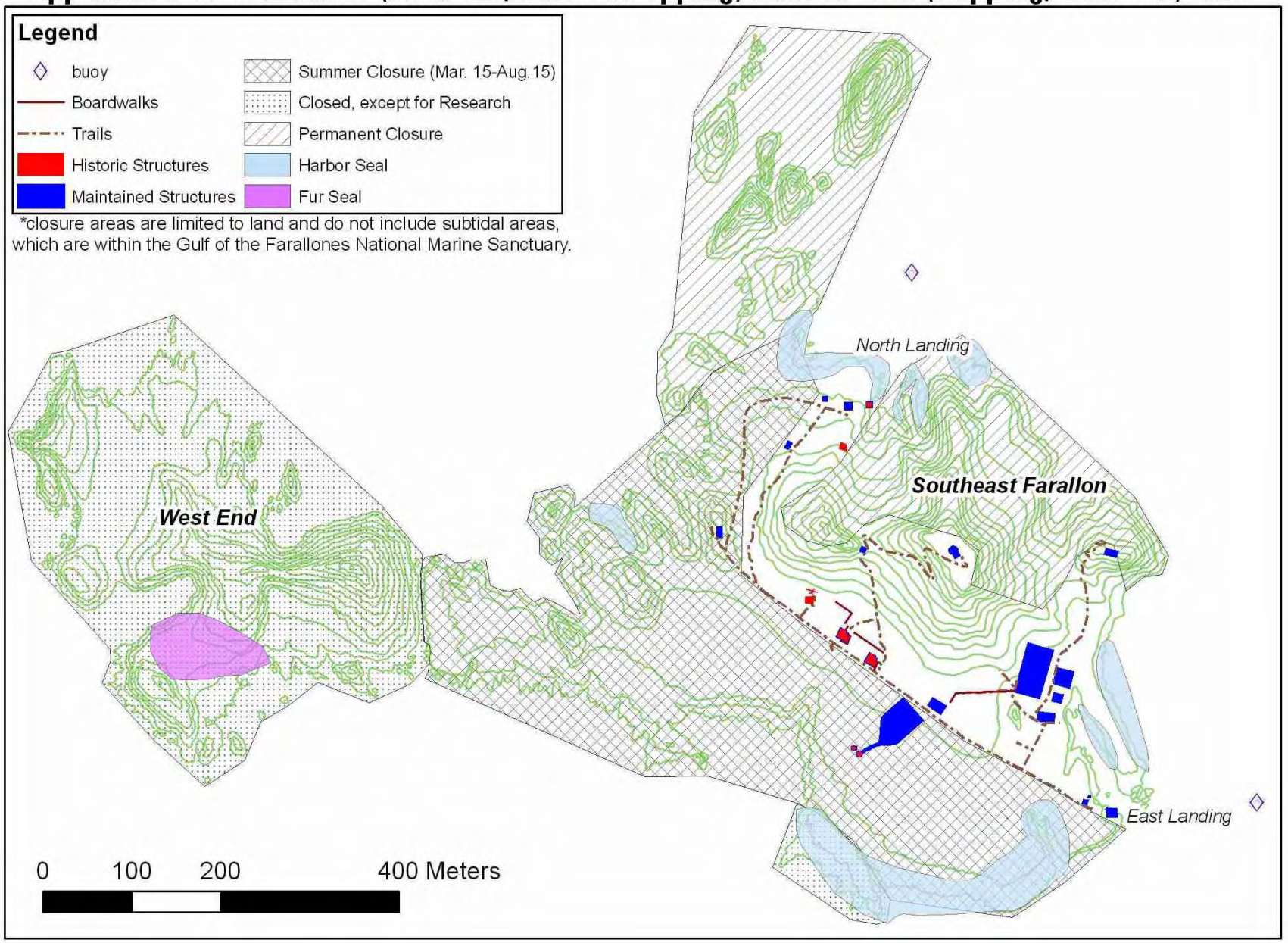
Appendix B-5. SFI California Sea Lion Sites



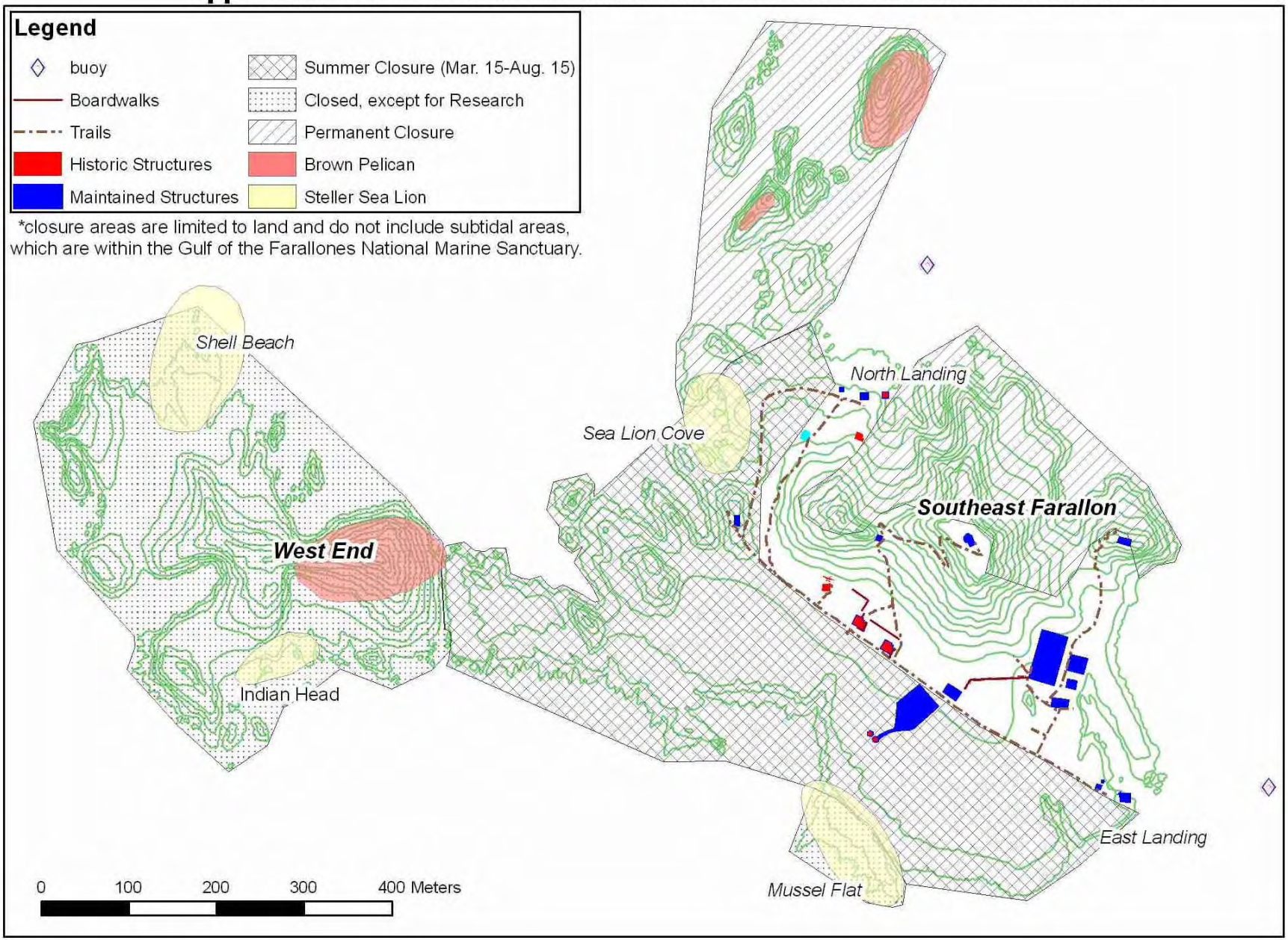
Appendix B-6. SFI Elephant Seal Sites



Appendix B-7. SFI Harbor (Haul-out, Limited Pupping) and Fur Seal (Pupping, Haul-out) Sites



Appendix B-8. SFI Steller Sea Lion and California Brown Pelican Sites



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Appendix C. Glossary of Terms and Acronyms

BLM	Bureau of Land Management
CCNM	California Coastal National Monument
CCP	Comprehensive Conservation Plan
CDFG	California Department of Fish and Game
EA	Environmental Assessment
EO	Executive Order
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
GFNMS	Gulf of the Farallones National Marine Sanctuary
GGNRA	Golden Gate National Recreation Area
GIS	Geographic Information System
MMS	Maintenance Management System
MOU	Memorandum of Understanding
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRHP	National Register of Historic Places
NWR	National Wildlife Refuge
NWRS/Refuge System	National Wildlife Refuge System
NWS	National Weather Service
OSPR	Oil Spill Prevention and Response
PCB	Polychlorinated biphenyls
PRBO	Point Reyes Bird Observatory (PRBO Conservation Science)
PRNS	Point Reyes National Seashore
Refuge	Farallon National Wildlife Refuge
RONS	Refuge Operating Needs System
SEFI	Southeast Farallon Island
SFI	South Farallon Island
SWQPA	State Water Quality Protection Area
USFWS/Service	U.S. Fish and Wildlife Service
USCG	U.S. Coast Guard
WIMS	Weed Information Management System
WSA	Wilderness Study Area
1997 Improvement Act	The National Wildlife Refuge System Improvement Act of 1997 (P.L. 105-57)

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Appendix D
Farallon National Wildlife Refuge
Draft Environmental Assessment

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Chapter 1. Purpose and Need for Action

Introduction

This environmental assessment (EA), in accordance with the requirements of the National Environmental Policy Act (NEPA), evaluates the environmental effects of four alternatives for managing the Farallon National Wildlife Refuge (Refuge) as presented in the draft Comprehensive Conservation Plan (CCP). This assessment is being used by the Service to solicit public involvement in the refuge planning process and to determine whether implementing the CCP would have a significant effect on the quality of the human environment. This EA is part of the Service's decision-making process in accordance with the National Environmental Policy Act (NEPA).

Purpose and Need for Proposed Action

The purpose and need for the proposed action develop a CCP that will provide a 15-year management plan for the Refuge and long-term guidance in relation to management decisions, as directed by the National Wildlife Refuge System Improvement Act of 1997 (1997 Improvement Act). The NEPA requires that an EA or Environmental Impact Statement (EIS) be prepared to accompany the CCP to evaluate the effects of different alternatives which meet the goals of the Refuge and identifies the Service's preferred alternative for implementing the CCP.

Plan Area

The Refuge is located off the northern California coast in San Francisco County, California, 28 miles west of San Francisco, the nearest point of mainland. The waters surrounding the Refuge are designated the Gulf of the Farallones National Marine Sanctuary (GFNMS). The Refuge comprises four island groups totaling approximately 211 acres. The Refuge provides breeding and/or resting habitat for 12 seabird species and five marine mammal species; it also supports an endemic subspecies of arboreal salamander. Various landbirds and bats are present during migration periods. Some landbirds that arrive in the fall, including peregrine falcons and burrowing owls, may overwinter on the islands, but there are no breeding landbird species on the islands.

Preferred Alternative

The Service proposes implementing Alternative C, as described in this EA and the CCP for managing the Refuge.

NEPA and this Document

NEPA requires federal agencies to consider the environmental effects of actions[1] they propose to undertake. Federal agencies must also consider the environmental effects of a reasonable range of alternatives and make the public aware of the environmental effects of the preferred alternative and other reasonable alternatives. If adverse environmental effects cannot be avoided, NEPA requires an agency to show evidence of its efforts to reduce these adverse effects through mitigation. An EA documents that an agency has considered and addressed all these issues. This analysis will help the Service determine if it will need to prepare an Environmental Impact

[1] Under NEPA and implementing regulations, *action* refers to a policy, plan, program, or project that is implemented, funded, permitted, or controlled by a federal agency or agencies.

Statement (EIS) or a Finding of No Significant Impact (FONSI) regarding the preferred alternative for the Refuge.

NEPA also requires the Service to give serious consideration to all reasonable alternatives for managing refuges, including the no-action alternative representing continuation of current conditions and management practices. Alternative management scenarios were developed as part of the planning process described in this EA.

This EA describes the existing resources on the Refuge and the projected environmental effects of the four management alternatives on those resources. Three of the four alternatives presented in this EA are *action alternatives* that would involve a change in the current management of the Refuge. The remaining alternative is the *no-action alternative*, under which current management of the Refuge would continue. A final CCP would be prepared regardless of which alternative is selected.

Decisions to be Made

The Service will select an alternative to implement the CCP on the basis of the assessment described in this document and the input received from the public during the comment process. Implementation of the plan could begin according to the timing requirement of NEPA. The plan will be monitored annually and revised when necessary.

Comprehensive Conservation Planning Process

The Service developed the CCP using a systematic decision-making approach that encouraged public involvement in management decisions throughout the planning process. A planning team was assembled (see Chapter 5) of personnel from the Service's San Francisco Bay National Wildlife Refuge Complex and the California/Nevada Refuge Planning Office, the Point Reyes Bird Observatory Conservation Science (PRBO), and the U.S. Coast Guard (USCG). The Service contacted a wide array of people to participate, including representatives of federal agencies, Congress, state officials, state conservation agencies, conservation organizations, local interest groups, and other members of the public. These interested participants and local residents received announcements regarding the location, date, and time for the initial scoping meeting. At the scoping meeting the staff explained the Refuge's purpose, history, and laws and regulations governing management, as well as the purpose and need for the CCP and the relevant management activities and issues.

The planning team consists primarily of Refuge staff, Service technical experts, and other landowners of the Refuge (some Refuge lands are managed by the Service but owned by other public agencies). The team developed a list of issues and concerns that included comments generated from the scoping meeting, written comments, and verbal comments from discussions with various parties. The planning team reviewed the current Refuge management actions and ultimately presented four alternatives for future Refuge management during the planning process.

Key steps in the Service's comprehensive conservation planning process are listed below.

1. Preplanning.
2. Identifying issues and developing a vision statement.
3. Gathering information.

4. Analyzing resource relationships.
5. Developing alternatives and assessing environmental effects.
6. Identifying a preferred alternative.
7. Publishing the draft plan and NEPA document.
8. Addressing public comments on the draft plan.
9. Preparing the final plan.
10. Securing approval of the Regional Director.
11. Implementing the plan.

Issues Identification

The Service followed NEPA guidelines and identified issues, concerns, and opportunities through early planning discussions and the public scoping process, which began with the first planning update in November 2005. The planning team identified a range of reasonable alternatives, evaluated the consequences of each alternative, and identified a preferred alternative for guiding the Refuge's future direction. This planning effort and the planning team's ongoing dialogue with various federal, state, and county agencies; interest groups; and individuals provided important direction in synthesizing the proposed goals, objectives, and strategies found in the draft CCP. It will be necessary to further coordinate and cooperate with these entities to implement the plan.

Public Involvement

Public involvement is an essential component of the comprehensive conservation planning and NEPA process. The Service announced the beginning of this planning effort for the Farallon National Wildlife Refuge through a Federal Register Notice of Intent on May 31, 2005. The Service sent individual letters announcing commencement of the planning process to several local organizations, the local city government, congressional members, state officials, state agencies, interested parties, and conservation organizations. Since November 2005, the Service has sent three planning updates to a mailing list of more than 100 individuals. Staff also held a public scoping meeting on May 25, 2005, in San Francisco, California.

Written public input received during the process is incorporated into the CCP and EA when feasible, and a summary of the comments is presented in the CCP. The original comments are maintained in planning team files at the San Francisco Bay National Wildlife Refuge Complex headquarters in Fremont, California, and are available for review.

U.S. Fish and Wildlife Service and National Wildlife Refuge System

The mission of the Service is working with others, to conserve, protect, and enhance the nation's fish and wildlife and their habitats for the continuing benefit of the American people. The Service is the primary federal agency responsible for migratory birds, endangered plants and animals, certain marine mammals, and interjurisdictional fish. This responsibility to conserve the nation's fish and wildlife resources is shared with other federal agencies as well as with state and tribal governments.

As part of this responsibility, the Service manages the National Wildlife Refuge System (Refuge System). The Refuge System is the only nationwide system of federal lands managed and protected for wildlife and their habitats. The mission of the Refuge System is to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans. The Refuge is managed as part of the

Refuge System in accordance with the National Wildlife Refuge System Administration Act of 1966 as amended and other relevant legislation, executive orders, regulations, and policies.

Purposes of the Farallon National Wildlife Refuge

The Refuge was established "…as a preserve and breeding ground for native birds." (Executive Order 1043, dated Feb. 27, 1909).

According to these authorities, the primary Refuge-wide purposes are:

> "...for the development, advancement, management, conservation, and protection of fish and wildlife resources..." (16 United States Code [USC]. 742f[a][4]) and "...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude..." (16 USC 742f[b][1], Fish and Wildlife Act of 1956).
>
> "...suitable for (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, and (3) the conservation of endangered species or threatened species..." (16 USC 460k-l, Refuge Recreation Act).

"…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." 16 USC 715d (Migratory Bird Conservation Act of 1918).

Vision Statement

The imprint of California history and local wildlife is deeply embedded in the Farallon Islands, the largest seabird nesting colony in the contiguous United States. Refuge staff work to integrate the historic and future human imprint in a way that continues to enhance habitat and populations of nesting seabirds, marine mammals, and migratory species. Further, the human history and natural resources are shared with San Francisco Bay area residents and visitors. This is achieved in partnership with other organizations through monitoring, research, protection, and habitat restoration. Through high quality environmental education and interpretive opportunities, Bay Area residents and visitors are aware of and take stewardship of this jewel of the California coast.

Goals of the Refuge

Refuge goals were developed on the basis of four principles: wildlife management, habitat management, cultural resources and public access and education.

Goal 1: Protect, inventory, monitor, and restore to historic levels breeding populations of 12 seabird species, five marine mammal species, and other native wildlife. Maintain and develop partnerships to support wildlife and habitat conservation on the Refuge.

Goal 2: Restore degraded habitat and reduce the prevalence of nonnative vegetation in order to re-establish historic abundance and distribution of native plant species.

Goal 3: Increase public awareness of the marine environment and the Refuge's purposes through wildlife-dependent recreation, environmental education, and interpretation opportunities, while preserving and enhancing wildlife populations and the wilderness character of the Refuge.

Goal 4: Inventory and preserve the valuable cultural and wilderness elements of the Refuge in order to chronicle the history of the Farallon Islands and share this knowledge with the San Francisco Bay Area community and the public as a whole.

Chapter 2. Alternatives, Including the Preferred Alternative

Alternatives Development Process

Four alternatives were developed to manage the Farallon Refuge.

- Alternative A: current management (no action).
- Alternative B: expand resource management, and increase public education and outreach.
- Alternative C: expand resource management, increase public education and outreach, and develop a visitor services plan that evaluates on-site wildlife-dependent recreation opportunities. (*preferred alternative*)
- Alternative D: reduce human presence through closures of certain areas to monitoring and management activities, increase public education and outreach.

The alternatives development process was an iterative process that began after the planning team developed the Refuge vision statement and revised the Refuge's goals. The first step in this process was to identify all the important issues related to Refuge management. The list of issues was generated collaboratively by the core planning team, Service staff, and Refuge stakeholders. The public also helped to identify important management issues through the scoping process.

Once the list of important management issues was generated, the planning team described Alternative A (no action). It was important to describe this alternative accurately because the no-action alternative serves as the baseline against which all other alternatives are compared.

Next, the planning team listed a wide range of management actions that would address the issues identified and would achieve one or more of the Refuge goals. These actions were refined during several meetings and planning team reviews. The planning team then clustered these actions into logical groupings to form the action alternatives. Many actions are common to more than one alternative, but the actions within each alternative reflect a common management approach, as described in detail below. The staff then assessed physical, biological, economic, and social aspects affecting the Refuge to select the preferred alternative.

These alternatives are described below and summarized in Table 1 at the end of this chapter. All alternatives considered in this EA were developed with the mission of the Refuge System and the purposes of the Refuge as guiding principles. The Service's preferred alternative is Alternative C.

Description of Management Alternatives

Alternative A: Current Management (No Action)

Under Alternative A, the Service would continue to manage the Refuge as it has done in the recent past. The focus of the Refuge would remain the same: to provide breeding and resting habitat for migratory seabirds and pinnipeds. The Refuge would continue to be closed to general public access. The Refuge would continue to be staffed with a small number of people (3–8) to monitor wildlife, protect wildlife from human disturbance, restore habitats, and maintain facilities. Special Use Permits (SUPs) would be issued on a case-by-case basis to members of the media and outside researchers meeting certain criteria.

Habitat Management. Under Alternative A, the Service would continue to remove nonnative

vegetation through hand removal and herbicide treatment. Volunteers would continue to provide vegetation surveys every few years. Intertidal surveys would continue to be conducted by GFNMS two to three times per year.

Migratory Birds and Marine Mammals. Under Alternative A, the Service would continue to monitor seabird and marine mammal population size and reproduction through a cooperative agreement with PRBO. In addition to monitoring, investigations on diet and other life history parameters would be continued. Limited monitoring of other wildlife (e.g., landbirds, salamanders, bats) on the Refuge would also continue. Research that met certain criteria and fulfilled Refuge information needs would be permitted on a case by case basis under Special Use Permits. Wildlife would continue to be protected from most external disturbances (i.e., boating and aircraft) by the presence of a permanent staff and closure to the general public. Staff would continue to report any violations and as appropriate, refer instances of wildlife disturbances for prosecution.

Threatened and Endangered Species. Species listed under the Federal Endangered Species Act (ESA)—Steller sea lion and California brown pelican—breed or roost on the Refuge. Currently, staff presence protects these species from human disturbance by contacting boats or planes that might disturb wildlife, and reporting violations. Staff also limits their own impacts to listed species by closing certain areas of SFI permanently and seasonally to human access. Population and reproductive monitoring are also conducted for Steller sea lion. Numbers of roosting California brown pelicans are counted daily by PRBO, and the population counts are reported monthly to the Refuge. Because California brown pelicans only roost seasonally at the Refuge, in-depth studies are not conducted on these species.

Public Access and Education

The Refuge is closed to public visitation to protect wildlife and sensitive habitat from human disturbance. Safety is also a consideration. Steep rocky topography prevents boat landings on all islands except for SEFI. Embarking onto SEFI can be challenging, is weather dependent, and requires special equipment (e.g., landing derrick, shuttle boat) as well as a fair amount of strength and agility. These demands, together with uncertainties involving equipment reliability, make access dangerous for the public. Public outreach is conducted through media visits and boat tours. Under Alternative A, the Service would issue one to three SUPs per year for print or broadcast media. A SUP usually authorizes one to three journalists for a one-day visit; with a maximum of one multi-day visit per year. Alternatively, boat tours take visitors close enough to the Refuge to see seabirds nesting on cliffs and marine mammals resting along the shoreline, but the visitors do not disembark. An average 3,350 visitors per year tour the Refuge on day trips operated by commercial operators in the San Francisco Bay Area.

Cultural Resources

The Refuge contains several cultural features that have been assessed by the Service's archaeology branch. These features are described in Chapter 3, *Refuge and Resource Description*, of the CCP. Under Alternative A, the Refuge would continue to maintain known historic structures and archaeological sites on the Refuge. Any construction activity that may affect unknown cultural resources would be reviewed by Service cultural resources staff to assess impacts on cultural resources on the Refuge.

Alternative B: Expand Resource Management; Increase Public Education and Outreach

Habitat Management. Under Alternative B, the Service would continue habitat management activities as described for Alternative A, but would also develop a consistent restoration, monitoring, and prevention protocol to remove the majority of nonnative plants on the Refuge, (primarily on SEFI), and keep additional nonnative plants from becoming established. Nonnative plants have been introduced to the Refuge primarily through human activity. Under Alternative B, New Zealand spinach and cheeseweed would be the two priority invasive species targeted for 95 percent removal. Within the first ten years of the plan, spinach and cheeseweed will be reduced by 50 percent. Removal methods include hand-pulling (intermittently from November through early January and intensively from January through mid-March) and hand-spraying individual plants with herbicide (one week application in mid-August, with follow-up application, as needed, in September or October).

A similar strategy will be developed to apply grass-specific herbicides to control invasive nonnative grasses and plantain. Application of this herbicide is expected to occur during the winter and spring, prior to the arrival of seabirds and pinnipeds. The duration of application is expected to be similar to spinach and cheeseweed removal, but will be clarified through annual grass control plans because the activity is relatively new.

Excess infrastructure would either be removed or used for additional seabird nesting habitat, particularly on the Marine Terrace. Removal or reuse of excess infrastructure will take place intermittently, with procedures and during periods that will have reduced disturbance to wildlife and habitat.

The Service would also implement native plant restoration, which involves expanding the collection and planting of maritime goldfields seed. These efforts would be monitored using geographic information system (GIS) to determine efficacy. Seeds would be collected from the Refuge in summer and fall. Seeds would be sowed coinciding with the first winter rains. Different methods and plots would be tested. More details on weed management can be found in Appendix N of the CCP. This plan will be updated to review survey protocols, assess needs for additional closures, and consider additional plant management efforts.

Under this alternative, the Service will continue to allow surveys of the intertidal areas by partner agencies. Although no management activities are currently in place or planned for the intertidal areas, intertidal monitoring provides important baseline information in the event of an oil spill.

Migratory Birds and Marine Mammals. Except for limited media visits, the Refuge would continue to be closed to public access to protect nesting seabirds, marine mammals, and their habitats from disturbance. Nearly every square foot of SFI is utilized for nesting, roosting, pupping, or as a haul-out site. The Refuge would update existing GIS maps of seabird and pinniped colony locations on the Farallon Islands. Staff access to West End would be restricted to not more than six visits between September through October and not more than six visits between January through February to reduce disturbance to wildlife.

Seabirds and pinnipeds would continue to be monitored for population size and breeding success, but some studies and data would be refined. Diet and other ongoing studies of seabird life history parameters would continue. New studies that fill priority information or management need, or

contribute to protection, enhancement, or management of native Farallon wildlife populations or their habitats would be encouraged. Additional techniques (e.g., remote camera system) would also be implemented to improve monitoring of auklet and petrel species.

The Service would also review and contribute to regional fisheries and other ocean-based plans by providing information on seabird and pinniped population seasonal occurrence patterns and diet collected from the Refuge over the past 40 years. Research would also be integrated into larger study needs in the field of climate variability, climate change, marine protected areas, and fisheries. Staff would also participate in plans that reduce fisheries interaction by participating in working groups or providing comments to reduce impacts on seabirds. Staff would also coordinate with law enforcement from other agencies to reduce disturbance to wildlife. Staff would also work to update aeronautical and navigation charts to improve visibility of the Refuge among those target communities.

Landbirds would continue to be monitored in the fall and, as resources allow, during other seasons. Protocols would be reviewed and revised if necessary. The landbird dataset would be examined and analyzed to support development of management strategies for burrowing owls and other seabird predators. Wintering burrowing owls would be trapped and translocated to the mainland until house mice can be eradicated.

In recent years, the Refuge has become aware of the impact of nonnative house mice on the declining Ashy storm-petrel population. The Service would develop and implement a house mouse eradication plan in order to reduce seabird mortality as well as restore other elements of the natural biological integrity of the Farallons. The proposed eradication plan would include the use of rodenticide when wildlife is not breeding on the Refuge. It is important to note that eradication methods are not explored in depth in this document and will be further analyzed in a subsequent environmental plan and documentation.

Western gull predation on Ashy storm-petrels is another concern that would be reduced by removing individual problem gulls. Gull nests would be monitored for presence of storm-petrel remains. A pilot program to euthanize up to ten problem gulls would be conducted annually through a Migratory Bird Treaty Act permit. This program would be monitored over several years to determine its efficacy on reducing predation pressure on Ashy storm-petrels.

Habitat for crevice-nesting seabirds such as Ashy storm-petrels, pigeon guillemots, and auklets would be enhanced by rebuilding the Lighthouse Hill Trail to be bird-friendly, removing derelict foundations, and creating nesting structures with recycled rubble.

Northern fur seals recolonized the Refuge as a breeding site in 1996. Population size and pup production have recently been growing exponentially, but there has been little population monitoring because the seals primarily use an area on West End (designated as Wilderness) that is not visible from SEFI. Under this alternative, the Service would investigate and implement techniques (e.g., remote camera system) to better monitor fur seals without disturbing nesting seabirds or Steller sea lions.

Threatened and Endangered Species. Under this alternative, the Refuge would continue to reduce this disturbance by monitoring and reporting boating and aircraft incidents that cause these species to flush or show other signs of disturbance. Staff would also work to implement

recovery plan objectives. In addition, an outreach program to pilots, boaters, and the public would also be undertaken. Further research on Steller sea lions would be encouraged to understand limiting factors and enhancement opportunities. The Refuge would also coordinate research and data with other regional colonies being studied.

Other Species. The arboreal salamander pilot monitoring study would be continued and expanded to obtain more information on population size and distribution of salamanders. Sightings of whales, insects, and butterflies would continue to be documented. Protocols for monitoring bats would be reviewed and revised if necessary. Long-term data collected for hoary bats would be analyzed. Non-intrusive research studies to expand our understanding of the Refuge's lesser known fauna would be encouraged.

Public Access and Education. Under this alternative, the Refuge would remain closed to the public. However, the Service would develop and maintain a workshop for charter boat staff and naturalists to enhance off-Refuge tours. Such enhancements could include educational materials and interactions between the Refuge staff and the wildlife tour boats.

Off the Refuge, environmental education would be expanded at partner visitor centers. Programs about the Refuge would be presented to environmental and civic groups. Educational materials and interpretive displays would be updated, and the existing website would be improved and expanded to provide real-time information and visuals. A web camera would be installed during the seabird and marine mammal breeding season and feed from the camera would be made accessible at the Refuge and partner visitor centers. The existing marine mammal and seabird interpretation program at local schools would be further enhanced.

One- to three-person media visits (up to three per year) would continue to be authorized under an SUP at current levels, including a maximum of one multi-day visit per year. Visits would be contingent on logistical, weather, and financial considerations.

Fishing would continue to be allowed by boat in the waters off the Refuge, but boat distance (based on state regulations) from the Refuge must be adhered.

Cultural Resources. Under Alternative B, cultural resource elements would be inventoried and preserved. This information would be used to develop interpretive displays and educational materials for outreach at school programs and public events. Cultural resources on the North Farallons would also be assessed within the life of the plan.

Wilderness. Portions of the Refuge are designated as Wilderness Area which requires these areas to be managed in ways that preserve its wilderness character. The use of motorized equipment, motorized vehicles, motorboats, or aircraft is prohibited in Wilderness Areas. North Farallon will be visited twice in the life of the plan to conduct an assessment of its resources. No motorized equipment will be used on the island. Nonnative plants will be mapped on West End during the non-breeding and non-nesting season by foot not more than twice per year, and a restoration plan will be developed. Methods to remove nonnative plants from West End would be compatible with maintaining wilderness characteristics.

Staff would only be allowed to access the area by foot, without the use of any motorized equipment. The purposes of these visits would be specifically to monitor pinnipeds during the

seabird non-breeding season or vegetation management. House mouse eradication activities would also take place in West End. Rodenticide application methods, timing, and protocols will be analyzed further in a subsequent environmental document. A Minimum Requirements Decision Process will be conducted to determine the most appropriate method to conduct the eradication in designated Wilderness.

Alternative C: Expand Resource Management, Increase Public Education and Outreach, and Develop a Visitor Services Plan that Evaluates On-Site Wildlife-Dependent Recreation Opportunities (preferred alternative)

Habitat Management. Habitat management activities would be conducted as described in Alternative B. In addition, the Service would evaluate the need to close additional areas of the Refuge to protect native plant areas from the effects of increased human presence resulting from any types of on-site public opportunities developed in the visitor services plan. Increased monitoring would be added under this alternative to keep abreast of introductions of nonnative vegetation that could result from public activities.

Migratory Birds and Marine Mammals. Under this alternative, the Refuge staff would conduct migratory bird and marine mammal activities as described in Alternative B. In addition, general studies on foraging ecology, broader ecosystem-based research, and studies investigating environmental change effects on Refuge wildlife would be permitted under Special Use Permits.

Threatened and Endangered Species. Protection of listed species would the same as described for Alternative B.

Public Access and Education. Under Alternative C, public access and education activities would be the same as those described for Alternative B. In addition, Alternative C would include developing a visitor services plan that further assesses visitor activities off-site and on-site. On-site visitor activities that will be evaluated include the potential for group media tours, guided tours and volunteer opportunities. Potential approved refuge uses that may be achieved through these opportunities include wildlife photography, wildlife observation, environmental education and interpretation. The two other approved public uses, hunting and fishing will not be considered. There are no species on the Refuge that are appropriate for hunting, and there are no safe locations on the Refuge to provide good quality fishing.

Cultural Resources. Cultural resource activities would be conducted as described for Alternative B. In addition, cultural resource interpretation would be considered in conjunction with the analysis of possible wildlife-dependent recreational opportunities on the Refuge. The Service would also develop a Farallon NWR brochure to educate the public about historic uses of the islands.

Wilderness. Activities in Wilderness Areas will be the same as conducted as in Alternative B.

Alternative D: Reduce Human Presence through Closures of Certain Areas to Monitoring and Management Activities; Increase Public Education and Outreach

Habitat Management. Habitat management activities under Alternative D would be the same as under Alternative B. However, human access to North Landing (except for emergency situations), portions of Lighthouse Hill, and additional areas would be prohibited during the seabird nesting season to reduce disturbance and encourage expansion of nesting habitat. Such reduced access would decrease the spread of invasive plants. However, reduced access could also limit detection of potential nonnative vegetation population expansion. Designated wilderness areas would be closed to foot traffic; these areas would only be monitored by boat.

Migratory Birds and Marine Mammals. Under this alternative, monitoring and data collection of wildlife would be reduced. Web cameras would be relied on as a means to allow monitoring in lieu of human access. The closure of certain areas listed above would reduce data collection for Brandt's cormorant, common murre, and pelagic cormorant species. Burrow and crevice monitoring would be reduced to protect habitat and prevent disturbance. A mouse eradication plan and removal of problem gulls would still be developed and implemented as prescribed in Alternative B.

Threatened and Endangered Species. Protection of listed species would the same as described for Alternative B.

Public Access and Education. Under Alternative D, access would be substantially limited for both staff and visitors. Public access would not be allowed, and access to North Landing and the Lighthouse Hill Trail would be prohibited to staff during the seabird nesting season.

Cultural Resources. Cultural resource activities would be conducted as described for Alternative B.

Wilderness. Activities in Wilderness Areas will be conducted as in Alternative B.

Features Common to All Alternatives

Nonnative Plant Management

All the alternatives prescribe some level of plant restoration. Nonnative plants, introduced primarily by human vectors, have dramatically altered the natural landscape of SEFI. All alternatives call for the removal of plants by hand-pulling and herbicide application.

Cultural Resources

Not all objects or structures on the Refuge have been assessed. All the alternatives will consider efforts to assess and maintain culturally important resources. Structures are assessed by the Cultural Resources branch of the Service when there are renovation needs.

Environmental Education

Environmental education is crucial to a remote Refuge. Currently, environmental education is conducted at schools along the coast and near the San Francisco Bay NWR Complex. All the alternatives would continue to provide environmental education to local San Francisco Bay area schools.

Wildlife Observation and Photography

Wildlife observation is prescribed in all of the alternatives. Under all the alternatives, the public is able to visit the Refuge by boat, but not allowed to land on the Refuge. In Alternative C, wildlife observation and photography opportunities on the Refuge will be further considered through the visitor services plan.

Features Common to Action Alternatives

Plant Restoration Plan

All action alternatives include a component to develop a restoration plan that will map and monitor plant restoration activities over time to measure the efficacy of restoration efforts. This plan will include development of protocols to prevent future introductions of nonnative plants.

Nonnative House Mouse Eradication

House mice would be eradicated under all the action alternatives. Rodenticide would be applied to SEFI and West End during the non-breeding and non-nesting season. It is anticipated that the activity will take place over a one-time two-week period. The method of application will be determined through a separate environmental analysis subsequent to this CCP.

Removal of Excess Infrastructure

The Refuge has had a long history of human presence, some debris and unused infrastructure remains from previous occupancy. This excess material is located primarily on the Marine Terrace of SEFI. These materials would be removed when they pose a threat to human safety or are a wildlife hazard, or as funds are available. Removal or reuse of materials could provide additional habitat for wildlife. Prior to removal, these materials are evaluated for historic importance by the Service's cultural resource specialists. The action alternatives would include an assessment of existing infrastructure and the development of a timeframe for removal or reuse as wildlife habitat.

Wildlife Monitoring and Research

Monitoring and research are the primary activities conducted on the Refuge. Eleven of twelve species of birds (Leach's storm-petrels are only banded) and five species of pinnipeds are monitored on the Refuge. Research studies are conducted on some of these species. The primary difference between Alternative B and C is that permitted research under Alternative B would still have to meet the criteria of being focused on a refuge information need, while research would be expanded to include topics that benefited conservation of wildlife in general and understanding of marine ecosystems in Alternative C. It is therefore anticipated that more research would occur under Alternative C because criteria is less restrictive. Alternative D would reduce monitoring and research to allow birds to expand their nesting habitat.

Alternatives Considered but Eliminated from Detailed Analysis

Unlimited Public Access

Unlimited public access was dismissed from further analysis due to resource sensitivity, safety concerns, logistical constraints, and incompatibility with Refuge purposes. Unlimited public access would be unreliable due to weather and equipment unpredictability. Additionally,

unlimited access would necessitate a larger staff to host visitors. Water and power resources are insufficient to support a larger staff and unlimited visitors. SEFI is the only part of the Refuge where access could be allowed on the Refuge because it has equipment to transport visitors ashore. Access to the islands requires significant support from island staff due to the rocky shoreline of the SEFI. Visitors would need to be transported onto the island by small boat and a landing platform. However, visitors could not be guaranteed access onto SEFI given the variability of weather and tides, in addition to landing equipment unpredictability.

Allowing unlimited public access would introduce the potential for major wildlife and habitat disturbance. The majority of land on SEFI is used by wildlife as haul-out, roosting, and nesting sites. Nests and burrows are located all over the Refuge and could be easily damaged by human traffic. Public access would increase the potential for habitat loss. Moreover, because the Refuge hosts globally significant wildlife populations, any major human disturbances could result not only in repercussions to a specific colony, but to overall populations.

Seasonal Access for Field Station Staff
Seasonal access was eliminated from detailed analysis because it would conflict with the Refuge's purpose of protecting and restoring seabird populations. Limiting access for Refuge or PRBO staff would result in reduced research and monitoring of wildlife, as well as reduced protection of wildlife from human disturbance. Accessing the Refuge on a limited basis would not provide protection from boat and aircraft disturbance, which are known threats to wildlife on the Refuge. In addition, the infrastructure required to access SEFI needs continual maintenance. The landing crane requires continual upkeep and a power source that could not be maintained under seasonal access. Changing weather conditions and SEFI's rocky shoreline preclude staff from simply boating up to the island.

No Access
Eliminating all access to the Refuge, including Refuge staff, was considered but dismissed from detailed analysis because it would conflict with the Refuge purpose of protecting and restoring seabird populations. Eliminating access for Refuge staff would result in reduced research and monitoring of wildlife. While the removal of human presence might increase the extent of available habitat, wildlife would likely be more susceptible to aircraft and boating disturbance in the absence of existing staff surveillance and enforcement. Without a small but vigilant human presence on SEFI to prevent boats and aircraft from approaching too close to the island, seabirds and marine mammals would be flushed from nesting colonies, possibly during critical times in the breeding season.

Aircraft flying lower than 1,000 feet over the island, and boats approaching too close to the shoreline, have been observed flushing seabirds and marine mammals, and are therefore treated as potential violations of Service regulations. When such an incident occurs, island personnel immediately attempt to make contact with the pilot or skipper, advising them to alter their course or face a potential citation. A vessel description, identification numbers, activity description, and any wildlife disturbance are carefully noted and sent to Refuge law enforcement or other appropriate enforcement agencies. Refuge officers follow up with appropriate action—either a warning or citation. This approach has been successful in reducing the number of low-level flights, from an annual average of five to ten prior to 2002 to three or fewer in 2006.

The California Code of Regulations prohibits boats from approaching within 300 feet of the

shoreline between March 15 and August 15. Due to the Refuge's remoteness and unpredictable sea conditions, this regulation is difficult for California Department of Fish and Game (CDFG) to enforce. Island personnel are in contact with fisherman and other boaters on a daily basis, informing them of the regulations and documenting any violations. Approximately 8–10 violations of the CDFG closed area are recorded each year; several of these cause some level of wildlife disturbance.

It is believe that the frequency and magnitude of human-caused disturbance would increase if personnel were removed from the Refuge. Prior to establishment of a human presence in the 1960s, USCG informed the Service that quite a few people landed on the islands at various times to the detriment of nesting colonies of Brandt's cormorant, whose nestlings were heavily preyed upon by gulls (Gene Kridler pers. comm. July 2, 2005). Trespassers have also killed gulls and sea lions (Farallon journals, unpublished; White 1995). Even now people occasionally try to land on the island but are intercepted and escorted off the island before they cause any damage.

Because many seabirds lay only one egg per year, even one human disturbance event during a critical time of the nesting season (egg laying, chick rearing) can cause reproductive failure of cliff-nesting species (e.g., common murre) for that season. Repeated disturbances could cause abandonment of an entire colony.

If a human disturbance event were to involve the introduction of a mammal (e.g., cat, rat, or even rabbit), such an introduction could lead to extirpation of other burrowing seabirds as well. The consequences of introduced mammalian predators and competitors on island species are well documented (Copson 1986, Faulkner et al. 2001, Keitt et al. 2002). Prior to Refuge acquisition of SEFI in 1969, nonnative cats and rabbits were present. Following their removal, ground-nesting seabird populations rebounded, and rhinoceros auklet returned as a nesting species.

Without a small staff on the island, the Service would be unable to document and respond to off-Refuge events that affect Refuge wildlife. Long-term monitoring of common murre populations and documented gillnet mortality contributed to closure of the near-shore gillnet fishery in 1987. In 2003, island personnel documented the emergence of squid fishing close to the island and its potential effects on nocturnal seabirds such as Ashy storm-petrels and Cassin's auklets. Following presentations by Refuge and PRBO staff to the California Fish and Game Commission, the waters surrounding the Refuge were closed to night fishing.

Oil spills are another threat to seabirds in general, and common murres in particular, that nest on the Refuge. Refuge personnel record all oiled wildlife daily, reporting any unusual incidents or increases to the Oil Spill Prevention and Response Division of CDFG. When a spill event is suspected, Refuge staff collects oiled birds or carcasses for evidence. Several successful cases (i.e. Apex-Houston, Command, Luckenbach) resulting in large financial settlements and restoration of seabirds and habitat, have been based on documentation collected by Refuge staff. Collecting oil spill impacts to seabirds may also explain population-level effects over time.

Removing the human presence on the island would also impede the Service's ability to fulfill its public outreach mission. Journalists and other media personnel are periodically granted access to write articles or to film news segments and documentaries. Refuge staff people have intimate knowledge of resident wildlife and can supervise these limited access events in a manner that greatly reduces disturbance while at the same time allowing the public an opportunity to learn

about the Refuge's resources. Refuge staff also communicates with charter boat operators that bring people out to see the Refuge from the water.

The combination of restricted public access and staff presence has facilitated the recolonization of once extirpated species to the Refuge. Historical estimates indicate that at least 500,000 common murres and thousands of northern fur seals once populated the Farallon Islands. Fur seals have only recently returned as a breeding species after an absence of more than 150 years. Common murres have slowly rebuilt from a low point of just a few thousand in the early 1900s to more than 250,000 today. Wildlife still remains vulnerable to human disturbance, nonnative species, oil spills, and other off-Refuge events that cannot be predicted. Removing island staff (and consequently removing impediments to unauthorized public access) would reverse gains in wildlife restoration that have occurred since the Refuge was established.

Table 1. Summary of Alternatives

Issue Area	**Alternative A** No Action (Current Management)	**Alternative B** Expand resource management; and increase public education and outreach	**Alternative C** Expand Resource Management, Increase Public Education and Outreach, and Develop a Visitor Services Plan that Evaluates On-Site Wildlife-Dependent Recreation Opportunities (*preferred alternative)*	**Alternative D** Reduce human presence through closures of certain areas to monitoring and management activities; increase public education and outreach
Wildlife Management	• Monitor breeding populations and breeding success of 11 seabird and five pinniped species. • Census and collect reproduction and resighting information weekly for elephant seals. • Identify threats and options for removing them; conduct investigations of diet and other life history parameters of selected seabirds and pinnipeds. • Monitor wildlife response to habitat restoration and other management activities. • Monitor and quantify landbird arrivals during fall migration. • Record observations of whales, bats, salamanders, butterflies, insects, and other non-	• Same as Alt. A, but: • Coordinate law enforcement and outreach (to boaters and pilots) with other agencies to reduce disturbance to wildlife. • Initiate/support studies that focus on foraging ecology of breeding birds on SEFI. • Investigate new techniques (e.g., remote camera system) or protocols to monitor growth and reproduction, especially of the northern fur seal colony on West End. • Review and contribute to regional fisheries, emerging fisheries and other ocean-based management plans to identify problems and solutions that relate to foraging seabirds. • Contribute seabird and pinniped monitoring data to regional efforts and other large-scale monitoring efforts. • Establish and maintain a variety of partnerships to collaborate on	• Same as Alt. B, but: • Permit/encourage on-island research focused on broad ecosystem questions that support the conservation of Refuge wildlife.	• Same as Alt. A, but: • Close North Landing, a portion of Lighthouse Hill, and other feasible areas during the seabird nesting season to provide additional nesting habitat. • Limit data collection on Brandt's cormorant, common murre, and pelagic cormorant species to increase habitat at North Landing, Lighthouse Hill, and other feasible sites.

Issue Area	Alternative A No Action (Current Management)	Alternative B Expand resource management; and increase public education and outreach	Alternative C Expand Resource Management, Increase Public Education and Outreach, and Develop a Visitor Services Plan that Evaluates On-Site Wildlife-Dependent Recreation Opportunities (*preferred alternative)*	Alternative D Reduce human presence through closures of certain areas to monitoring and management activities; increase public education and outreach
	bird migratory species. • Continue to allow intertidal studies for baseline data collection.	ecosystem-based and other joint research projects. • Integrate research on Farallon wildlife into studies on marine ecological consequences of climate variability and change, marine protected areas, marine ecosystem conservation, and fisheries management. • Repeat the 1989 auklet burrow survey; develop a better method of tracking population trends of Cassin's and rhinoceros auklets. • Reassess breeding population size and trends of storm-petrel and auklet species by refining methodology to conduct a status assessment to review population status and trends, limiting factors, and conservation recommendations. • Continue to refine and update GIS map of seabird colonies and pinniped haul-out/pupping areas. • Prepare supplemental NEPA documentation and permitting and secure funding to eradicate nonnative house mouse; develop a plan to prevent future rodent		

Issue Area	**Alternative A** No Action (Current Management)	**Alternative B** Expand resource management; and increase public education and outreach	**Alternative C** Expand Resource Management, Increase Public Education and Outreach, and Develop a Visitor Services Plan that Evaluates On-Site Wildlife-Dependent Recreation Opportunities (*preferred alternative)*	**Alternative D** Reduce human presence through closures of certain areas to monitoring and management activities; increase public education and outreach
		introductions, and detect and respond to rodent introductions. • Monitor and reduce predation on seabird species by western gull; study extent of problem and conduct a pilot program that euthanizes no more than 10 problem gulls annually to lower Ashy storm-petrel predation rate. • Until mice are eradicated, continue to translocate individual problem burrowing owls. • Review/revise monitoring and research plan for landbirds. • Expand arboreal salamander and hoary bat surveys to fall/winter annual data collection. • Encourage non-intrusive research studies that would help inventory and understand some of the Refuge's lesser known fauna, such as insects, bats, and salamanders.		
Endangered Species Management	• Protect species from human disturbance. • Monitor population and reproduction of Steller sea lion. • Conduct daily population	• Reduce disturbance to threatened/endangered species by monitoring and reporting boat and aircraft disturbance. • Encourage Steller sea lion research to determine limiting factors to	• Same as Alt. B.	• Same as Alt. B.

Issue Area	Alternative A No Action (Current Management)	Alternative B Expand resource management; and increase public education and outreach	Alternative C Expand Resource Management, Increase Public Education and Outreach, and Develop a Visitor Services Plan that Evaluates On-Site Wildlife-Dependent Recreation Opportunities (*preferred alternative)*	Alternative D Reduce human presence through closures of certain areas to monitoring and management activities; increase public education and outreach
	counts of roosting California brown pelicans.	reproductive success, causes of declining breeding populations, enhancement opportunities; and coordinate with research at other Steller colonies. • Implement action items from the recovery plans. • Note unusual mortality events, and incidental and direct take of Steller sea lions and report to NMFS. • Continue to protect post-breeding roosting habitat on the Refuge for California brown pelicans. • Include California brown pelican and Steller sea lion information in outreach activities and materials.		
Fire Management	• Refuge exempt from fire management plan preparation (no burnable acres).	• Same as Alt. A	• Same as Alt. A	• Same as Alt. A
Habitat Management	• Hand removal and herbicide spraying of New Zealand spinach and cheeseweed to prevent expansion into new areas and reduce density. • Create nesting habitat using excess	• Same as Alt. A, but: • Develop a plan to reduce the footprint of New Zealand spinach and cheeseweed by 50 percent in 10 years and eradication of 95 percent of these species in the long-term by hand spraying herbicide and manual pulling.	• Same as Alt. B; but: • Evaluate need for additional closed areas to protect native plant areas from increased human presence.	• Close trail to North Landing and portion of Lighthouse Trail seasonally to reduce spread of invasive species.

Issue Area	Alternative A No Action (Current Management)	Alternative B Expand resource management; and increase public education and outreach	Alternative C Expand Resource Management, Increase Public Education and Outreach, and Develop a Visitor Services Plan that Evaluates On-Site Wildlife-Dependent Recreation Opportunities (*preferred alternative)*	Alternative D Reduce human presence through closures of certain areas to monitoring and management activities; increase public education and outreach
	infrastructure. • Collect maritime goldfield seeds and seed areas. • Close areas to staff during sensitive seasons. • Remove excess infrastructure when possible.	• Expand maritime goldfield seed collection in the fall and summer, and expand outplanting areas. • Develop and implement standard operating procedures to prevent future introductions (e.g., seed spread) or spread of nonnative species. • Develop and implement a strategy to reduce the footprint of nonnative grasses and plantain. • Use weed information management system, global positioning system, and GIS to track vegetation types and management areas. • Monitor and document management efforts for success of control measures and responses of seabirds. • Establish experimental plots to assess the efficacy of different restoration techniques. • Analyze all existing plant data and management efforts and prepare a report on past vegetation management. • Finalize draft plant sampling protocols and manual. • Identify and prioritize for		

Issue Area	Alternative A No Action (Current Management)	Alternative B Expand resource management; and increase public education and outreach	Alternative C Expand Resource Management, Increase Public Education and Outreach, and Develop a Visitor Services Plan that Evaluates On-Site Wildlife-Dependent Recreation Opportunities (*preferred alternative)*	Alternative D Reduce human presence through closures of certain areas to monitoring and management activities; increase public education and outreach
		removal of unnecessary debris and manmade structures, primarily on Marine Terrace. • Utilize appropriate excess materials for seabird nesting habitat, primarily in Sea Lion Cove. • Rebuild Lighthouse Trail for crevice-nesting species and safe access to the lighthouse. • Implement seasonal and year-round closures in sensitive habitat and areas where access is not necessary to monitor wildlife or maintain operations to reduce habitat impacts and invasive plant dispersal (include procedures to enter closed areas).		
Wilderness Management	• Limited access for elephant seal monitoring purposes only.	• Limit research access to West End to only those surveys needed to assess pinniped population levels and pup numbers: six visits between September and October to assess the expanding fur seal colony and six visits between January and February to monitor elephant seals. • Develop a vegetation restoration plan and map for West End, limit visits to twice per year during the non-breeding season.	• Same as Alt. B	• Do not access wilderness areas. Only monitor by boat.

Issue Area	**Alternative A** No Action (Current Management)	**Alternative B** Expand resource management; and increase public education and outreach	**Alternative C** Expand Resource Management, Increase Public Education and Outreach, and Develop a Visitor Services Plan that Evaluates On-Site Wildlife-Dependent Recreation Opportunities (*preferred alternative)*	**Alternative D** Reduce human presence through closures of certain areas to monitoring and management activities; increase public education and outreach
		• Eliminate nonnative house mice on the West End using methods compatible with wilderness values. • Conduct boat-based or onsite investigation of North Farallons at least twice during this plan. • Review and update the Farallon Wilderness Plan within five years.		
Resource Protection	• Monitor and enforce prohibition on landing on the Refuge, contact boats and aircraft when they approach too close. • Continue to monitor, report and, when possible, prosecute overflight and boat wildlife disturbances. • Monitor and maintain a database of oiled wildlife; report numbers and incidents to Oil Spill Prevent and Response Team. • Monitor the occurrence of oiled seabirds on and around the Refuge and report numbers to OSPR.	• Same as Alt. A, but: • Coordinate with other agencies for joint law enforcement to prevent boat and aircraft disturbance. • Deploy buoys to mark closed areas for seasonal and permanent closures. Evaluate the need to expand closure areas. • Work with the Federal Aviation Administration (FAA), USCG, and NOAA to identify Refuge areas on aeronautical and navigation charts and develop "notice to pilots" to expand outreach to reduce wildlife disturbance. • Coordinate with USCG and GFNMS to develop an outreach program to commercial and recreational boaters and private/military pilots. • Review plans for existing and	• Same as Alt. B	• Close North Landing, portion of Lighthouse Hill, and additional areas to human access during seabird nesting season when feasible to reduce disturbance; monitoring and research activities will be reduced.

Issue Area	Alternative A No Action (Current Management)	Alternative B Expand resource management; and increase public education and outreach	Alternative C Expand Resource Management, Increase Public Education and Outreach, and Develop a Visitor Services Plan that Evaluates On-Site Wildlife-Dependent Recreation Opportunities (*preferred alternative)*	Alternative D Reduce human presence through closures of certain areas to monitoring and management activities; increase public education and outreach
	• Use baseline data and continue population estimates of Farallon seabirds and other wildlife to evaluate impacts of catastrophic and chronic spills. • Coordinate with OSPR and Trustee Agencies to develop restoration and mitigation projects that restore resources lost in oil spills.	emerging fisheries through NMFS and CDFG to identify seabird and marine mammal mortality problems and solutions. • Train staff that work on the Refuge how to identify, respond to, and report oil spills. Attend spill responder course given by CDFG's Oil Spill Prevention and Response network (OSPR) and NOAA. • Implement strategies developed through Sanctuary Vessel Spill Plan and other plans to reduce oil pollution.		
Wildlife Viewing and Photography	• Wildlife-viewing boat tours off-Refuge; no access to the Refuge.	• Same as Alt. A; but: • Develop and initiate a naturalist workshop for Farallon charter boat operators, interface with tours through radio communication.	• Same as Alt. B, but: • Develop a visitor services plan that evaluates wildlife observation, photography, and volunteer opportunities (e.g., tours) on SEFI.	• Same as Alt. B
Environmental Education and Public Outreach	• Provide limited interpretive information at visitor centers, website, and school program on coastal wildlife.	• Same as Alt. A, but: • Coordinate with PRBO and other agencies to expand public outreach activities. • Update Refuge brochures and materials.	• Same as Alt. B	• Same as Alt. B

Issue Area	Alternative A No Action (Current Management)	Alternative B Expand resource management; and increase public education and outreach	Alternative C Expand Resource Management, Increase Public Education and Outreach, and Develop a Visitor Services Plan that Evaluates On-Site Wildlife-Dependent Recreation Opportunities (*preferred alternative)*	Alternative D Reduce human presence through closures of certain areas to monitoring and management activities; increase public education and outreach
	• Implement marine resource education program for selected schools. • Allow up to 3 media visits (of 1-3 persons) per year under SUP.	• Update website with real-time information; install a web camera during the breeding season. • Expand school program on marine environmental education. • Utilize cultural resource assessment to develop an interpretive program for outreach events. • Develop traveling interpretive displays and educational materials about the cultural resources of the Farallons. • Hire a seasonal environmental education specialist to develop a public outreach program that promotes environmental education and outreach to use at fairs, public events, organization newsletters, and boating organizations. • Develop a program to celebrate the 100th anniversary of the Refuge's establishment.		
Hunting and Fishing	• No hunting; fishing in waters off-Refuge permitted.	• Same as Alt. A	• Same as Alt. A	• Same as Alt. A
Boating	• Boating allowed; no landing on the Refuge; must comply with state	• Same as Alt. A	• Same as Alt. A	• Same as Alt. A

Issue Area	Alternative A No Action (Current Management)	Alternative B Expand resource management; and increase public education and outreach	Alternative C Expand Resource Management, Increase Public Education and Outreach, and Develop a Visitor Services Plan that Evaluates On-Site Wildlife-Dependent Recreation Opportunities (*preferred alternative)*	Alternative D Reduce human presence through closures of certain areas to monitoring and management activities; increase public education and outreach
	and federal regulations.			
Access	• None except staff, permitted researchers, supervised volunteers, and media by SUP.	• Same as Alt. A	• Same as Alt. A, but: • Develop a visitor services plan that evaluates options for public access (e.g., tours) to SEFI.	• Same as Alt. B
Cultural Resources	• Assessments of infrastructure on a case-by-case basis.	• Work with Service cultural resource specialists to define, map, and record specific historic structures that contribute to SEFI's listing in National Register of Historic Places. • Prioritize list of non-historic artificial structures/objects to be removed. • Assess potential for cultural resources on North Farallons. • Train new island personnel and interns on protecting and preserving cultural resources.	• Same as Alt. B	• Same as Alt. B

Chapter 3. Affected Environment

This chapter is intended to describe the physical resources, biological resources, cultural resources, and social and economic environment that would most likely be affected by the alternatives. Chapter 3, *Refuge and Resource Description*, of the CCP provides a detailed description of each of these components. Specific resources and activities, including agriculture and local economy, are not addressed because they are not considered relevant, do not exist on the Refuge, or are not expected to be affected by the management alternatives.

Chapter 4. Environmental Consequences

This chapter of the EA provides an analysis of the significance of the potential impacts for each alternative based on the physical, biological, cultural, social and economic resources of the local environment. Impacts will be focused on SEFI because most of the proposed activities take place on that part of the Refuge. Direct, indirect, and cumulative impacts are described for each alternative. Alternative A (no action) is a continuation of management practices that are currently in place and serves as a baseline against which Alternatives B, C, and D are compared.

In describing the significant of impacts, the Service defers to NEPA Implementing Regulations at 40 CFR 1508.27. Significantly as used in NEPA requires considerations of both context and intensity of an action. With regard to context, the significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected region, the affected interests, and the locality. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend upon the effects in the locale rather than in the world as a whole. Both short- and long-term effects are relevant. With regard to intensity, significance refers to the severity of impact.

NEPA requires the development of mitigation measures when federal activities are likely to result in adverse impacts on the human environment. None of the activities proposed under the three action alternatives are intended or expected to result in adverse environmental impacts that would require mitigation measures. However, the CCP contains measures that would prevent the occurrence of any significant environmental impacts.

Physical Resources

Hydrology

The harsh marine conditions are slowly altering the landscape of the Refuge. None of the alternatives will prevent these natural erosion effects on the Refuge. Because of the slow timescale of natural erosion, mitigation for these threats was not developed in the CCP, but effects should be monitored and actions will be reevaluated when the CCP is revised, if appropriate. None of the alternatives will accelerate erosion.

A catchment pad was constructed on SEFI in 1905 to collect rainwater. This water is used by staff on the Refuge for residential needs and not for wildlife or vegetation purposes. No changes are proposed to this system under any of the alternatives, and therefore are not expected to alter

the hydrology of SEFI.

Under Alternative A, current management activities are focused on SEFI and do not substantially alter the hydrology of the Refuge. Current vegetation removal is not intensive and does not change the hydrology. Under Alternatives B, C, and D, plant restoration would primarily focus on removing two invasive species on SEFI: New Zealand spinach and cheeseweed; a secondary priority would be removing nonnative grasses and plantain. This removal might modify the short-term hydrologic flow on a very small scale, but would not be likely to result in long-term hydrologic changes. Restoration activities would be conducted intermittently during the seabird non-breeding season (mid-August through late March) by small groups of people using manual herbicide applications and hand pulling to limit disturbance to soil and nesting habitat. Native plants would be reseeded wherever large areas of invasive weeds are cleared to promote revegetation of desirable species and to prevent erosion. Large-scale erosion is not expected because the Refuge is primarily granitic rock with low erosion potential. The Service would not water seeds but would rely instead on natural rainfall. No other activities under the alternatives would be expected to require water sources that might affect hydrology. Therefore, we have concluded that none of the alternatives are expected to adversely affect hydrological patterns.

Water Quality and Contaminants

The waters surrounding the Refuge have been designated by the State of California as the "Farallon Islands Area of Special Biological Significance". Discharges into waters with such a designation are prohibited, unless authorized by the State Water Resources Control Board through a permitting process. An on-site survey of SEFI by State Water Resources Control Board personnel in 2003 identified several potential sources of discharge which included six discharge points and two springs/seeps (uncontaminated) (State Water Resources Control Board 2003). The most serious discharge was untreated sewage from the houses. This discharge was eliminated by a septic system installed in 2005. Other potential sources of discharge are concrete slabs that are either water catchments or former building foundations located on upland areas. Water falling on catchment pads is channeled into a storage cistern. Water falling on former building foundations is absorbed into soil and does not reach the ocean. Therefore, current refuge operations result in no discharge to state waters and therefore have no affect on water quality.

Under all alternatives, nonnative vegetation would be removed from the Refuge through a combination of manual and chemical means. However, removal would occur at a higher magnitude in Alternative B, C and D. Under Alternative A, chemical application would be used on a limited basis in invasive plant removal activities. Under Alternative B, C and D, more chemical is likely to be used on more plants, but applied with the same methods as Alternative A. It is not anticipated that any of the alternatives would adversely affect water quality off the California coast. Herbicides would only be applied directly to target vegetation by handheld sprayer in accordance with label instructions. Only approved pesticides will be used according to label directions, and non-aquatic herbicides will be applied a sufficient distance (usually 100 feet) from water. Glyphosate-based herbicides (4 percent solution) are the most commonly used, although grass-specific herbicides (sethoxydim, 18 percent solution) are used in winter and spring to minimize damage to native plants.

Glyphosate has been approved for use by the U.S. EPA in estuarine environments. Glyphosate is water-soluble and may be transported by surface waters. It is stable in water and sunlight, but is degraded rapidly by bacteria. It is considered moderately persistent in soils with an estimated

half-life of 47 days. Because glyphosate adheres strongly to particles, it does not readily leach to waters (Sprankle et al., 1975 cited in Albertson, 1998). There could be adverse impacts on non-target vegetation from pesticide drift, but these effects are expected to be minimal because herbicides are used in the fall when native plants are dormant, and herbicides would not be applied during inclement weather or high winds (greater than 10 miles per hour). Herbicides are used in the upland areas of the Refuge and not in the intertidal zone, which makes runoff to the ocean unlikely. The use of herbicides is highly regulated through the Service's annual Pesticide Use Proposal (PUP) process. This approach notes environmental hazards, efficacy and costs. All herbicides used by the Service are stored in approved spill-resistant and locked pesticide storage containers. Only a one-year supply will be stored on the Refuge, not more than ten gallons.

Sethoxydim (Poast) photo degrades in water in less than one hour (EXTONET 1996). However, sethoxydim is moderately to slightly toxic to aquatic species. It will not be applied in intertidal areas of the Refuge and areas where surface water is present. Furthermore, application of this herbicide will not occur during inclement weather or high winds to reduce drift into the ocean. Like glyphosate, this herbicide is highly regulated through the Service's annual PUP process. Only a one-year supply will be stored on the Refuge of not more than ten gallons.

Rodenticide would not be used under Alternative A. The use of rodenticide in Alternatives B, C, and D is not expected to significantly impact the marine environment or the Refuge water supply. The application methods for the rodenticide have not been determined. The methods will be analyzed in a subsequent environmental document. Procedures and/or technology will be developed to prevent rodenticide from being dispersed into the intertidal zone or the ocean. The brodifacoum-based rodenticide pellets that will be used are composed of compressed grain, similar to breakfast cereal. The pellets are highly water-soluble and in the unlikely event that the pellets enter the water, they would rapidly disintegrate to undetectable levels. Brodifacoum-based rodenticide pellets have been used on Anacapa Island in southern California, no brodifacoum residues were detected in the marine water samples collected after bait application (Howald et al. 2005).

The risk of rodenticides entering and contaminating the human water supply on the Refuge is very low. Bait application actions would include the following mitigation to avoid the entry of any bait pellets into the water supply and water catchment areas. Rodenticide would not be applied to the water catchment areas or water supply tanks. The water supply would also be monitored for brodifacoum levels after bait application.

Transportation methods could have impacts to the marine environment. Traveling to the Refuge is complicated and often unpredictable due to changing weather conditions. The Service does not have a boat suitable for transporting staff and supplies to the Refuge. Instead, it relies on volunteer captains and their boats for transport. Travel to and from the Refuge is currently conducted by sailboats and, less often, motor boats. These vessels are generally of small capacity, carrying only a small group of people, and do not visit the Refuge on a daily basis; most typically they arrive once every two weeks, tie up to a mooring buoy for two to four hours, drop off and receive supplies and staff, and then depart. This limits the risk of direct impacts on the local environment. Under all alternatives, reliance on volunteers and their boats would continue. The use of gas-powered vessels would have the potential to introduce various contaminants, including fuel oils, grease and other petroleum products, to the surface waters. Because the use of gas-powered vessels is infrequent and the boats carry small amounts of fuel (less than ten gallons), the

risk of petroleum contamination is minimal.

Under Alternative B, C, and D, additional research activities could increase vessel traffic and impact water quality. Under Alternative C, any on-site public opportunities developed under the visitor services plan could result in slightly increased vessel traffic and incidental impacts on water quality. It is likely that additional boats would be needed for any activities on the Refuge, separate from staff- and supply-related transportation. This is not likely to be significant because the Refuge can only support a limited number of people at one time. Additionally, these boats would be required to follow the same protocols as supply-related transportation in properly maintaining the vessels to reduce impacts to water quality (i.e., no ballast dumping near the Refuge, maintaining engines properly to reduce release of contaminants into the waters off the Refuge). Activities are not likely to be conducted on a daily or high volume basis because weather conditions, wildlife sensitivity, and management activities would limit visitation. Public uses could increase the potential for trash to enter the local environment. However, visitor protocol would need to be developed in order to reduce impact on the Refuge environment.

Overall, impacts to water quality from any of the alternatives are expected to be minimal.

Geology and Soils

The Refuge is primarily made up of granitic rock with very little exposed soil. Consequently, soil erosion is naturally limited. Likewise, plant communities are limited in both variety and extent. The strong to moderate winds that characterize the San Francisco coast naturally erode rock and soil at the Refuge. Erosion is also expected to result from rising temperature and sea level associated with climate change (Malcolm and Pitelka 2000).

Soil erosion is not anticipated to result from the nominal on-site activities occurring under Alternative A (no action). Restoration activities under alternatives B, C, and D may result in minimal soil erosion. Expanded removal of nonnative vegetation would expose soil, potentially increasing short-term erosion. Herbicides could potentially persist in the soils. Glyphosate herbicide tends to strongly adsorb to organic matter and fine sediments but is physiologically inactive. The reported rate of glyphosate decomposition and persistence in soil varies a great deal: most studies suggest rapid decomposition, while others detect persistence in the soil for more than a year (Ebasco 1993). Conversely, sethoxydim has low soil persistence. Reported field half-lives range from 5-25 days and sethoxydim has a weak tendency to adsorb to soil particles (EXTOXNET 1996). Disappearance of sethoxydim is primarily due to action by soil microbes. Long-term effects of herbicide in the soil and geology are not expected to be significant.

Plant removal activities would be conducted during the dry season, limiting the erosion potential from rain. Removal areas are in the interior of SEFI and are not likely to result in runoff into the ocean. Furthermore, establishment of native plant communities will likely mitigate any soil erosion resulting from invasive plant removal. Removal of derelict infrastructure under Alternatives B, C, and D would also expose bare soil; however, these areas will either be seeded with native plants or replaced by habitat structures.

The use of brodifacoum-based rodenticide in Alternative B, C, and D is not expected to significantly impact soil. Cereal-based bait pellets would be used to eradicate mice that have been designed to degrade rapidly in moist environments such as the Farallons. The bait product contains an extremely low concentration of brodifacoum (between 20 and 50 part per million, or

between 0.002 and 0.005 percent) that is highly unlikely to result in a measurable level if leached into the environment (Sheppard, pers. comm.). Brodifacoum in soil can persist in soil with half-life from 28-178 days (USEPA 1998)). On Anacapa Island, brodifacoum was used to effectively eradicate rodents. No brodifacoum residues were found in soil samples collected after bait application, with the exception of one sample that contained only trace levels (Howald et al. 2005). This sample was likely taken from a point in the immediate vicinity of a disintegrated bait pellet.

Soil erosion from volunteers, visitors, and staff are expected to be minimal. People are expected to stay on established trails and boardwalks unless supervised by staff that are familiar with the soil conditions in non-trail areas.

In summary, the alternatives would have only minimal effects on geology and soils. Soil erosion would be limited by removing invasive plants in the dry season, establishing native plants where invasives or derelict infrastructure are removed, and using a rodenticide that degrades rapidly.

Air Quality

Under Alternative A (no action), only negligible air quality impacts are expected. Existing impacts on air quality are incidental to transportation; weekly or biweekly staff and supply trips currently cause short-term increases in air emissions. The Service has not engaged in any other activities that would permanently affect the surrounding air quality. Removal of infrastructure under Alternatives B, C, and D may temporarily create short-term increases in airborne particulate matter. Herbicide application in all the alternatives is not likely to affect air quality. Herbicide would be applied by hand-spraying in close contact to the plant which would reduce or eliminate drift. Also, spraying would not occur during inclement weather or high winds to avoid the possibility of chemical drift. The rodenticide proposed for use is not expected to cause any air quality impacts because pellets are not easily airborne.

Any public access opportunities developed in the visitor services plan under Alternative C would result in minor short-term increases in vehicle exhaust emissions given transportation requirements to access the Refuge. The number of people and trips to the Refuge would be limited because of the small size of the SEFI and the sensitivity of wildlife to human disturbance.

Hazardous Materials and Safety Issues

The storage of petroleum-based chemicals is one of the main hazardous materials on the Refuge. All are stored in approved containers, which include secondary containment. The Refuge has a current spill contingency and response plan, which guides handling and storage of petroleum products.

A soil sample revealed the presence of hydrocarbons very close to the powerhouse, potentially resulting from waste oil and diesel containers stored on SEFI (GeoEngineers 2006). While no cleanup standards are available for the Refuge's environment, clean-up was largely conducted through passive remediation. Waste oil and diesel were removed and a bio-venting system installed to reduce hydrocarbon concentrations in the problem areas as part of a hazardous materials cleanup project in 2002.

Under all the alternatives, herbicides will only be stored and used on SEFI. These herbicides are not expected to result in any long-term adverse impacts to the local environment. Storage would

not pose any safety or hazardous material dangers because only a one-year supply will be stored on the Refuge, not more than 20 gallons (not more than ten gallons of sethoxydim and glyphosate, each). The herbicides will be stored in an approved spill-proof locker, according to label directions, California regulations, and Service policy. Crews applying the herbicide will be trained in storage and application to these same standards. In the long-term, the use of herbicides is expected to decrease. Historical (pre-1998) herbicide treatment was inconsistent, with spraying sometimes occurring after seeds were dispersed, resulting in a seed bank in the soil. Current and future herbicide application will be conducted prior to seed dispersal each year which will reduce the seed bank and over time reduce the amount of herbicide required.

Under Alternative B, C, and D, a brodifacoum-based rodenticide would be used for mouse eradication but would not be stored on the Refuge over the long-term. It is expected that all bait application activities would be contained within a time period of less than 30 days. This rodenticide would only be stored on the Refuge during this period. Its application would be highly supervised, according to label directions, California regulations, and Service policy. Therefore, no safety or hazardous materials issues are anticipated.

The natural and artificial landscapes of the entire Refuge pose safety concerns for staff and visitors. All four groups of islands that make up the Refuge are extremely difficult to access because they are rocky and affected by tide conditions (beach landings are not possible). Only SEFI has a landing boom to transfer people and equipment from the boat onto the Island. Alternatively, SEFI has a secondary entry point which is a metal grate platform only accessible at calm conditions. Even with this equipment, weather conditions can change quickly and equipment can fail, making transfers risky. Safety concerns for staff and volunteers are largely the same under each alternative. Under all of the alternatives, staff and volunteers would receive safety instruction prior to visiting the islands to minimize the chance of injury.

Under Alternatives B and D the Refuge would remain closed to the general public thereby reducing safety risks to visitors. However, volunteers, staff, and researchers continue to encounter safety risks when visiting SEFI. Under Alternative C, any public access opportunities developed under the visitor services plan for the Refuge could pose some safety risks in the transport of visitors on and off the Refuge. Safety consideration would need to be thoroughly addressed when activities would be further evaluated. Protocols would need to be developed to reduce the risks. Even with these measures in place, minor to moderate risks to visitors would remain.

Media visits (no more than one to three persons at a time) would occur under each of the alternatives. Visits by non-staff who are unfamiliar with the refuge conditions could present some safety issues. As described above for visitation under Alternative C, media representatives would be instructed on how to make the transfer safely and protocols would be put in place to ensure that transfers are not made during unfavorable weather conditions.

The Lighthouse Trail is in poor condition, presenting some tripping hazards to both staff and visitors. Alternatives B, C, and D include an objective to repair the trail, which would reduce safety hazards in this area.

Wilderness

Under Alternative A, access to wilderness areas would be prohibited except for management,

limited research and monitoring at West End. Alternative A does not specify limits on the number of visits allotted for monitoring and research. Under Alternative B and C, wilderness would be afforded greater protection than Alternative A because access would be restricted to six visits between September and October to assess the expanding fur seal colony, and six visits between January and February to monitor elephant seals. Under Alternatives B and C, nonnative vegetation will be removed and native plant restoration activities will take place on West End. These activities will not occur during the breeding or nesting season, thus avoiding impacts to sensitive wildlife. Visits to West End for restoration activities will not likely exceed two visits per year. However, the wilderness aesthetic may be temporarily disturbed by herbicide spraying, pulling of nonnative vegetation, and seeding. No mechanized equipment will be used in the wilderness areas. However, boats will be required to reach wilderness areas. In the long-term, this plant restoration will have a beneficial effect of restoring the wilderness value of West End. Alternative D would provide the greatest protection to wilderness resources because no access would be allowed on West End. However, nonnative vegetation may spread without control methods.

House mice are present on West End, which is designated as wilderness and closed to public access. Alternatives B, C and D include a program to eradicate mice. Under these alternatives, brodifacoum-based rodenticide would be dispersed onto West End when seabirds and pinnipeds are not breeding or nesting in the area. The exact method of application will be determined in a subsequent environmental document assessing different options. The use of rodenticide will have short-term human disturbance of the West End and its wilderness features. In the long-term, eradication of mice from this wilderness area is expected to improve the wilderness character of West End by removing a human-introduced species and restoring the area for seabirds relying on this area for breeding. The impacts of this activity on wilderness will be further evaluated in a separate environmental document for the mouse eradication plan. In addition, a Minimum Requirements Decision process will be conducted to assess any machinery used in wilderness areas on the Refuge.

Biological Resources

Vegetation

No federally listed plants occur on the Refuge. Maritime goldfield, an endemic annual to offshore seabird nesting islands in California, is the most abundant native plant on SEFI. Nonnative species such as cheeseweed, New Zealand spinach, and grasses can outcompete with maritime goldfields. Under each of the alternatives, nonnative vegetation will be removed from SEFI by manual and chemical methods. These activities would occur at a reduced rate under Alternative A (no action) compared to Alternatives B, C, and D. Nonnative vegetation will be individually hand-pulled, which will reduce the possibility of accidentally removing native vegetation.

The application of herbicides will be properly calibrated to needs. Use of herbicides would result in reduced nonnative vegetation and allow for expansion of native plant communities. Glyphosate is a broad-spectrum herbicide, toxic to nonnative and native plants. Sethoxydim is toxic only to grasses and is not expected to affect any native grasses which are very sparse and not located in areas where nonnative grasses would be sprayed. When applied broadly across large areas, the alternatives in the plan incorporate protocols to minimize adverse effects. Application of herbicides will be conducted by hand to individual plants, reducing probability of impacting native plants. Moreover, herbicides will only be used when native plants are not in their growing season

(nonnative plants on the Refuge grow actively in the late summer while native plants actively grow in the spring). The removal areas would be seeded with maritime goldfields to facilitate expansion of native plant communities, which would also be suitable for seabird nesting habitat. Refuge staff would use different planting techniques in experimental plots and compare results with control plots to determine how best to encourage the growth of native plant communities. Alternatives B, C, and D would revise the current vegetation management plan with the goal of removing 50 percent of invasive New Zealand spinach and cheeseweed in ten years and 95 percent over the long-term through hand and chemical means. Additional vegetation management would include monitoring removal and planting technique efficacy over time, employing GIS and other mapping technology.

The brodifacoum-based rodenticide proposed for use in Alternatives B, C and D has no known toxic effects to vegetation.

Under Alternative C, any public access opportunities developed in the visitor services plan would likely increase foot traffic on the Refuge and might introduce nonnative vegetation (from footwear, clothing), increase soil compaction, or trample of native vegetation. Designated foot trails and close supervision would need to be included in any of the potential wildlife-viewing activities evaluated under this alternative in order to reduce impacts to native vegetation. Protocols and monitoring would also need to be implemented to reduce the likelihood of introduction. Impacts to vegetation would need to be evaluated further in the visitor services plan. Under Alternative D, closure of certain trails during the nesting season might promote the growth and expansion of native plant communities with the reduction of human access.

Under all alternatives, the abundance of native vegetation is expected to expand on the Refuge. Habitat restoration fulfills the Service's congressional mandate to preserve, restore, and enhance habitat for threatened and endangered species, songbirds, waterfowl, other migratory birds, interjurisdictional fish, marine mammals, resident wildlife, and plants. Overall, plant restoration activities under Alternatives B, C, and D are expected to increase the Refuge's native habitat in comparison to Alternative A (no action). In summary, only minor impacts are expected from the removal of invasives and other management activities. Long-term beneficial effects would outweigh the impacts of the short-term activities.

Wildlife

Seabirds and pinnipeds would continue to be the focal points of refuge management under all alternatives. Monitoring during the nesting and pupping season is crucial to determining the health of seabirds and pinnipeds. Moreover, long-term data from these top marine predators can be used as an indicator of changes in the marine environment. Populations and breeding success can fluctuate drastically based on ocean conditions.

Under Alternative A (no action), no major wildlife impacts are expected. The Service and research staff would continue to monitor and research seabird and pinniped populations. Staff currently provides protection for wildlife by discouraging and recording aircraft or boating disturbance.

However, challenges including predation of Ashy storm-petrels by house mice and expansion of non-native vegetation would continue to persist. The current footprint of nonnative vegetation would remain stable to slightly decreased, and density of mat-forming plants (e.g., New Zealand

spinach, cheeseweed) would decrease. Therefore, habitat for burrow-nesting auklets would improve. The application of herbicides and the hand-pulling of nonnatives are not expected to affect wildlife because these activities would only be conducted from the fall through the early spring season (when most wildlife is not breeding or not present).

However, requested media visits existing under this alternative may result in disturbance to non-breeding wildlife. To reduce any potential for disturbance, media personnel will be supervised at all times when on the Refuge and limited to a maximum of three visits per year with no more than one to three media representatives per visit.

Alternative B would include those activities in Alternative A, but also provide more protections from disturbance. The Service would work with relevant partners, such as USCG and GFNMS, to coordinate enforcement. The Service would also develop educational materials and programs to educate boaters and pilots about the sensitive nature of wildlife on the Refuge. The Service would also participate in fisheries plans (e.g., those developed by NMFS) to reduce fisheries-seabird interaction.

Wildlife research would be expanded under Alternative B, which could increase our understanding of breeding species' off-refuge foraging needs or mortality factors. Expanded research may result in an increase in disturbance levels greater than Alternative A. However, the same wildlife protocols and standards for research under Alternative A will be applied to new research studies in Alternative B. The number of personnel on the island at any one time will continue to be limited. This new research could ultimately lead to better protection of breeding species both on and off the refuge (e.g., through input into fisheries management plans). Alternative B would also increase our understanding and management of other species that use the Refuge such as salamanders, bats, and insects.

Wildlife would benefit from the habitat changes prescribed under Alternative B. The removal of excess infrastructure would open additional habitat for wildlife and reduce hazards. The reuse of infrastructure materials would provide additional nesting habitat for crevice-nesting species. The removal of excess infrastructure would not occur during the breeding season in order to limit wildlife disturbance. Accelerated removal of nonnative plants and native planting under Alternative B would provide additional habitat and nesting material for cormorants and western gulls.

Use of herbicides and hand-pulling to remove nonnative plants has the potential to impact biological organisms. Short-term impacts of plant removal are likely to include disturbance of roosting (non-breeding) wildlife within close proximity to the field crews conducting the removal. Such disturbance may cause wildlife to relocate to other parts of the Refuge temporarily (less that one hour). These effects are minor because once the crews depart, the wildlife would likely return. Herbicide spraying would occur during a one- to two-week period per year and would not be conducted during the breeding, pupping, or nesting season to reduce exposure to wildlife.

It is unlikely that terrestrial wildlife will be exposed to herbicides because each plant is individually sprayed by hand and the chemical dries in less than an hour, becoming inactive when dry. Laboratory tests of glyphosate generally indicate it to be nontoxic or low in toxicity to mammals and birds, particularly at the concentrations or doses that occur in field conditions,

according to Extension Toxicology Network (EXTOXNET[2] 1996). Most information about glyphosate toxicity to animals comes from experiments on rats, mice and rabbits, and some on dogs. Little information is available on glyphosate toxicity or its breakdown products on most wildlife species. Toxic effects of glyphosate are usually achieved in laboratory animals at very high doses (hundreds or many thousands of times the exposure expected from concentrations and doses applied in field conditions) comparable to portions of animal diets, are often required to generate acute effects (Ebasco 1993, Giesy 2000). Glyphosate's toxicity is categorized as Caution, according to the U.S. EPA. Caution means the product in slightly toxic if eaten, absorbed through the skin, or inhaled, or it causes slight eye or skin irritation. It is the least toxic of the four categories (Caution, Warning, Danger, and Danger-Poison).

Glyphosate to be used on the Refuge is a much lower concentration than that used in lab conditions. Aquatic wildlife is not anticipated to be impacted by glyphosate because the application will be conducted upland, away from intertidal areas making it unlikely that fish and invertebrates will be affected. Based on this information and the timing of herbicide application, it is unlikely that wildlife on the Refuge will be significantly impacted.

Sethoxydim is practically nontoxic to birds and has low toxicity to wildlife (EXTOXNET 1996). It has been shown to be moderately to slightly toxic to aquatic species, but not to bees. Sethoxydim is categorized as Caution with regard to its toxicity. Significant wildlife impacts are not expected from herbicide application. Like glyphosate, sethoxydim will be applied by hand directly to grass patches making it unlikely that wildlife would receive direct exposure. Grasses primarily occur in the upland parts of the Refuge away from the intertidal zone, making it unlikely that aquatic species would be exposed to sethoxydim.

Alternative B, C, and D propose the eradication of non-native house mice and the lethal removal of up to ten western gulls per year. Individual gulls that are identified as petrel predators would be trapped and humanely euthanized under an experimental program. This pilot program would be monitored to determine the efficacy of removing individual program gulls. This taking of problem gulls would be reviewed under a Migratory Bird Treaty Act permit. While gulls are listed as migratory birds, this take is not expected to affect their population level. Moreover, it is expected to reduce predation pressure on the Ashy storm-petrel population, which is currently a candidate for ESA-listing. Minimal, but positive impacts to mainland burrowing owl populations are expected. Migratory burrowing owls that land on SEFI in the fall will move off the island after a few days to more suitable wintering areas on the mainland. Most burrowing owls that currently over-winter on SEFI (enticed to stay by nonnative mice) perish from starvation or are killed by gulls.

Under alternative B, C, and D, brodifacoum-based rodenticide, considered the most effective method for eradicating mice, would be used. Much of SFI is suitable for mouse habitat, including many sheer cliffs and ledges that are difficult to access by foot. This rodenticide has been effectively used on over 300 islands worldwide to effectively eradicate rodents (Island Conservation Group, unpub. data). This eradication is expected to lead to an increase in Ashy storm-petrel numbers, which have been in decline for several years and is currently a candidate

[2] EXTOXNET is an independent collaborative information project about pesticide, established by the Cooperative Extension Offices of Cornell University, Oregon State University, the University of Idaho, the University of California, Davis, and the institute for Environmental Toxicology, Michigan State University.

species. Recent documentation revealed that burrowing owls have been predating on mice and subsequently, storm-petrels, when the mice population declines each year. Eliminating mice is expected to discourage burrowing owls from overwintering on the Refuge and preying upon the storm- petrels. Over the long-term, seabirds are expected to benefit from mouse eradication because of the elimination of this predator. In the short-term, individual songbirds migrating through the Refuge may attempt to feed on the pellets and may be fatally poisoned.

Overall, seabirds and songbirds are not expected to be at significant risk from the rodenticide. Most seabirds are exclusively marine predators and are not expected to feed while on land. However, western gulls have the potential to ingest bait pellets. Most songbirds present on the Farallons are vagrant landbird individuals, on the Refuge during spring and fall migration. The application of rodenticide will take place in the early winter, when there are very few songbirds or seabirds on the Refuge. Incidental mortality among individual songbirds may occur, but is not expected to have a population-level effect to a songbird species because songbirds species do not migrate to the Refuge is large numbers. Individual songbirds that eat grains may attempt to eat the bait. Bait pellets would be dyed green, which has been found to discourage birds from swallowing the pellets. Unconsumed bait pellets could last for a period of between one week and six months after the initial application.

Brown pelicans use the Refuge greatest from September through November. Pelicans may be roosting on the island during the rodenticide application and may be temporarily flushed. There would be no direct effect of the rodenticide on the pelicans since they are piscivorous (fish eating). The application would not have an adverse impact on the roosting or breeding population size of brown pelicans. Pelicans on East Anacapa Island in 2001 were not adversely affected by rodenticide application.

Pinnipeds on the Refuge are not expected to be harmed by the rodenticide used in Alternative B, C and D. While the rodenticide is toxic to vertebrates, even the smallest pinniped would have to consume hundreds of bait pellets to experience any toxic effect. Furthermore, pinnipeds are exclusively piscivorous and would not to be interested in ingesting bait pellets.

Broadcast of rodenticide pellets and associated human activity is also not expected to have long-term disturbance to sensitive wildlife. Rodenticide application may have short term effects that would occur for a few hours. There is also potential for minor wildlife disturbances due to personnel on foot, conducting activities such as post-application monitoring. Personnel activity would not be more intense than ongoing Refuge maintenance activities that are currently conducted year-round on the islands. Resting birds or pinnipeds may flush or disperse temporarily as a result of personnel presence. However, the application of rodenticide would occur some time from September through mid-December when none of the species on the Refuge is breeding in order to reduce impacts. Furthermore, SFI would be treated in distinct segments, providing alternative habitat for wildlife to roost or haul out throughout the bait application.

The rodenticide proposed for use is also not expected to have toxic effects on reptiles, amphibians, or insects (Hoare and Hare 2006). Careful monitoring on Anacapa Island during their broadcast of rodenticide found no evidence of negative impacts on native salamanders or reptiles (Howald et al. 2005).

The rodenticide is not expected to have an effect on marine and terrestrial invertebrates because

they have different blood clotting systems (Hoare and Hare 2006). Very few fish are attracted to grain-based bait pellets. Studies in New Zealand and California have documented no evidence of fish consuming brodifacoum moving through the marine ecosystem (ICEG 2000).

Mice that have eaten the rodenticide are not expected to significantly impact other animals through secondary poisoning (predators or scavengers eating the mice). Burrowing owls, barn owls, and infrequently-occurring kestrels are the only birds of prey on the Farallons that eat mice. Application will take place during the early winter, when there will be few birds of prey. Due to the small numbers of birds present on the Farallons, any incidental mortality of birds of prey through consumption of poisoned mice would have no population-level effects. The Service may consider temporarily capturing and holding or relocating some birds of prey prior to broadcast of rodenticide. Gulls have been known to consume mice, both alive and dead, and there may be incidental mortality of individual gulls as a result of secondary poisoning. However, this mortality is not expected to have any noticeable population-level effects. The rodenticide application would be timed to coincide with the annual low point in gull populations on the Farallons, outside of the breeding season. Further analyses will be conducted in a subsequent environmental plan prior to the eradication in order to fully identify the best method for deploying the rodenticide.

Alternative B would expand environmental education offered to the public to promote understanding of wildlife and its needs. These activities will take place off-site and are not expected to impact wildlife.

Alternative C could yield more disturbance of wildlife than the other alternatives. The addition of public access opportunities might increase wildlife disturbance, crush seabird nesting burrows, or otherwise damage nesting habitat. These activities will be evaluated further in a visitor services plan to determine their affects to wildlife, especially during the sensitive breeding, pupping, and nesting seasons. Public visitation would likely take place during the non-breeding and non-nesting seasons to reduce wildlife disturbance. Close supervision by staff would be necessary for undertaking these activities.

Alternative D would likely improve wildlife habitat more than the other alternatives. In addition, Alternative D would include closure of the Lighthouse Trail and North Landing during the breeding season. These closures would increase breeding and nesting habitat. USCG operations at the lighthouse would be excluded from closures. However, reduced access to monitoring sites would decrease collection of wildlife data.

Cultural Resources

Refuge management activities have the potential to disturb cultural resources under all the alternatives. To preserve Refuge historic resources, all undertakings, including but not limited to maintenance activities, will be coordinated with the Service's Regional Archaeologist. There are no known accounts of Native American use of the Farallon Islands. The most evident cultural resources relate to the sealing and egg gathering activities that took place in the nineteenth and twentieth centuries. Any culturally important objects potentially affected by Refuge activities are handled in accordance with federal cultural resource regulations.

SEFI was listed in the National Register of Historic Places in 1977. Most of the buildings and structures on SEFI have been assessed by the Service's Regional Archaeologist under Section 106 of the National Historic Preservation Act. The buildings and structures that qualify as historic

properties or contribute to the historic landscape will be maintained according to the *Secretary of the Interior's Standards for the Treatment of Historic Properties*. Under Alternative A, any renovations, repairs, or modifications to historic properties will strive to maintain their historic character.

Restoration of vegetation and removal of excess infrastructure under any of the alternatives can potentially disturb subsurface cultural resources. Because these activities have the potential to affect cultural resources and to cause soil erosion, they will be carefully monitored. Steps will be taken to preserve significant structures or mitigate potential effects of their removal.

Alternatives B, C, and D specify an outreach and education component that will include a history of the cultural resources on the islands. Environmental education brochures for visitors and local residents will include information on historic structures and artifacts. The existing marine resource school program will be expanded to include this cultural resource component. Under Alternative C, any type of public access could have the potential of damaging or degrading cultural resources on the islands. This will be evaluated further in the visitor services plan, including methods for avoidance, protection, or mitigation.

Social and Economic Environment

None of the alternatives are expected to have major effects on the social and economic environment of San Francisco County. The Refuge is not adjacent to any communities to which it could provide immediate recreation or economic opportunities. Similarly, the Refuge does not currently provide any direct tourism. Wildlife-viewing tour boats that visit the Refuge vicinity (though they do not land) indirectly contribute tourism revenue to San Francisco. However, tourism revenue may be generated through the public access opportunities considered under Alternative C.

Recreation

Alternative A (no action) does not provide recreational opportunities on the Refuge. However, fishing and boating has occurred in the area from before the Refuge's establishment into the present, and chartered wildlife-viewing tour boats frequent the Refuge's waters. Alternative B, C, and D would continue to allow these activities. Under Alternative B, brochures and information about the Farallon Islands wildlife would be created to communicate the Refuge's purpose and history. Alternative C would include the recreational opportunities described for Alternative B; additionally, the Refuge would conduct an analysis of appropriate public access opportunities that could be conducted on the Refuge. Examples of such activities to be considered include wildlife observation and photography through guided tours. These activities would need to be assessed for safety, biological impacts, costs, and infrastructure needs.

Employment

Under all the alternatives, the Refuge is not expected to create a significant number of employment opportunities for the surrounding community. Alternatives B, C, and D would make the Refuge operations specialist a permanent position, and a seasonal environmental education specialist position would be added.

Unavoidable Adverse Impacts

None of the alternatives considered for the Refuge would be expected to result in unavoidable adverse environmental effects. Refuge staff will monitor any incremental or unforeseen adverse

effects on the Refuge and mitigate them accordingly.

Irreversible and Irretrievable Commitments of Resources

Most management actions identified in this document would require a commitment of funds that would then be unavailable for use on other Service projects. At some point, commitment of funds to these projects would be irreversible; once used, these funds would be irretrievable. Nonrenewable or nonrecyclable resources committed to projects identified in this CCP, such as fuel for chartering boats to the Refuge; supplies used in management or maintenance activities (e.g., herbicide, infrastructure supplies, signage); and materials for enhancement and restoration projects would also represent an irreversible or irretrievable commitment of resources.

Finally, Alternatives B, C, and D would result in the eradication of nonnative mice and euthanizing up to ten gulls per year. This would represent an irreversible and irretrievable loss of wildlife resources, but this activity would result in the overall net benefit of restoring native wildlife resources on the Refuge.

Short-Term Uses vs. Long-Term Productivity

An important goal of the Refuge System is to maintain the long-term ecological productivity and integrity of the biological resources on NWRs. This system-wide goal is the foundation for the goals presented in the CCP. Alternatives B and D favor long-term productivity over short-term uses by limiting public and research access, focusing instead on the expansion and protection of wildlife habitat. The resulting long-term productivity would include increased protection and survival of migratory seabird species, pinnipeds, and endemic and rare plants on the Farallon Islands. With the preservation of these plant and animal species, the public would gain long-term opportunities for wildlife-dependent recreational activities. Alternative C will consider on-site public opportunities through a visitor service plan which may affect wildlife habitat damage or introduce nonnative species, but would have the potential to expand public outreach.

Cumulative Effects

Cumulative effects are those effects on the environment resulting from incremental consequences of the Service's proposed actions when added to other past, present, and reasonably foreseeable future actions, regardless of who undertakes those actions. Cumulative effects can be the result of individually minor impacts that can become significant when added over a period of time. It is difficult to accurately analyze cumulative effects because one action may increase or improve a resource in one area, while other unrelated actions may decrease or degrade that resource in another area. Moreover, CCP actions may be inhibited or accelerated by other activities or management plans occurring in the same area. This section must assess how those other activities, in addition to the CCP actions, would affect the physical, biological, cultural, and social and economic environment.

The Refuge is located so far offshore that only a small number of projects would result in a synergistic effect when added to those activities in the CCP.

Cumulative Effects on the Physical Environment

The California State Legislature passed the Marine Life Protection Act in 1999 mandating the State to design and manage an improved network of marine protected areas to, among other things, protect marine life and habitats, marine ecosystems, and marine natural heritage. The process for this initiative is just beginning, but could have a profound beneficial affect on the

Refuge and resources adjacent to the Refuge (e.g., foraging conditions for breeding birds). The management plan for GFNMS focuses on enforcement and off-Refuge activities that are not likely to affect the physical appearance of the Refuge. Some beneficial physical changes will occur under the CCP alternatives. Primarily, nonnative vegetation and excess infrastructure will be removed. Excess infrastructure will be reused for bird habitat when possible. No digging or construction of additional structures is planned. The Refuge is rustic, containing very basic infrastructure for limited staff and maintenance equipment. While Alternative C could increase the number of humans on the refuge through a visitor services plan, no buildings would be constructed to accommodate the potential increase in visitors. The restoration proposals described for the Refuge would contribute minimally to the overall cumulative effect of this plan and other projects.

Climate change could have a profound effect on an island refuge such as the Farallon Islands. Sea-level rise, a consequence of climate change, could reduce the total land area of the Refuge; some parts of the islands could become permanently submerged if the estimated sea-level rise of 0.1–0.2 mm/yr should transpire (IPCC 2001). Over time, this could result in significant ramifications for wildlife and vegetation. Habitat for wildlife at the shore could disappear, forcing wildlife to move onto higher ground, possibly competing with other wildlife for habitat. Plant communities at the shore could be inundated or be forced to migrate to higher ground, competing with other vegetation (Smerling et al. 2005). Changing temperatures could also shift vegetation endemic to an area to new locations (Malcolm and Pitelka 2000).

Cumulative Effects on Biological Resources

The GFNMS management plan, the Luckenbach Restoration Plan and the Marine Life Protection Act process are likely to benefit wildlife on the Refuge by providing additional protections from human disturbance and funds to enhance or protect seabird nesting habitat. The GFNMS plan will provide increased enforcement and stricter laws protecting Refuge resources, such as wildlife. The Luckenbach Plan will provide increased protection (from human disturbance and raven predation) by funding house mouse eradication and increased public awareness of seabird breeding colonies in the central Coast, including the Refuge. The Marine Life Protection Act process in intended to protect the natural resources in the Gulf of Farallones. Fish in the Gulf are an important foraging resource for the wildlife on the Refuge. The CCP alternatives, coupled with the GFNMS plan, will provide increased protection for wildlife resources. Under Alternatives B, C, and D, the Refuge would expand the restoration of habitat (i.e., creation of burrowing habitat, removal of excess infrastructure, removal of nonnative vegetation, seeding of native vegetation), which would provide new habitat areas. Under all the alternatives, expanded coordination with partners to improve law enforcement would also help to monitor and reduce wildlife disturbance.

House mouse eradication is included in the Alternatives B, C, and D, but a more detailed eradication plan and environmental documentation will be developed subsequent to the CCP to determine the most appropriate method for rodenticide application. While the plan would result in the extermination of house mice on the Refuge, there would be a net benefit to the Ashy storm-petrel population on the Refuge which is predated upon by the mouse. Also, burrowing owls, which overwinter to feed on the mice would starve or begin predating on Ashy storm-petrels once the mouse population on the Refuge crashed. By eliminating mice as a food source, burrowing owls would not be enticed to overwinter on the Refuge. Ashy storm-petrels would also benefit from the removal of problem western gulls included in Alternatives B, C, and D.

Under Alternative C, the introduction of any on-site public opportunities has the potential of

damaging wildlife habitat. This could result in a long-term or cumulative effect to the seabirds and pinnipeds that rely on the Refuge for roosting, breeding and nesting.

Climate change could also magnify impacts on wildlife habitat, reduce native vegetation, and increase occurrence of nonnative (plant and animal) species on the Refuge. Climate change can result in physiological changes, phenological (lifecycle) changes, range shifts, community changes, ecosystem process shifts, and multiple stressor conditions (Parmesan and Galbraith 2004). Global warming may require organisms to migrate at much higher rates than they have done in the recorded past (Malcolm and Pitelka 2000). Native plants could be eliminated from the Refuge by changing temperatures, which could affect the nesting material needs of breeding birds. Moreover, climate change could result in changes in local marine food web dynamics, altering prey resources in the waters adjacent to the Refuge. The potential decrease in food availability near the Refuge could deter seabirds or pinnipeds from migrating to or even breeding on the Farallon Islands and could reduce the ability for wildlife to rear young.

All alternatives would have long-term benefits for native wildlife species and habitats within the area. The protection of wildlife habitats within the Refuge would benefit the long-term conservation of migratory birds and other native wildlife species. Alternative A, while supporting habitat restoration, may not produce meaningful changes as quickly as the other alternatives. Plant restoration activities prescribed under all the alternatives may help slow erosion of the islands caused by the harsh marine environment. Overall, the preferred alternative would integrate wildlife conservation activities with compatible wildlife-dependent opportunities that would represent a cumulative benefit for local wildlife, native plant communities, and human communities.

Cumulative Effects on Cultural Resources

Adherence to the policies and regulations pertaining to the protection of cultural resources would avoid or mitigate any significant adverse effects of all the alternatives. No adverse effects on cultural resources are anticipated from any of the alternatives. Climate change could accelerate the deterioration of cultural resources on SEFI. Increased funding will be needed to adequately address the increasing maintenance needs for of the historical buildings and structures.

Cumulative Effects on the Social and Economic Environment

Because the Refuge is located offshore of San Francisco, the CCP alternatives will not cumulatively affect local and regional traffic. The GFNMS management plan is not likely to generate more visitors to the sanctuary.

The action alternatives, particularly those involving expansion of wildlife-dependent recreation and environmental education, would provide benefits to the public. In addition, the environmental education and outreach programs would attempt to reach a diverse audience.

Under all the alternatives, no significant economic impacts on the local or regional economy are anticipated. Under Alternative C, any evaluated on-site public opportunities may provide some economic benefit to the community. Such benefits could include charter boat operators that would be paid to transport visitors out to the Refuge. The Refuge does not provide any other foreseeable commercial benefits (e.g., farming or fishing) that would be altered under the alternatives. Therefore, few employment and economic opportunities would be gained by any of the alternatives.

Table 2. Summary Impacts of Alternatives

Resource	Alternative A **No Action**	Alternative B **Expand Resource Management; Increase Public Education and Outreach**	Alternative C **Expand Resource Management, Increase Public Education and Outreach, and Evaluates On-Site Opportunities (preferred alternative)**	Alternative D **Reduce Human Presence through Closures of Certain Areas to Monitoring and Management Activities; Increase Public Education and Outreach**
Physical Environment				
Hydrology	No significant impact.	No significant impact.	No significant impact.	No significant impact.
Water Quality/ Contaminants	No significant impact.	No significant impact.	No significant impact.	No significant impact.
Geology	No significant impact.	No significant impact.	No significant impact.	No significant impact.
Air Quality/Climate	No significant impact.	No significant impact.	No significant impact.	No significant impact.
Hazardous Materials/ Safety	No significant impact.	No significant impact.	No significant impact.	No significant impact.
Biological Environment				
Vegetation	Reduced nonnative vegetation and increased native vegetation.	Accelerated removal of nonnative vegetation and accelerated increase in native species.	Same as Alt. B; on-site visitor opportunities may increase foot and boat traffic with the potential to increase spread of nonnative vegetation.	Area closures will reduce the spread of nonnative vegetation.
Wildlife	Expanded wildlife habitat.	Expanded wildlife habitat; expanded protection from disturbance.	Same as Alt. B; on-site visitor opportunities may result in disturbance to wildlife and damage to breeding habitat.	Increased nesting habitat from area closures; decreased monitoring effort could result in slower detection of problems and management response.
SOCIAL AND ECONOMIC ENVIRONMENT				
Recreation	No significant impact.	No significant impact.	Potential recreational opportunities may	Same as Alt. B.

			be available once a visitor services plan is completed.	
Employment	No significant impact.	No significant impact.	Some jobs or income could be generated from providing on-site visitor opportunities.	Same as Alt. B.
Cultural Resources	No significant impact.	Increased documentation and cultural interpretation.	Same as Alt. B.	Same as Alt. B.

Chapter 5. List of Planning Team Members and Persons Responsible for Preparing this Document

Joelle Buffa	U.S. Fish and Wildlife Service
Winnie Chan	U.S. Fish and Wildlife Service
Jesse Irwin	U.S. Fish and Wildlife Service (former)
Gerry McChesney	U.S. Fish and Wildlife Service
Mark Pelz	U.S. Fish and Wildlife Service

Chapter 6. Coordination, Consultation, and Compliance

Agency Coordination and Public Involvement

The draft CCP and EA were prepared with the involvement of technical experts, community groups, and private citizens. The Service has invited and continues to encourage public participation through planning updates and public comment periods.

Notice of Intent

A Notice of Intent to prepare a CCP for Farallon NWR was published in the Federal Register on May 31, 2005.

Environmental Review and Consultation

As a federal agency, the Service must comply with provisions of NEPA. An EA was developed to evaluate reasonable alternatives that would meet stated goals and assess the possible environmental, social, and economic impacts on the human environment. This EA serves as the basis for determining whether implementation of the preferred alternative would result in a federal action significantly affecting the quality of the environment. The EA also acts as a vehicle for consultation with other government agencies and interface with the public in the decision-making process.

Other Federal Laws, Regulations, and Executive Orders

In undertaking the preferred alternative, the Service would comply with the following federal laws, Executive Orders (EOs), and legislative acts: Intergovernmental Review of Federal Programs (EO 12372); Archaeological Resources Protection Act of 1979, as amended; Fish and Wildlife Act of 1956; Fish and Wildlife Conservation Act of 1980 (16 USC 661-667e); Fish and Wildlife Improvement Act of 1978; Endangered Species Act of 1973 (16 USC 1531 et seq.); National Environmental Policy Act of 1969; Federal Noxious Weed Act of 1990; National Historic Preservation Act of 1966, as amended; National Wildlife Refuge System Improvement Act of 1997; Antiquities Act of 1906; Protection and Enhancement of the Cultural Environment (EO 11593); Archaeological and Historic Preservation Act of 1974 (PL 93-291; 88 STAT 174; 16 USC 469); Environmental Justice (EO 12898); Management and General Public Use of the National Wildlife Refuge System (EO 12996); Refuge Recreation Act of 1962, as amended; Invasive Species (EO 13112); Migratory Bird Treaty Act of 1918, as amended (MBTA); and Responsibilities of Federal Agencies to Protect Migratory Birds (EO 13186).

Distribution and Availability

The draft CCP and EA has been sent to various agencies, organizations, community groups, and individuals for review and comment. Copies of this EA are available from the San Francisco Bay National Wildlife Refuge Complex, 1 Marshlands Road, Newark, CA, 94536 (phone 510/792 0222).

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Appendix E. Southeast Farallon Island Plant List (Surveys between 1997-2001)

Scientific Name

**Agrostis sp.*
Amaranthus deflexus
**Amsinckia spectabilis*
**Anagallis arvensis*
**Anagallis arvensis f. caerulea*
Apium graveolens
**Arnaranthus sp.*
Aster chileonis
Atriplex sp. (hortensis?)
**Avena fatua*
Baccharis pilularis
Brassica oleracea
**Bromus diandrus*
Bromus carinatus var. *maritimus*
Bromus maritimus
**Cakile maritime*
Calandrinia ciliate
Cerastium viscosum
**Chenopodium murale*
**Chenopodium sp.*
Cirsium vulgare
Claytonia perfoliata
**Coprosma repens*
**Coronopus didymus*
**Cotula australis*
Crassula connata
Crassula erecta
**Cupressus macrocarpa*
Cymbalaria murale
**Cynodon dactylon*
**Cyperus sp.*
Daucus Carota
**Digitaria sanginalis*
Erigeron glaucous
**Erodium cicutarium*
**Erodium moschatum*
**Geranium molle*
Gnaphalium luteo-album
Grindelia nana var. incarnatum
Heliotropium curassavicum
**Hordeum leporinum*
**Hulkus linatus*
Hypochoeris glabra
Juncus bufonius
Lasthenia maritime
Lasthenia minor
**Lavatera arborea*
Leontodon leysseri
**Lolium multiflorum*
Lycopersicum esulentum
**Malva parviflora*
Medicago hispida
Melica imperfecta
**Meliolotus indicus*
Melilotus sp.
Mesembrianthemum chilense
Montia hallii
Oxalis corniculata
Oxalis suksdorfi
Phyllospadix torreyi
**Pinus radiata*
Plagyobothrys reticulatus
**Plantago coronopus*
**Poa annua*
**Polycarpon tetraphyllum*
**Polygonum arenastrum*
**Polypogon monspeliensis*
Portulaca oleracea
Psilocarphus tenellus
Raphanus sativus
**Rumex acetosella*
**Rumex crispus*
Sagina occidentalis
**Senecio vulgaris*
**Sisymbrium orientale*
Solanum furcatum
**Sonchus asper*
**Sonchus oleraceus*
Spergularia macrotheca
Spergularia marina
**Spergularia media*
**Stellaria media*
**Tetragonia tetragonioides*
Trifolium fucatum
Trifolium incarnatum
Trifolium variegatum
**Urtica urens*
**Vulpia bromoides*
**Vulpia myuros*
**Zantedeschia aethiopica*

*introduced species
Source: Farallon Plant Notes Excerpted from SEFI Journals 1981-2001 (compiled by Malcolm Coulter)

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Appendix F. Special-Status Species on the Refuge

Common and/or Scientific Name	Legal Status: Federal/BCC[1]/State
Ashy storm-petrel *Oceanodroma homochroa*	-/X/SC[3]
Tufted puffin *Fratercula cirrhata*	-/-/SC
Rhinoceros auklet *Cerorhinca monocerta*	-/-/SC
Cassin's auklet *Ptychoramphus aleuticus*	-/X/SC
Double-crested cormorant *Phalacrocorax auritus*	-/-/SC
Northern fur seal *Callorhinus ursinus*	Protected under the Marine Mammal Protection Act
Stellar sea lion *Eumetopius jubatus*	Threatened and protected under the Marine Mammal Protection Act /-/-
Northern elephant seal	Protected under the Marine Mammal Protection Act /-/Threatened

[1]USFWS Birds of Conservation Concern
[3]Species of Concern

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Appendix G. Summary for 385 Migratory Bird Species Recorded from 1968 to 1999.

Table 1 Occurrence and Seasonal Distribution of Birds on Southeast Farallon Island

Species	Spring					Fall				Winter	
	Total	Seasonal Total	Date Range	Mean ± S.D.	High Count and Date	Seasonal Total	Date Range	Mean ± S.D.	High Count and Date	Total	Residents
Red-throated Loon	115	32	7 Mar–11 Jul	21 Apr ±36	4 30 Mar 69	72	1 Aug–19 Dec	2 Nov ±27	6 1 Nov 75	11	0
Gavia stellata											
Pacific Loon	53,790	8850	1 Mar–14 Jul	23 Apr ±17	1853 24 Apr 81	39,022	17 Jul–19 Dec	11 Nov ±11	4000 15 Nov 83	5918	59
G. pacifica											
Common Loon	2049	238	2 Mar–13 Jul	10 May ±19	100 8 May 84	1426	18 Jul–19 Dec	3 Nov ±16	200 5 Nov 83	385	2
G. immer											
Yellow-billed Loon[a]	1	0	—	—	0	1	16 Dec	16 Dec —	1 17 Dec 97[b]	0	0
G. adamsii											
Pied-billed Grebe	13	1	14 Jul	14 Jul —	1 14 Jul 86	12	26 Aug–28 Oct	27 Sep ±21	2 29 Aug 89[b]	0	0
Podilymbus podiceps											
Horned Grebe	92	12	1 Mar–24 Mar	17 Mar ±15	4 5 Mar 77[b]	58	16 Sep–16 Dec	26 Oct ±22	6 2 Oct 96	22	7
Podiceps auritus											
Red-necked Grebe	154	30[c]	1 Mar–29 May	27 Mar ±24	3 10 Mar 85[b]	71[c]	12 Sep–19 Dec	19 Nov ±25	6 19 Dec 87	53[c]	12
P. grisegena											
Eared Grebe	14,367	3213[c]	1 Mar–23 Jun	27 Mar ±17	1100 10 Apr 77	5559[c]	17 Jul–19 Dec	20 Nov ±23	350 19 Dec 76	5595[c]	7578
P. nigricollis											
Western Grebe	418	12	7 Mar–7 Jul	3 May ±40	2 1 Jul 95[b]	388	17 Jul–12 Dec	22 Oct ±21	73 27 Oct 88	18	21
Aechmophorus occidentalis											
Clark's Grebe	47	11	19 Mar–27 Jun	28 May ±34	3 15 Jul 77	35	23 Jul–29 Nov	18 Oct ±33	4 24 Nov 99	1	0
A. clarkii											
Total W./Clark's Grebe	1039	124	1 Mar–10 Jul	7 May ±33	8 24 Mar 74	864	17 Jul–19 Dec	22 Oct ±23	74 27 Oct 88	51	32
A. occidentalis/clarkii											
Laysan Albatross	5	2	21 Mar–22 Mar	22 Mar ±1	1 22 Mar 95[b]	2	7 Dec	7 Dec —	1 7 Dec 83	1	0
Phoebastria immutabilis											
Black-footed Albatross	294	243[c]	1 Mar–5 Jul	19 Apr ±34	32 22 Mar 95	43[c]	19 Jul–18 Dec	24 Sep ±50	5 9 Sep 99	8[c]	0
P. nigripes											
Northern Fulmar	9536	1535[c]	1 Mar–28 Jun	18 Mar ±17	200 19 Apr 90	4254[c]	28 Jul–19 Dec	23 Nov ±20	990 2 Dec 90	3747[c]	0
Fulmarus glacialis											

Murphy's Petrel	1	0	—	—	0	1	27 Aug	27 Aug	1	0	0
Pterodroma ultima								—	27 Aug 90		
Pink-footed Shearwater	18,895	1184	27 Feb–	23 May	50	17,711	19 Jul–	30 Sep	1093	0	0
Puffinus creatopus			14 Jul	±28	31 May 90		18 Dec	±27	7 Nov 97		
Flesh-footed Shearwater	25	0	—	—	0	25	15 Sep–	14 Oct	3	0	0
P. carneipes							7 Nov	±18	30 Oct 98		
Buller's Shearwater	40,243	0	—	—	0	40,243	3 Aug–	6 Oct	1570	0	0
P. bulleri							1 Dec	±16	3 Oct 86		
Sooty Shearwater	5,283,793	2,259,105[c]	1 Mar–	29 May	400,000	3,024,309[c]	15 Jul–	3 Sep	220,125	379[c]	0
P. griseus			14 Jul	±22	18 Jun 74		19 Dec	±19	28 Aug 84		
Short-tailed Shearwater	477	7	1 Mar–	3 Mar	2	464	23 Aug–	12 Nov	80	6	0
P. tenuirostris			6 Mar	±2	4 Mar 91[b]		12 Dec	±21	25 Nov 98		
Manx Shearwater[a]	7	1	22 Mar	22 Mar	1	6	31 Aug–	24 Sep	1	0	0
P. puffinus				—	21 Mar 95		15 Oct	±16	3 Oct 98[b]		
Black-vented Shearwater	15,607	13	1 Mar–	14 Apr	4	15,593	19 Jul–	8 Nov	6924	1	0
P.opisthomelas			2 Jun	±40	2 Jun 92		12 Dec	±13	7 Nov 97		
Fork-tailed Storm-Petrel	1119	1065	13 Mar–	21 Mar	1000	13	27 Jul–	25 Sep	3	41	0
Oceanodroma furcata			23 Jun	±12	18 Mar 77		4 Nov	±29	14 Oct 97		
Black Storm-Petrel	45	0	—	—	0	45	22 Aug–	27 Aug	27	0	0
O. melania							28 Oct	±12	24 Aug 83		
Red-tailed Tropicbird[a]	2	1	3 Jul	3 Jul	1	1	11 Sep	11 Sep	1	0	0
Phaethon rubricauda				—	3 Jul 79			—	11 Sep 96		
Masked Booby[a]	1	0	—	—	0	1	9 Aug	9 Aug	1	0	0
Sula dactylatra								—	9 Aug 94		
Brown Booby[a]	11	2	25 May–	13 Jun	1	9	9 Aug–	25 Sep	1	0	0
S. leucogaster			1 Jul	±26	13 Jul 92[b]		1 Nov	±27	7 Nov 99[b]		
Red-footed Booby[a]	2	0	—	—	0	2	26 Aug–	19 Sep	1	0	0
S. sula							12 Oct	±33	12 Oct 75[b]		
Brown Pelican	268,004	20,542[c]	2 Mar–	11 Jun	2454	233,849[c]	15 Jul–	29 Sep	5670	13,613[c]	0
Pelecanus occidentalis			14 Jul	±28	8 Jun 88		19 Dec	±33	9 Sep 84		
Magnificent Frigatebird[d]	6	3	20 May–	13 Jun	1	3	16 Jul–	6 Sep	1	0	0
Fregata magnificens			2 Jul	±22	17 Jun 93[b]		16 Dec	±87	16 Dec 88[b]		
Great Frigatebird[a, d]	1	1	14 Mar	14 Mar	1	0	—	—	0	0	0
Fregata minor				—	14 Mar 92						

(continued)

Table 1 *(Continued)*

Species	Spring					Fall				Winter	
	Total	Seasonal Total	Date Range	Mean ± S.D.	High Count and Date	Seasonal Total	Date Range	Mean ± S.D.	High Count and Date	Total	Residents
American Bittern *Botaurus lentiginosus*	5	0	—	—	0	5	16 Sep–26 Oct	10 Oct ±16	1 16 Sep 91[b]	0	0
Great Blue Heron *Ardea herodias*	212	12[c]	3 Mar–14 Jul	11 Jun ±44	2 6 Jul 88[b]	198[c]	16 Jul–6 Dec	9 Sep ±24	6 18 Sep 92	2[c]	3
Great Egret *A. alba*	58	2	13 Jun–14 Jun	14 Jun ±1	1 13 Jun 75[b]	55	24 Jul–19 Nov	24 Sep ±31	4 14 Sep 93	1	0
Snowy Egret *Egretta thula*	45	7	27 Apr–13 Jul	16 Jun ±31	1 11 May 89[b]	38	18 Jul–19 Dec	20 Sep ±40	7 8 Oct 88	0	1
Cattle Egret *Bubulcus ibis*	104	1	18 May	18 May —	1 18 May 94	95	16 Sep–19 Dec	22 Nov ±17	21 23 Nov 84	8	6
Green Heron *Butorides virescens*	25	5	29 Apr–13 Jul	16 Jun ±30	1 14 Jun 87[b]	20	1 Aug–14 Oct	17 Sep ±17	1 22 Sep 98[b]	0	0
Black-crowned Night-Heron *Nycticorax nycticorax*	12	1	18 Mar	18 Mar —	1 18 Mar 95	10	18 Aug–12 Nov	24 Sep ±30	2 21 Oct 97[b]	1	0
White-faced Ibis *Plegadis chihi*	1	0	—	—	0	1	17 Sep	17 Sep —	1 18 Sep 99[b]	0	0
Turkey Vulture *Cathartes aura*	2	2	22 May	22 May ±0	2 22 May 79	0	—	—	0	0	0
Greater White-fronted Goose *Anser albifrons*	306	3	10 Mar–6 Jul	28 Mar ±31	2 10 Mar 80	380	20 Sep–6 Nov	10 Oct ±13	97 2 Oct 99	1	0
Emperor Goose[d] *Chen canagica*	2	0	—	—	0	0	—	—	0	2	1
Snow Goose *C. caerulescens*	146	0	—	—	0	146	15 Oct–1 Dec	5 Nov ±3	128 6 Nov 90	0	1
Ross' Goose *C. rossii*	14	0	—	—	0	14	6 Nov–11 Dec	9 Nov ±9	13 6 Nov 90	0	0
Canada Goose *Branta canadensis*	915	2	15 Mar–30 Apr	7 Apr ±33	1 30 Apr 80[b]	889	19 Sep–18 Dec	8 Nov ±11	401 4 Nov 78	24	10
Brant *B. bernicla*	16,413	1451	18 Mar–22 May	11 Apr ±22	440 22 Mar 79	14,960	2 Oct–18 Dec	7 Nov ±6	7200 4 Nov 83	2	1

Tundra Swan	11	0	—	—	0	11	11 Nov–	14 Nov	10	0	0
Cygnus columbianus							18 Dec	±11	11 Nov 78		
Wood Duck	2	0	—	—	0	2	21 Sep–	11 Oct	1	0	0
Aix sponsa							31 Oct	±20	31 Oct 95[b]		
Gadwall	8	0	—	—	0	8	14 Aug–	10 Oct	3	0	0
Anas strepera							19 Dec	±45	30 Oct 96		
Eurasian Wigeon	1	0	—	—	0	1	1 Oct	1 Oct	1	0	0
A. penelope								—	1 Oct 98		
American Wigeon	98	0	—	—	0	98	11 Sep–	15 Oct	20	0	0
A. americana							24 Nov	±15	18 Oct 99		
Mallard	101	7	31 Mar–	13 Apr	2	94	13 Aug–	24 Oct	13	0	0
A. platyrhynchos			30 Apr	±12	10 Apr 88[b]		8 Dec	±25	16 Oct 99		
Blue-winged Teal	7	0	—	—	0	7	22 Sep–	2 Oct	2	0	0
A. discors							13 Oct	±8	5 Oct 90[b]		
Cinnamon Teal	115	10[c]	1 Mar–	2 Mar	7	88	5 Sep–	24 Sep	17	17[c]	0
A. cyanoptera			2 Mar	±0	2 Mar 79		10 Nov	±12	20 Sep 91		
Northern Shoveler	56	1	27 Jun	27 Jun	1	55	14 Aug–	5 Oct	12	0	0
A. clypeata				—	27 Jun 89		14 Nov	±20	1 Oct 98		
Northern Pintail	3554	5	12 Mar–	15 Mar	3	3546	27 Jul–	22 Sep	175	3	0
A. acuta			20 Mar	±3	15 Mar 77		8 Dec	±25	19 Oct 78		
Green-winged Teal	381	0	—	—	0	380	14 Aug–	13 Oct	39	1	0
A. crecca							17 Dec	±25	13 Oct 87		
Canvasback	2	0	—	—	0	2	24 Oct–	11 Nov	1	0	0
Aythya valisineria							28 Nov	±25	24 Oct 88[b]		
Ring-necked Duck	1	0	—	—	0	1	7 Oct	7 Oct	1	0	0
A. collaris								—	8 Oct 87[b]		
Greater Scaup	128	1	24 Apr	24 Apr	1	125	19 Sep–	22 Oct	18	2	0
A. marila				—	24 Apr 93		11 Dec	±14	27 Oct 88		
Lesser Scaup	13	0	—	—	0	13	29 Sep–	25 Oct	6	0	0
A. affinis							8 Nov	±14	30 Oct 89		
Harlequin Duck	23	3	25 Mar–	22 Apr	2	11	23 Jul–	6 Oct	2	9	5
Histrionicus histrionicus			20 May	±28	24 Apr 81[b]		19 Dec	±52	2 Dec 78		
Surf Scoter	5405	2245	2 Mar–	4 Apr	200	2406[c]	16 Jul–	12 Nov	233	754	474
Melanitta perspicillata			5 Jul	±21	21 Apr 82[b]		19 Dec	±20	13 Nov 89		

(continued)

Table 1 *(Continued)*

Species	Spring					Fall				Winter	
	Total	Seasonal Total	Date Range	Mean ± S.D.	High Count and Date	Seasonal Total	Date Range	Mean ± S.D.	High Count and Date	Total	Residents
White-winged Scoter *M. fusca*	469	188	1 Mar–6 Jul	5 Apr ±20	33 9 Apr 85	197	14 Sep–19 Dec	7 Nov ±19	35 30 Oct 71	84	28
Black Scoter *M. nigra*	25	2	7 Mar–23 Mar	15 Mar ±11	1 23 Mar 95[b]	13	9 Oct–9 Dec	5 Nov ±27	5 9 Oct 85	10	0
Long-tailed Duck *Clangula hyemalis*	31	5[c]	2 Mar–10 Mar	8 Mar ±3	2 10 Mar 81[b]	14[c]	16 Oct–11 Dec	16 Nov ±24	3 20 Nov 80[b]	12[c]	0
Bufflehead *Bucephala albeola*	8	6	2 Apr–7 Apr	6 Apr ±2	5 7 Apr 82	2	13 Nov–17 Dec	30 Nov ±24	1 13 Nov 89[b]	0	0
Common Goldeneye[d] *B. clangula*	19	5	12 Apr–6 Jun	7 May ±22	2 15 May 70	2	7 Dec–17 Dec	12 Dec ±7	2 17 Dec 78	12	2
Barrow's Goldeneye[d] *B. islandica*	1	0	—	—	0	0	—	—	0	1	0
Red-breasted Merganser *Mergus serrator*	388	53[c]	4 Mar–17 May	28 Mar ±19	6 18 Mar 86[b]	193[c]	16 Oct–19 Dec	24 Nov ±14	10 23 Nov 73	142[c]	112
Ruddy Duck *Oxyura jamaicensis*	29	1	11 Apr	11 Apr —	1 11 Apr 97	26	27 Sep–7 Dec	25 Oct ±18	15 25 Oct 70	2	0
Osprey *Pandion haliaetus*	51	7	29 Mar–31 May	6 May ±23	1 27 Apr 92[b]	44	23 Jul–20 Nov	19 Sep ±22	2 24 Sep 89	0	0
White-tailed Kite *Elanus leucurus*	23	0	—	—	0	23	11 Sep–8 Dec	12 Oct ±20	2 19 Sep 99[b]	0	0
Bald Eagle *Haliaeetus leucocephalus*	7	0	—	—	0	5	1 Oct–22 Nov	30 Oct ±24	1 10 Oct 98[b]	2	0
Northern Harrier *Circus cyaneus*	237	1	6 Apr	6 Apr —	1 6 Apr 82	236	27 Jul–13 Dec	20 Oct ±25	6 6 Oct 94[b]	0	0
Sharp-shinned Hawk *Accipiter striatus*	333	0	—	—	0	331	11 Sep–29 Nov	8 Oct ±19	13 18 Sep 88	2	0
Cooper's Hawk *A. cooperii*	28	0	—	—	0	28	12 Sep–22 Oct	1 Oct ±8	3 29 Sep 74	0	0
Red-tailed Hawk *Buteo jamaicensis*	16	4	6 Apr–22 May	21 Apr ±21	1 14 Apr 99[b]	10	24 Sep–12 Dec	2 Nov ±21	1 7 Nov 97[b]	2	3

Rough-legged Hawk *B. lagopus*	49	0	—	—	0	47	28 Sep– 11 Dec	9 Nov ±17	12 27 Oct 73	2	4
Golden Eagle *Aquila chrysaetos*	1	0	—	—	0	1	28 Oct	28 Oct —	1 28 Oct 71	0	0
American Kestrel[d] *Falco sparverius*	475	4	8 Mar– 26 Jun	25 May ±52	2 14 Mar 89[b]	460	24 Jul– 15 Dec	8 Oct ±26	5 1 Oct 98[b]	11	32
Merlin *F. columbarius*	246	0	—	—	0	246	7 Sep– 24 Nov	10 Oct ±18	5 30 Sep 98	0	0
Peregrine Falcon[d] *F. peregrinus*	531	75	1 Mar– 29 Jun	20 Apr ±28	4 29 Mar 95[b]	428	22 Jul– 18 Dec	14 Oct ±26	6 7 Oct 97[b]	28	103
Prairie Falcon *F. mexicanus*	1	0	—	—	0	1	23 Sep	23 Sep —	1 23 Sep 80	0	0
Virginia Rail *Rallus limicola*	8	0	—	—	0	8	11 Aug– 21 Sep	30 Aug ±12	2 26 Aug 87	0	0
Sora *Poranza carolina*	24	3	28 Mar– 30 Jun	18 May ±48	1 28 Mar 90[b]	21	21 Jul– 15 Oct	11 Sep ±21	2 15 Oct 82	0	0
Common Moorhen *Gallinula chloropus*	3	2	13 May– 6 Jun	25 May ±17	1 22 May 89[b]	1	—	—	0	0	0
American Coot *Fulica americana*	18	2	11 May– 12 May	12 May ±1	1 12 May 81[b]	16	11 Aug– 27 Oct	30 Sep ±17	2 29 Sep 96[b]	0	0
Black-bellied Plover *Pluvialis squatarola*	1156	62	1 Mar– 11 May	30 Mar ±16	11 14 Mar 80[b]	1068	17 Jul– 15 Dec	25 Sep ±35	42 26 Oct 81	26	365
American Golden-Plover[e] *P. dominica*	5	0	—	—	0	5	5 Sep– 17 Sep	13 Sep ±5	2 17 Sep 91[b]	0	0
Pacific Golden-Plover[e] *P. fulva*	32	0	—	—	0	32	17 Sep– 2 Dec	11 Oct ±18	8 5 Oct 91	0	1
Total Lesser Golden-Plover[e] *P. dominica/fulva*	161	3	28 Apr– 28 May	8 May ±17	1 28 May 80[b]	157	8 Aug– 9 Dec	7 Oct ±23	14 17 Oct 89	1	1
Snowy Plover *Charadrius alexandrinus*	4	0	—	—	0	4	27 Aug– 5 Oct	17 Sep ±16	1 22 Sep 91[b]	0	0
Semipalmated Plover *C. semipalmatus*	300	0	—	—	0	300	21 Jul– 28 Oct	31 Aug ±14	30 26 Aug 75	0	0
Killdeer[d] *C. vociferus*	578	18	16 Mar– 16 Jun	14 May ±26	2 4 May 80[b]	488	12 Jul– 19 Dec	19 Oct ±30	27 26 Oct 88	72	23

(continued)

Table 1 *(Continued)*

Species	Spring					Fall				Winter	
	Total	Seasonal Total	Date Range	Mean ± S.D.	High Count and Date	Seasonal Total	Date Range	Mean ± S.D.	High Count and Date	Total	Residents
Eurasian Dotterel[a] *C. morinellus*	2	0	—	—	0	2	12 Sep–15 Sep	14 Sep ±2	1 15 Sep 89[b]	0	0
Black-necked Stilt *Himantopus mexicanus*	4	0	—	—	0	2	23 Jun	23 Jun ±0	2 23 Jun 99	2	0
American Avocet *Recurvirostra americana*	6	0	—	—	0	5	28 Jul–29 Nov	19 Aug ±73	2 29 Nov 95	1	0
Greater Yellowlegs *Tringa melanoleuca*	87	1	29 Apr	29 Apr —	1 29 Apr 68	86	5 Jul–2 Dec	22 Sep ±25	5 20 Sep 91	0	0
Lesser Yellowlegs *T. flavipes*	63	1	3 May	3 May —	1 3 May 71	62	27 Sep	10 July–21 Aug ±19	6 16 Aug 87	0	0
Solitary Sandpiper *T. solitaria*	1	0	—	—	0	1	7 Sep	7 Sep —	1 7 Sep 89	0	0
Willet *Catoptrophorus semipalmatus*	934	31	22 Mar–20 Jun	9 May ±25	23 6 Mar 83	896	15 Dec	21 Jun–2 Sep ±37	27 20 Oct 77	7	528
Wandering Tattler *Heteroscelus incanus*	1744	336	2 Mar–16 Jun	1 May ±20	21 19 May 76[b]	1393	23 Jun–10 Dec	1 Sep ±33	56 17 Aug 89	15	375
Spotted Sandpiper *Actitis macularia*	158	12	20 Apr–14 Jun	14 May ±14	1 25 Mar 94[b]	146	23 Jul–15 Nov	6 Sep ±20	4 4 Sep 89[b]	0	2
Upland Sandpiper[a] *Bartramia longicauda*	2	0	—	—	0	2	22 Aug–27 Aug	25 Aug ±4	1 27 Aug 89[b]	0	0
Whimbrel *Numenius phaeopus*	1437	276	7 Mar–19 Jun	13 May ±16	90 19 May 91	1153	24 Jun–13 Dec	29 Aug ±29	131 27 Aug 83	8	345
Long-billed Curlew *N. americanus*	7	0	—	—	0	7	28 Jun–23 Nov	20 Aug ±52	1 30 Sep 96[b]	0	0
Bar-tailed Godwit[a] *Limosa lapponica*	1	0	—	—	0	1	11 Sep	11 Sep —	1 11 Sep 99	0	0
Marbled Godwit *Limosa fedoa*	560	9	16 Mar–1 Jun	3 May ±28	2 1 Jun 92[b]	551	28 Jun–27 Nov	4 Sep ±22	27 14 Aug 75	0	0
Ruddy Turnstone *Arenaria interpres*	438	49	13 Mar–5 Jun	2 May ±21	12 6 Mar 87	373	2 Jul–19 Dec	13 Sep ±35	25 16 Dec 87	16	90

Black Turnstone	3851	139	1 Mar–	18 Apr	71	3459	21 Jun–	17 Sep	106	253	1824
A. melanocephala			10 Jun	±29	5 Mar 85		15 Dec	±35	25 Sep 75		
Surfbird	261	21	21 Mar–	20 Apr	5	226	17 Jul–	2 Sep	19	14	19
Aphriza virgata			2 May	±9	21 Apr 90[b]		19 Dec	±30	8 Aug 68		
Red Knot	6	0	—	—	0	6	7 Sep–	17 Sep	1	0	0
Calidris canutus							3 Oct	±10	15 Sep 91[b]		
Sanderling	195	3	23 Mar–	25 Mar	2	189	6 Jul–	12 Sep	14	3	0
C. alba			29 Mar	±3	23 Mar 90		14 Dec	±31	17 Sep 75		
Semipalmated Sandpiper[e]	12	0	—	—	0	12	3 Aug–	18 Aug	2	0	0
C. pusilla							16 Sep	±10	20 Aug 77		
Western Sandpiper	976	0	—	—	0	970	5 Jul–	31 Aug	96	6	0
C. mauri							14 Dec	±18	17 Aug 89		
Least Sandpiper	508	9	6 Mar–	31 Mar	6	496	10 Jul–	2 Sep	24	3	0
C. minutilla			10 May	±18	31 Mar 90		15 Dec	±21	16 Aug 97		
Baird's Sandpiper	286	1	11 May	11 May	1	285	10 Jul–	26 Aug	16	0	0
C. bairdii				—	11 May 69		11 Oct	±14	16 Aug 87		
Pectoral Sandpiper	362	1	4 May	4 May	1	361	27 Jul–	20 Sep	60	0	0
C. melanotos				—	4 May 68		23 Oct	±12	20 Sep 91		
Sharp-tailed Sandpiper[e]	6	0	—	—	0	6	2 Sep–	29 Sep	1	0	0
C. acuminata							7 Nov	±27	17 Sep 96[b]		
Rock Sandpiper	18	0	—	—	2	16	19 Oct–	10 Nov	2	2	12
C. ptilocnemis					3 Apr 80[b]		5 Dec	±14	18 Dec 79[b]		
Dunlin	174	1	20 May	20 May	1	172	14 Sep–	13 Oct	70	1	2
C. alpina				—	20 May 71		9 Dec	±11	14 Oct 87		
Buff-breasted Sandpiper	7	0	—	—	0	7	15 Aug–	30 Aug	2	0	0
Tryngites subruficollis							8 Sep	±8	29 Aug 78		
Ruff	1	0	—	—	0	1	15 Oct	15 Oct	1	0	0
Philomachus pugnax								—	15 Oct 93		
Short-billed Dowitcher	1002	13	6 Apr–	3 Jun	11	989	2 Jul–	24 Aug	150	0	0
Limnodromus griseus			13 Jun	±24	13 Jun 93		19 Oct	±20	4 Sep 85		
Long-billed Dowitcher	367	2	11 May–	13 May	1	364	18 Jul–	1 Oct	41	1	0
L. scolopaceus			15 May	±3	15 May 90[b]		10 Dec	±25	22 Sep 86		
Wilson's Snipe	148	6	3 Apr–	6 May	1	141	18 Jul–	11 Oct	4	1	0
Gallinago delicata			28 May	±19	9 May 89[b]		12 Dec	±27	27 Oct 88		

(continued)

Table 1 *(Continued)*

Species	Spring					Fall				Winter	
	Total	Seasonal Total	Date Range	Mean ± S.D.	High Count and Date	Seasonal Total	Date Range	Mean ± S.D.	High Count and Date	Total	Residents
Wilson's Phalarope	3	0	—	—	0	3	20 Jul–17 Aug	1 Aug ±14	1 17 Aug 88[b]	0	0
Phalaropus tricolor											
Red-necked Phalarope	179,227	31,174	12 Apr–12 Jun	9 May ±12	6300 30 Apr 82	148,053	19 Jul–28 Nov	1 Sep ±18	19,500 22 Aug 68	0	0
P. lobatus											
Red Phalarope	262,901	21,682	5 Mar–12 Jun	15 May ±13	3500 8 May 96	240,734	14 Jul–19 Dec	18 Sep ±33	30,000 4 Sep 94	485	0
P. fulicarius											
South Polar Skua	24	0	—	—	0	24	26 Aug–31 Oct	7 Oct ±15	2 3 Oct 99	0	0
Stercorarius maccormicki											
Pomarine Jaeger	773	7	1 Mar–27 Apr	25 Mar ±29	2 1 Mar 90	764	3 Aug–10 Dec	8 Oct ±20	26 5 Nov 97	2	0
S. pomarinus											
Parasitic Jaeger	229	1	9 Jun	9 Jun —	1 9 Jun 95	227	20 Aug–22 Nov	30 Sep ±19	18 2 Oct 97	1	0
S. parasiticus											
Long-tailed Jaeger	14	1	29 Apr	29 Apr —	1 29 Apr 71	13	24 Aug–23 Oct	7 Sep ±41	1 11 Oct 99[b]	0	0
S. longicaudus											
Laughing Gull	2	1	2 Jun	2 Jun —	1 3 Jun 88[b]	1	3 Aug	3 Aug —	1 3 Aug 77	0	0
Larus atricilla											
Franklin's Gull	2	1	19 May	19 May —	1 19 May 91	1	4 Sep	4 Sep —	1 4 Sep 83	0	0
L. pipixcan											
Bonaparte's Gull	40,139	37,516	2 Mar–28 May	24 Apr ±6	30,000 26 Apr 70	2597	28 Sep–19 Dec	6 Nov ±9	475 27 Oct 91	26	0
L. philadelphia											
Heerman's Gull	17,789	288	2 Mar–14 Jul	15 Apr ±65	40 20 Jun 97	17,249	15 Jul–19 Dec	2 Oct ±30	820 9 Aug 83	252	42
L. heermanni											
Mew Gull	968	43	1 Mar–9 May	17 Mar ±14	3 24 Mar 85[b]	725	31 Aug–19 Dec	8 Nov ±19	50 14 Oct 70	200	18
L. canus											
Ring-billed Gull	160	20	3 Mar–14 Jul	22 Apr ±49	1 18 Apr 93[b]	127	30 Jul–15 Dec	18 Oct ±31	6 5 Oct 68[b]	13	0
L. delawarensis											
California Gull	53,725	1189	1 Mar–14 Jul	2 Apr ±25	250 27 Mar 90	51,376	16 Jul–19 Dec	26 Oct ±31	2500 7 Nov 97	1160	3
L. californicus											

Herring Gull	9763	2187[c,f]	1 Mar–	19 Mar	125	3171[c]	19 Aug–	21 Nov	120	4405[c]	563
L. argentatus			12 Jul	±14	4 Mar 77		19 Dec	±20	7 Dec 96		
Thayer's Gull	470	90[c]	1 Mar–	19 Mar	8	222[c]	2 Jul–	18 Nov	8	158[c]	2
L. thayeri			30 May	±15	10 Mar 91		19 Dec	±20	31 Oct 85		
Glaucous-winged Gull	17,395	4012[c,f]	1 Mar–	18 Mar	350	4670[c]	20 Jul–	30 Nov	440	8713[c]	1796
L. glaucescens			4 Jul	±14	13 Mar 94		19 Dec	±23	18 Dec 79		
Glaucous Gull	59	18[c]	2 Mar–	20 Mar	3	10[c]	24 Oct–	20 Nov	1	31[c]	4
L. hyperboreus			6 May	±18	8 Mar 97[b]		15 Dec	±17	21 Nov 98[b]		
Sabine's Gull	1939	16	26 Mar–	14 May	10	1923	20 Aug–	13 Sep	600	0	0
Xema sabini			16 Jun	±18	18 May 77		11 Nov	±12	22 Sep 96		
Black-legged Kittiwake	28,168	22,903	1 Mar–	16 Mar	4000	1315	16 Aug–	12 Nov	450	3950	0
Rissa tridactyla			1 Jun	±11	4 Mar 76		19 Dec	±12	19 Nov 70		
Caspian Tern	33	8	26 May–	16 Jun	2	25	15 Jul–	27 Aug	3	0	0
Sterna caspia			9 Jul	±16	13 Jun 89[b]		10 Oct	±26	17 Jul 83[b]		
Elegant Tern	2933	0	—	—	0	2933	2 Aug–	27 Sep	671	0	0
S. elegans							14 Nov	±16	28 Sep 97		
Common Tern	12	0	—	—	0	12	31 Aug–	13 Sep	1	0	0
S. hirundo							28 Sep	±9	5 Sep 99[b]		
Arctic Tern	13,978	1	24 May	24 May	1	13,977	23 Aug–	6 Sep	7500	0	0
S. paradisaea				—	24 May 92		9 Oct	±9	31 Aug 93		
Forster's Tern	1	0	—	—	0	1	28 Oct	28 Oct	1	0	0
S. forsteri								—	28 Oct 86		
Thick-billed Murre[a]	2	0	—	—	0	2	31 Oct	1 Nov	1	0	0
Uria lomvia							1 Nov	±1	1 Nov 94		
Marbled Murrelet	3	0	—	—	0	3	11 Oct–	9 Nov	2	0	0
Brachyrampus marmoratus							24 Nov	±25	24 Nov 99		
Xantus's Murrelet	22	5	7 Mar–	18 Apr	2	17	17 Jul–	31 Aug	2	0	0
Synthliboramphus hypoleucus			12 May	±31	12 May 91		16 Dec	±42	20 Jul 99[b]		
Craveri's Murrelet	26	0	—	—	0	26	7 Sep–	13 Oct	10	0	0
S. craveri							15 Nov	±15	13 Oct 98		
Ancient Murrelet	692	59[c]	1 Mar–	27 Mar	10	241[c]	16 Jul–	22 Nov	30	392[c]	41
S. antiquus			10 Jun	±25	2 Mar 96		19 Dec	±30	11 Dec 75		
Horned Puffin[a]	27	16	7 Mar–	6 May	4	7	26 Sep–	19 Oct	2	4	0
Fratercula corniculata			22 Jun	±40	29 Mar 90		2 Nov	±19	25 Oct 75		

(continued)

Table 1 *(Continued)*

Species	Spring					Fall				Winter	
	Total	Seasonal Total	Date Range	Mean ± S.D.	High Count and Date	Seasonal Total	Date Range	Mean ± S.D.	High Count and Date	Total	Residents
Rock Dove	183	89	2 Mar–14 Jul	10 May ±31	3 15 May 77[b]	85	15 Jul–16 Dec	29 Sep ±32	12 14 Sep 75	9	0
Columba livia											
Band-tailed Pigeon	373	157	24 Mar–14 Jul	27 May ±29	6 7 Jul 70[b]	214	15 Jul–11 Dec	17 Sep ±37	4 21 Oct 72	2	0
C. fasciata											
White-winged Dove	19	0	—	—	0	19	20 Jul–24 Nov	29 Sep ±28	1 7 Oct 98[b]	0	0
Zenaida asiatica											
Mourning Dove	871	192	29 Mar–14 Jul	17 May ±21	14 29 Apr 68	675	17 Jul–8 Dec	16 Sep ±23	20 3 Sep 72	4	0
Z. macroura											
Black-billed Cuckoo[a]	2	0	—	—	0	2	26 Aug–18 Oct	22 Sep ±38	1 26 Aug 87[b]	0	0
Coccyzus erythropthalmus											
Yellow-billed Cuckoo	23	10	14 Jun–7 Jul	23 Jun ±9	1 15 Jun 97[b]	13	21 Jul–7 Nov	31 Aug ±32	1 10 Oct 96[b]	0	0
C. americanus											
Barn Owl	15	1	13 Jul	13 Jul —	1 13 Jul 73	14	3 Aug–27 Oct	28 Sep ±27	5 27 Oct 99	0	4
Tyto alba											
Great Horned Owl	1	0	—	—	0	1	21 Nov	21 Nov —	1 21 Nov 70	0	0
Bubo virginianus											
Burrowing Owl	304	30	2 Mar–20 May	4 Apr ±20	6 10 Mar 97	268	28 Aug–17 Dec	9 Oct ±21	10 12 Oct 89[b]	6	72
Athene cunicularia											
Long-eared Owl	57	5[f]	6 Mar–14 Jul	31 May ±53	1 6 Mar 95[b]	52	17 Jul–26 Nov	15 Sep ±37	3 5 Aug 74[b]	0	0
Asio otus											
Short-eared Owl	261	4	16 Apr–5 Jul	3 Jun ±35	1 16 Apr 88[b]	249	16 Jul–7 Dec	13 Oct ±18	17 27 Oct 88	8	4
A. flammeus											
Northern Saw-whet Owl	20	0	—	—	0	18	20 Sep–21 Nov	27 Oct ±16	2 19 Nov 87[b]	2	0
Aegolius acadicus											
Lesser Nighthawk	52	44	18 May–14 Jul	14 Jun ±17	2 30 Jun 80[b]	8	19 Jul–9 Sep	10 Aug ±20	1 24 Jul 91[b]	0	0
Chordeiles acutipennis											
Common Nighthawk	4	2	2 Jun–16 Jun	9 Jun ±10	1 2 Jun 99[b]	2	8 Sep	8 Sep ±0	1 8 Sep 87[b]	0	0
C. minor											
Common Poorwill	8	0	—	—	0	8	9 Sep–31 Oct	11 Oct ±18	1 29 Oct 93	0	0
Phalaenoptilus nuttallii											

Black Swift *Cypseloides niger*	20	7	16 May– 8 Jul	11 Jun ±15	3 11 Jun 75	13	1 Aug– 9 Oct	3 Sep ±21	2 9 Aug 89[b]	0	0
Chimney Swift *Chaetura pelagica*	24	11	26 May– 9 Jul	10 Jun ±11	4 11 Jun 75	13	8 Sep– 2 Oct	21 Sep ±8	2 16 Sep 99[b]	0	0
Vaux's Swift *C. vauxi*	1412	14	16 Apr– 7 Jul	25 May ±23	3 22 May 83[b]	1398	21 Jul– 27 Oct	27 Sep ±8	102 23 Sep 85	0	0
White-throated Swift *Aeronautes saxatalis*	19	14	6 Apr– 25 May	14 May ±19	10 25 May 99	5	15 Aug– 26 Oct	8 Oct ±30	1 26 Oct 97[b]	0	0
Ruby-throated Hummingbird[a] *Archilochus colubris*	4	0	—	—	0	4	21 Aug– 12 Sep	1 Sep ±10	1 7 Sep 94[b]	0	0
Black-chinned Hummingbird *A. alexandri*	5	0	—	—	0	5	28 Aug– 27 Oct	16 Sep ±24	1 9 Sep 99[b]	0	0
Anna's Hummingbird *Calypte anna*	582	45	1 Mar– 14 Jun	25 Apr ±30	2 24 Mar 74[b]	518	21 Jul– 10 Dec	14 Oct ±22	7 9 Oct 89	19	0
Costa's Hummingbird *C. costae*	21	16	26 Mar– 13 Jul	12 May ±30	2 28 May 85	5	13 Aug– 11 Oct	16 Sep ±31	1 8 Oct 90[b]	0	0
Calliope Hummingbird *Stellula calliope*	10	8	5 Apr– 8 May	23 Apr ±14	1 13 Apr 88[b]	2	16 Sep- 5 Oct	26 Sep ±13	1 25 Sep 99[b]	0	0
Rufous Hummingbird *Selasphorus rufus*	496	291[f]	15 Feb– 4 Jun	11 Apr ±16	50 13 Apr 78[b]	205[f]	19 Jul– 11 Nov	26 Aug ±17	10 26 Aug 87[b]	0[f]	0
Allen's Hummingbird *S. sasin*	92	74[f]	5 Feb– 11 Jul	3 May ±38	3 8 May 95[b]	18[f]	23 Jul– 12 Sep	7 Aug ±12	3 3 Aug 87	0[f]	0
Total Rufous/Allen's Hummingbird *S. rufus/sasin*	681	407[f]	5 Feb– 13 Jul	17 Apr ±25	51 13 Apr 78[b]	274[f]	19 Jul– 11 Nov	24 Aug ±17	10 26 Aug 87[b]	0[f]	0
Belted Kingfisher *Ceryle alcyon*	143	23	2 Mar– 11 Jul	4 May ±40	2 14 Apr 77	116	17 Jul– 1 Dec	9 Sep ±29	4 15 Sep 74	4	24
Lewis' Woodpecker *Melanerpes lewis*	8	5	29 Apr– 8 May	4 May ±5	2 8 May 77[b]	3	6 Sep– 27 Sep	19 Sep ±9	1 12 Sep 95[b]	0	0
Acorn Woodpecker *M. formicivorus*	14	0	—	—	0	13	24 Aug– 25 Nov	4 Oct ±28	2 12 Sep 89[b]	1	0
Yellow-bellied Sapsucker *Sphyrapicus varius*	2	0	—	—	0	2	18 Oct– 29 Oct	24 Oct ±8	1 29 Oct 95[b]	0	0
Red-naped Sapsucker *S. nuchalis*	5	1	18 Jun	18 Jun —	1 20 Jun 74[b]	4	13 Sep– 13 Oct	29 Sep ±12	1 13 Sep 94[b]	0	0

(continued)

Table 1 *(Continued)*

Species	Spring					Fall				Winter	
	Total	Seasonal Total	Date Range	Mean ± S.D.	High Count and Date	Seasonal Total	Date Range	Mean ± S.D.	High Count and Date	Total	Residents
Red-breasted Sapsucker	21	2	25 Mar–	7 Apr	1	19	27 Sep–	8 Oct	4	0	0
S. ruber			19 Apr	±18	19 Apr 81[b]		2 Nov	±9	2 Oct 68[b]		
Northern Flicker	604	90	1 Mar–	6 Apr	8	502	5 Aug–	16 Oct	18	12	32
Colaptes auratus			6 Jun	±17	4 Apr 73		18 Dec	±19	3 Oct 86		
Yellow-shafted Flicker	70	7	23 Mar–	13 Apr	3	62	13 Sep–	15 Oct	5	1	1
C. a. luteus			22 May	±20	5 Apr 84		27 Nov	±17	8 Oct 72		
Yellow × Red-shafted Flicker intergrade	59	5	26 Mar–	7 Apr	2	54	26 Sep–	16 Oct	3	0	3
			23 Apr	±12	26 Mar 82		5 Dec	±15	8 Oct 86[b]		
Red-shafted Flicker	371	65	8 Mar–	7 Apr	7	297	5 Aug–	17 Oct	14	9	28
C. a. cafer subspecies group			6 Jun	±17	4 Apr 73		18 Dec	±20	5 Oct 72		
Olive-sided Flycatcher	185	104	22 Apr–	22 May	10	81	16 Jul–	8 Sep	8	0	0
Contopus cooperi			27 Jun	±13	27 May 70[b]		27 Oct	±16	6 Sep 85		
Western Wood-Pewee	1695	1138	20 Apr–	29 May	80	557	15 Jul–	11 Sep	60	0	0
C. sordidulus			12 Jul	±12	28 May 83		19 Nov	±14	6 Sep 85		
Eastern Wood-Pewee[a]	2	1	15 Jun	15 Jun	1	1	5 Sep	5 Sep	1	0	0
C. virens				—	15 Jun 75			—	5 Sep 98		
Yellow-bellied Flycatcher[a]	6	0	—	—	0	6	25 Aug–	10 Sep	1	0	0
Empidonax flaviventris							27 Sep	±11	10 Sep 97[b]		
Alder Flycatcher[a]	2	0	—	—	0	2	27 Aug–	30 Aug	1	0	0
E. alnorum							2 Sep	±4	27 Aug 88[b]		
Willow Flycatcher	414	124	22 Apr–	2 Jun	20	290	20 Jul–	11 Sep	6	0	0
E. traillii			12 Jul	±14	5 Jun 69		29 Oct	±14	25 Aug 87[b]		
Least Flycatcher[e]	116	7	17 May–	5 Jun	1	109	17 Aug–	23 Sep	4	0	0
E. minimus			8 Jul	±16	17 May 85[b]		22 Nov	±17	26 Sep 76		
Hammond's Flycatcher	158	116	25 Mar–	8 May	12	42	1 Aug–	25 Sep	3	0	0
E. hammondii			17 Jun	±15	9 May 77		28 Oct	±16	4 Oct 86[b]		
Gray Flycatcher	99	84	18 Apr–	4 May	7	15	24 Aug–	13 Sep	2	0	0
E. wrightii			26 May	±10	21 Apr 77		14 Oct	±14	6 Sep 85		
Dusky Flycatcher	110	80	14 Apr–	9 May	8	30	1 Aug–	17 Sep	1	0	0
E. oberholseri			9 Jul	±15	9 May 69		21 Oct	±17	10 Sep 99[b]		

Western Flycatcher	1277	305	19 Mar–	20 May	50	972	15 Jul–	12 Sep	65	0	0
E. difficilis/occidentalis			14 Jul	±24	5 Jun 69[b]		14 Nov	±14	15 Sep 93		
Black Phoebe	413	15	4 Mar–	2 Apr	7	377	21 Jul–	10 Oct	10	21	68
Sayornis nigricans			17 May	±24	2 Mar 87[b]		18 Dec	±22	31 Oct 96[b]		
Eastern Phoebe	23	4	18 May–	29 May	1	19	24 Sep–	3 Nov	1	0	0
S. phoebe			6 Jun	±8	2 Jun 91[b]		21 Nov	±15	29 Oct 99[b]		
Say's Phoebe	263	12[f]	22 Feb–	1 Apr	2	251	22 Jul–	24 Sep	10	0[f]	4
S. saya			14 May	±26	22 Feb 84		3 Nov	±13	29 Sep 68		
Ash-throated Flycatcher	214	77	16 Apr–	2 Jun	6	136	16 Jul–	31 Aug	7	1	0
Myiarchus cinerascens			10 Jul	±17	12 Jun 75		20 Nov	±25	16 Aug 87		
Great-crested Flycatcher[a]	10	0	—	—	0	10	5 Sep–	29 Sep	1	0	0
M. crinitus							13 Oct	±11	30 Sep 96[b]		
Brown-crested Flycatcher	1	0	—	—	0	1	17 Sep	17 Sep	1	0	0
M. tyrannulus								—	18 Sep 83[b]		
Tropical Kingbird	14	1	6 Jun	6 Jun	1	13	7 Aug–	7 Oct	1	0	0
Tyrannus melancholicus				—	7 Jun 91[b]		18 Nov	±29	23 Sep 95[b]		
Cassin's Kingbird	2	1	6 Jun	6 Jun	1	1	25 Aug	25 Aug	1	0	0
T. vociferans				—	7 Jun 91[b]			—	25 Aug 83		
Western Kingbird	192	69	19 Mar–	5 May	11	123	15 Jul–	6 Sep	5	0	0
T. verticalis			14 Jul	±28	29 Mar 86		20 Oct	±21	19 Oct 69		
Eastern Kingbird	42	14	12 May–	9 Jun	2	28	19 Jul–	3 Sep	2	0	0
T. tyrannus			9 Jul	±17	22 May 92[b]		28 Sep	±16	3 Sep 89		
Scissor-tailed Flycatcher[a]	3	2	18 May–	23 May	1	1	30 Sep	30 Sep	1	0	0
T. forficatus			27 May	±6	30 May 99[b]			—	30 Sep 85		
Brown Shrike[a]	1	0	—	—	0	1	20 Sep	20 Sep	1	0	0
Lanius cristatus								—	22 Sep 84[b]		
Loggerhead Shrike	14	6	3 Apr–	28 Apr	1	8	26 Jul–	24 Aug	1	0	1
L. ludovicianus			24 May	±17	6 May 90[b]		11 Sep	±15	10 Sep 98[b]		
Northern Shrike	2	0	—	—	0	2	18 Oct–	24 Oct	1	0	0
L. excubitor							29 Oct	±8	21 Oct 93[b]		
White-eyed Vireo[a]	2	1	4 Jun	4 Jun	1	1	28 Oct	28 Oct	1	0	0
Vireo griseus				—	5 Jun 69[b]			—	28 Oct 92		
Bell's Vireo[d]	2	0	—	—	0	2	15 Sep–	17 Sep	1	0	0
V.bellii							18 Sep	±2	19 Sep 93[b]		

(continued)

Table 1 *(Continued)*

Species	Spring					Fall				Winter	
	Total	Seasonal Total	Date Range	Mean ± S.D.	High Count and Date	Seasonal Total	Date Range	Mean ± S.D.	High Count and Date	Total	Residents
Yellow-throated Vireo[a]	1	1	12 Jun	12 Jun	1	0	—	—	0	0	0
V. flavifrons				—	13 Jun 69[b]						
Plumbeous Vireo	1	0	—	—	0	1	15 Sep	15 Sep	1	0	0
V. plumbeus								—	15 Sep 92		
Cassin's Vireo	180	57	19 Mar–	22 Apr	5	123	4 Aug–	8 Sep	7	0	0
V. cassinii			5 Jul	±22	21 Apr 87		22 Oct	±18	22 Aug 70		
Blue-headed Vireo[a]	31	0	—	—	0	31	9 Sep–	30 Sep	2	0	0
V. solitarius							2 Nov	±15	27 Sep 96[b]		
Total Solitary Vireo	213	57	19 Mar–	22 Apr	5	156	4 Aug–	13 Sep	7	0	0
V. solitarius/cassinii/plumbeus			5 Jul	±22	21 Apr 87		2 Nov	±19	22 Aug 70		
Hutton's Vireo	55	14[f]	23 Feb–	19 Apr	2	41	18 Jul–	23 Sep	2	0[f]	0
V. huttoni			20 May	±23	16 Apr 83		8 Nov	±28	8 Nov 81		
Warbling Vireo	804	184	11 Mar–	10 May	15	620	21 Jul–	13 Sep	25	0	0
V. gilvus			10 Jul	±18	9 May 90		20 Nov	±14	11 Sep 77		
Philadelphia Vireo[a]	13	2	6 Jun–	9 Jun	1	11	11 Sep–	29 Sep	1	0	0
V. philadelphicus			12 Jun	±4	6 Jun 89[b]		9 Nov	±19	19 Sep 95[b]		
Red-eyed Vireo	89	55	5 May–	9 Jun	3	34	18 Jul–	12 Sep	2	0	0
V. olivaceus			2 Jul	±10	14 Jun 98		6 Oct	±17	12 Sep 95[b]		
Yellow-green Vireo[a]	6	0	—	—	0	6	29 Sep–	19 Oct	1	0	0
V. flavoviridis							30 Oct	±11	17 Oct 94[b]		
Clark's Nutcracker	4	0	—	—	0	4	28 Sep–	10 Oct	1	0	0
Nucifraga columbiana							27 Oct	±12	12 Oct 86[b]		
Common Raven	2	1	18 Apr	18 Apr	1	1	4 Oct	4 Oct	1	0	0
Corvus corax				—	18 Apr 72			—	1 Oct 95		
Horned Lark	153	10	1 Mar–	21 Apr	2	143	13 Sep–	23 Oct	16	0	0
Eremophila alpestris			21 Jun	±45	6 Mar 78[b]		19 Dec	±16	16 Oct 81		
Purple Martin	43	6	28 May–	10 Jun	1	37	11 Aug–	5 Sep	4	0	0
Progne subis			17 Jun	±8	10 Jun 77[b]		4 Oct	±11	3 Sep 96[b]		
Tree Swallow	164	94[f]	8 Feb–	4 Apr	11	70	20 Jul–	6 Oct	7	0[f]	0
Tachycineta bicolor			8 Jul	±32	27 Mar 82[b]		8 Dec	±30	26 Oct 98		

Violet-green Swallow	1054	69[d,f]	3 Feb–	13 Apr	10	985	20 Jul–	7 Oct	100	0[f]	0
T. thalassina			11 Jul	±35	25 May 99		18 Dec	±13	4 Oct 81		
Northern Rough-winged Swallow	282	27[f]	9 Mar–	21 May	4	255	19 Jul–	31 Aug	15	0	0
Stelgidopteryx serripennis			19 Jun	±25	12 Jun 74		4 Oct	±14	8 Sep 72		
Bank Swallow	48	14	3 May–	20 May	2	34	17 Aug–	23 Sep	12	0	0
Riparia riparia			15 Jun	±12	17 May 84[b]		27 Oct	±26	19 Oct 98		
Cliff Swallow	163	23	14 Apr–	20 May	3	140	17 Jul–	17 Sep	10	0	0
Petrochelidon pyrrhonota			22 Jun	±20	9 May 76[b]		8 Nov	±24	14 Aug 97		
Barn Swallow	809	232	5 Apr–	18 May	20	577	21 Jul–	20 Sep	49	0	0
Hirundo rustica			8 Jul	±19	25 May 99		12 Nov	±18	28 Sep 98		
Red-breasted Nuthatch	1103	34	12 Apr–	22 May	3	1069	16 Jul–	26 Sep	75	0	0
Sitta canadensis			8 Jul	±21	7 May 78		6 Dec	±20	15 Sep 69		
White-breasted Nuthatch	2	1	15 May	15 May	1	1	10 Oct	10 Oct	1	0	0
S. carolinensis				—	15 May 79			—	10 Oct 69[b]		
Pygmy Nuthatch	1	0	—	—	0	1	6 Aug	6 Aug	1	0	0
S. pygmaea								—	6 Aug 69		
Brown Creeper	143	2	14 Apr–	14 May	1	141	27 Sep–	26 Oct	8	0	0
Certhia americana			13 Jun	±42	18 Apr 78[b]		24 Nov	±9	19 Oct 86[b]		
Rock Wren[d]	263	29	4 Mar–	25 Apr	9	233	19 Aug–	2 Oct	12	1	74
Salpinctes obsoletus			26 Jun	±29	13 Jun 71		26 Nov	±19	11 Nov 72[b]		
Bewick's Wren	3	0	—	—	0	3	2 Oct–	16 Oct	1	0	1
Thryomanes bewickii							2 Nov	±16	19 Dec 81[b]		
House Wren	184	41	11 Mar–	2 May	2	143	15 Jul–	13 Sep	3	0	3
Troglodytes aedon			13 Jul	±35	25 Mar 92		30 Oct	±22	28 Sep 94[b]		
Winter Wren	185	23	7 Mar–	14 Apr	2	157	25 Jul–	26 Sep	3	5	2
T. troglodytes			20 Jun	±27	16 Apr 99		1 Dec	±22	21 Oct 72		
Marsh Wren	33	3	1 Apr–	16 May	1	30	15 Aug–	28 Sep	2	0	0
Cistothorus palustris			8 Jun	±39	8 Jun 92[b]		4 Nov	±19	3 Oct 96[b]		
Golden-crowned Kinglet	1192	101	27 Feb–	31 Mar	18	1091	17 Sep–	16 Oct	40	0	0
Regulus satrapa			27 Jun	±19	16 Mar 74		14 Dec	±13	6 Oct 93[b]		
Ruby-crowned Kinglet	4422	1472	7 Mar–	13 Apr	225	2939	26 Jul–	11 Oct	200	11	7
R. calendula			30 Jun	±16	16 Apr 83		19 Dec	±14	30 Oct 91[b]		
Lanceolated Warbler[a,d]	1	0	—	—	0	1	11 Sep	11 Sep	1	0	0
Locustella lanceolata								—	12 Sep 95[b]		

(continued)

Table 1 *(Continued)*

Species	Spring					Fall				Winter	
	Total	Seasonal Total	Date Range	Mean ± S.D.	High Count and Date	Seasonal Total	Date Range	Mean ± S.D.	High Count and Date	Total	Residents
Dusky Warbler[a] *Phylloscopus fuscatus*	2	0	—	—	0	2	27 Sep–14 Oct	6 Oct ±10	1 14 Oct 87[b]	0	0
Blue-gray Gnatcatcher *Polioptlia caerulea*	28	8	19 Mar–2 May	9 Apr ±17	2 9 Apr 92[b]	20	13 Aug–6 Nov	17 Sep ±19	1 5 Oct 99[b]	0	0
Red-flanked Bluetail[a] *Tarsiger cyanurus*	1	0	—	—	0	1	1 Nov	1 Nov —	1 1 Nov 89	0	0
Northern Wheatear[a] *Oenanthe oenanthe*	3	1	11 Jun	11 Jun —	1 11 Jun 71	2	26 Sep–6 Nov	17 Oct ±29	1 26 Sep 92[b]	0	0
Western Bluebird *Sialia mexicana*	2	1	1 Apr	1 Apr —	1 2 Apr 88[b]	1	14 Oct	14 Oct —	1 15 Oct 87[b]	0	0
Mountain Bluebird *S. currucoides*	20	4	3 Apr–16 Jun	30 Apr ±33	1 13 Apr 75[b]	15	12 Oct–26 Nov	2 Nov ±12	3 15 Nov 86	1	0
Townsend's Solitaire[e] *Myadestes townsendi*	28	4	12 Apr–5 Jun	6 May ±23	1 9 May 94[b]	19	11 Sep–3 Nov	10 Oct ±16	2 30 Sep 98[b]	5	0
Veery[a] *Catharus fuscescens*	3	1	28 May	28 May —	1 28 May 81	2	26 Sep–20 Oct	8 Oct ±17	1 29 Sep 85[b]	0	0
Gray-cheeked Thrush[a] *C. minimus*	13	2	28 May–11 Jun	4 Jun ±10	1 11 Jun 75[b]	11	10 Sep–17 Oct	26 Sep ±11	2 3 Oct 70	0	0
Swainson's Thrush *C. ustulatus*	1752	198	17 Apr–12 Jul	24 May ±13	35 28 May 71	1554	26 Aug–29 Nov	24 Sep ±11	60 22 Sep 93[b]	0	0
Hermit Thrush *C. guttatus*	2694	480	1 Mar–2 Jul	25 Apr ±20	25 11 May 71[b]	2149	1 Sep–18 Dec	9 Oct ±16	350 2 Oct 72	65	21
American Robin *Turdus migratorius*	1561	270	1 Mar–27 Jun	1 Apr ±22	40 4 Apr 73	829[f]	21 Jul–19 Dec	15 Nov ±22	74 23 Nov 96	462	10
Varied Thrush *Ixoreus naevius*	686	156	2 Mar–15 Jun	9 Apr ±24	22 4 Apr 73	490	24 Sep–19 Dec	2 Nov ±20	30 20 Oct 72	40	1
Gray Catbird[a] *Dumetella carolinensis*	12	3	29 May–24 Jun	15 Jun ±15	1 23 Jun 91[b]	9	25 Sep–31 Oct	12 Oct ±14	2 2 Oct 94	0	0
Northern Mockingbird *Mimus polyglottos*	225	60	3 Apr–10 Jul	1 Jun ±27	2 21 Jun 82[b]	164	15 Jul–23 Nov	8 Sep ±31	4 10 Aug 74	1	0

Sage Thrasher	70	11	19 Apr–	24 May	1	58	12 Aug–	4 Oct	3	1	0
Oreoscoptes montanus			23 Jun	±20	10 May 94[b]		13 Nov	±19	3 Oct 84		
Brown Thrasher	23	9	1 May–	3 Jun	1	14	22 Sep–	17 Oct	2	0	1
Toxostoma rufum			2 Jul	±19	3 Jun 98[b]		10 Nov	±14	9 Oct 74		
Bendire's Thrasher	6	4	17 Apr–	4 Jun	1	2	21 Aug–	27 Aug	1	0	0
T. bendirei			14 Jul	±40	6 Jul 92[b]		2 Sep	±8	22 Aug 76[b]		
European Starling[d]	59,577	178	1 Mar–	11 Apr	140	56,134	15 Jul–	7 Nov	3000	3265	3150
Sturnus vulgaris			14 Jul	±43	8 Mar 76		19 Dec	±19	14 Dec 96		
Yellow Wagtail[a]	2	0	—	—	0	2	12 Sep–	17 Sep	1	0	0
Motacilla flava							21 Sep	±6	12 Sep 99[b]		
White Wagtail[a]	1	0	—	—	0	1	10 Oct	10 Oct	1	0	0
M. alba								—	10 Oct 74		
Olive-backed Pipit[a,d]	1	0	—	—	0	1	26 Sep	26 Sep	1	0	0
Anthus hodgsoni								—	29 Sep 98[b]		
Red-throated Pipit[e]	31	0	—	—	0	31	20 Sep–	8 Oct	3	0	0
A. cervinus							3 Nov	±12	5 Oct 91		
American Pipit	4125	23[f]	5 Mar–	28 Apr	2	4098	6 Sep–	20 Oct	110	4	0
A. rubescens			3 Jul	±20	25 Apr 89[b]		19 Dec	±16	27 Oct 88		
Sprague's Pipit[a]	3	0	—	—	0	3	1 Oct–	9 Oct	1	0	0
A. spragueii							16 Oct	±8	16 Oct 87[b]		
Bohemian Waxwing	1	0	—	—	0	1	28 Nov	28 Nov	1	0	0
Bombycilla garrulus								—	28 Nov 68		
Cedar Waxwing	1245	112	4 May–	28 May	10	1120	16 Jul–	10 Oct	75	13	0
B. cedrorum			20 Jun	±9	30 May 82		19 Dec	±23	24 Oct 88		
Phainopepla	5	0	—	—	0	5	1 Sep–	14 Sep	1	0	0
Phainopepla nitens							26 Sep	±10	22 Sep 97[b]		
Blue-winged Warbler[a]	1	1	24 May	24 May	1	0	—	—	0	0	0
Vermivora pinus				—	25 May 92[b]						
Golden-winged Warbler[a]	6	3	3 Jun–	19 Jun	1	3	2 Sep–	15 Sep	1	0	0
V. chrysoptera			5 Jul	±16	3 Jun 91[b]		29 Sep	±14	30 Sep 98[b]		
Brewster's Warbler[a]	1	1	6 Jun	6 Jun	1	0	—	—	0	0	0
V. pinus × chrysoptera				—	6 Jun 91						
Tennessee Warbler	346	151	22 Apr–	1 Jun	10	195	18 Aug–	1 Oct	7	0	0
V. peregrina			17 Jul	±23	26 May 82		16 Dec	±23	12 Sep 77		

(continued)

Table 1 *(Continued)*

Species	Spring					Fall				Winter	
	Total	Seasonal Total	Date Range	Mean ± S.D.	High Count and Date	Seasonal Total	Date Range	Mean ± S.D.	High Count and Date	Total	Residents
Orange-crowned Warbler	1915	1228[f]	19 Feb–28 Apr	175		687[f]	16 Jul–21 Sep	18		0[f]	3
V. celata			7 Jul	±18	30 Apr 71		23 Dec	±23	2 Oct 84		
Nashville Warbler	361	63	9 Apr–10 May	3		298	31 Jul–6 Oct	4		0	0
V. ruficapilla			23 Jun	±18	28 Apr 68		11 Dec	±25	2 Oct 96[b]		
Virginia's Warbler	40	6	13 May–26 May	2		34	16 Aug–21 Sep	3		0	0
V. virginiae			17 Jun	±13	13 May 75		2 Nov	±16	1 Oct 68		
Lucy's Warbler	7	0	—	—	0	7	5 Sep–23 Oct	1		0	0
V. luciae							20 Nov	±28	27 Nov 99[b]		
Northern Parula[e]	41	34	29 Apr–3 Jun	3		7	9 Sep–22 Sep	1		0	0
Parula americana			6 Jul	±16	12 Jun 85[b]		6 Oct	±12	10 Sep 88[b]		
Yellow Warbler	2586	454	14 Apr–21 May	60		2132	16 Jul–12 Sep	46		0	0
Dendroica petechia			27 Jun	±12	17 May 85		13 Nov	±14	10 Sep 95		
Chestnut-sided Warbler[e]	224	42	1 May–8 Jun	3		182	2 Sep–22 Sep	7		0	0
D. pensylvanica			7 Jul	±12	24 May 92[b]		3 Nov	±11	24 Sep 76		
Magnolia Warbler[e]	279	115	12 May–9 Jun	8		164	22 Aug–26 Sep	4		0	0
D. magnolia			4 Jul	±9	12 Jun 75[b]		9 Nov	±16	7 Sep 86		
Cape May Warbler[e]	60	29	26 May–12 Jun	3		31	9 Sep–29 Sep	2		0	0
D. tigrina			30 Jun	±9	19 Jun 77[b]		31 Oct	±14	22 Sep 79[b]		
Black-throated Blue Warbler[e]	105	0	—	—	0	105	4 Sep–10 Oct	3		0	0
D. caerulescens							9 Nov	±12	14 Oct 87[b]		
Yellow-rumped Warbler	8071	1925[f]	1 Mar–17 Apr	295		5709[f]	15 Jul–19 Oct	185		437	77
D. coronata			13 Jul	±19	30 Apr 71		19 Dec	±18	30 Sep 98		
Audubon's Warbler	4547	1592	1 Mar–16 Apr	250		2810[f]	15 Jul–14 Oct	175		145	26
D. c. auduboni subspecies group			13 Jul	±17	30 Apr 71		19 Dec	±18	30 Sep 98		
Audubon's × Myrtle intergrade	86	11	25 Mar–11 Apr	4		72	7 Sep–17 Oct	3		3	1
			8 May	±16	26 Mar 69		3 Dec	±18	24 Oct 88		
Myrtle Warbler	3106	267[f]	1 Mar–30 Apr	45		2688	7 Sep–23 Oct	130		151	44
D. c. coronata subspecies group			18 Jul	±23	30 Apr 71		19 Dec	±16	24 Oct 88		
Black-throated Gray Warbler	487	56	22 Mar–21 May	6		431	26 Jul–20 Sep	12		0	1
D. nigrescens			3 Jun	±17	21 Apr 82		30 Nov	±19	18 Sep 94[b]		

Golden-cheeked Warbler[a]	1	0	—	—	0	1	9 Sep	9 Sep	1	0	0
D. chrysoparia								—	9 Sep 71		
Black-throated Green Warbler[e]	40	19	9 May–	3 Jun	3	21	3 Sep–	12 Oct	1	0	0
D. virens			18 Jun	±13	24 May 83		23 Nov	±24	17 Nov 97[b]		
Townsend's Warbler	2078	878	28 Mar–	11 May	75	1198	3 Aug–	17 Sep	30	2	1
D. townsendi			13 Jun	±11	8 May 69		22 Dec	±21	3 Sep 96		
Townsend's × Hermit Warbler	3	1	17 Apr	17 Apr	1	2	24 Sep–	26 Sep	1	0	0
D. townsendi × occidentalis				—	17 Apr 74		28 Sep	±3	29 Sep 90[b]		
Hermit Warbler	335	72	15 Apr–	8 May	5	263[f]	21 Jul–	31 Aug	8	0	0
D. occidentalis			27 May	±9	10 May 90		20 Nov	±19	9 Aug 73[b]		
Blackburnian Warbler[e]	91	6	31 May–	13 Jun	1	85	31 Aug–	29 Sep	3	0	0
D. fusca			9 Jul	±14	12 Jun 89[b]		30 Oct	±16	25 Sep 76		
Yellow-throated Warbler[a]	5	3	2 May–	4 Jun	1	2	16 Sep–	4 Oct	1	0	0
D. dominica			8 Jul	±34	7 May 80[b]		21 Oct	±25	21 Oct 86[b]		
Pine Warbler[a,d]	3	0	—	—	0	3	16 Oct–	28 Oct	1	0	0
D. pinus							18 Nov	±18	19 Nov 87[b]		
Prairie Warbler[e]	58	0	—	—	0	58	13 Aug–	20 Sep	3	0	0
D. discolor							22 Nov	±23	15 Sep 91[b]		
Palm Warbler	1481	37	14 Apr–	2 Jun	4	1444	31 Aug–	17 Oct	47	0	7
D. palmarum			3 Jul	±21	1 Jul 80		11 Dec	±16	9 Oct 93		
Bay-breasted Warbler[e]	64	31	23 May–	10 Jun	2	33[f]	22 Jul–	27 Sep	3	0	0
D. castanea			29 Jun	±10	21 Jun 82[b]		25 Oct	±16	15 Sep 93		
Blackpoll Warbler	698	57	6 May–	11 Jun	2	641[f]	22 Jul–	22 Sep	23	0	0
D. striata			12 Jul	±17	10 Jul 93[b]		16 Nov	±12	27 Sep 74		
Cerulean Warbler[a]	1	0	—	—	0	1	23 Oct	23 Oct	1	0	0
D. cerulea								—	24 Oct 81[b]		
Black-and-white Warbler	126	63	18 Apr–	1 Jun	5	63	11 Aug–	18 Sep	2	0	0
Mniotilta varia			9 Jul	±17	6 Jun 75		11 Nov	±16	18 Sep 94[b]		
American Redstart	527	89	5 May–	11 Jun	3	438	4 Aug–	19 Sep	15	0	0
Setophaga ruticilla			7 Jul	±11	6 Jun 92[b]		8 Nov	±14	15 Sep 75		
Prothonotary Warbler[a]	2	0	—	—	0	2	12 Sep–	3 Oct	1	0	0
Protonotaria citrea							23 Oct	±29	23 Oct 89[b]		
Worm-eating Warbler[a]	11	8	7 May–	3 Jun	1	3	21 Sep–	6 Oct	1	0	0
Helmitheros vermivorus			20 Jun	±13	7 Jun 92[b]		16 Oct	±13	24 Sep 94[b]		

(continued)

Table 1 *(Continued)*

Species	Spring					Fall				Winter	
	Total	Seasonal Total	Date Range	Mean ± S.D.	High Count and Date	Seasonal Total	Date Range	Mean ± S.D.	High Count and Date	Total	Residents
Ovenbird[e]	337	200	9 May–21 Jul	12 Jun ±12	6 16 Jun 88	137	19 Aug–8 Nov	22 Sep ±14	4 17 Sep 99[b]	0	0
Seiurus aurocapillus											
Northern Waterthrush	90	6	20 May–27 Jun	6 Jun ±14	1 23 May 91[b]	84	26 Jul–27 Oct	12 Sep ±17	2 10 Sep 95[b]	0	0
S. noveboracensis											
Louisiana Waterthrush[a]	1	0	—	—	0	1	2 Jun	2 Jun —	1 3 Jun 91[b]	0	0
S. motacilla											
Kentucky Warbler[a]	22	17[a,f]	4 May–14 Jul	2 Jun ±20	3 16 May 92[b]	5	27 Jul–1 Oct	7 Sep ±25	1 27 Jul 95[b]	0	0
Oporornis formosus											
Connecticut Warbler[a]	47	3	16 Jun–19 Jun	18 Jun ±2	1 16 Jun 90[b]	44	1 Sep–18 Oct	22 Sep ±11	3 23 Sep 74	0	0
O. agilis											
Mourning Warbler[a]	54	7	3 Jun–30 Jun	13 Jun ±9	1 13 Jun 98[b]	47	27 Aug–20 Oct	17 Sep ±13	3 8 Sep 89[b]	0	0
O. philadelphia											
MacGillivray's Warbler	432	91	6 Apr–23 Jun	16 May ±12	10 9 May 69[b]	341	23 Jul–20 Oct	5 Sep ±16	6 10 Sep 95[d]	0	0
O. tolmiei											
Common Yellowthroat	1373	536[f]	27 Feb–14 Jul	17 May ±29	16 19 Mar 92	837	15 Jul–17 Nov	22 Sep ±15	16 25 Sep 94[b]	0[f]	0
Geothlypis trichas											
Hooded Warbler[e]	29	24	5 May–1 Jul	1 Jun ±15	3 7 May 92	5	1 Sep–11 Oct	27 Sep ±15	1 11 Oct 89[b]	0	0
Wilsonia citrina											
Wilson's Warbler	4403	3226	18 Mar–28 Jun	13 May ±11	500 8 May 69	1177	13 Jul–5 Nov	3 Sep ±17	35 10 Sep 95	0	0
W. pusilla											
Canada Warbler[e]	51	15	24 May–29 Jun	11 Jun ±9	1 12 Jun 98[b]	36	8 Aug–26 Oct	17 Sep ±18	2 12 Sep 99[b]	0	0
W. canadensis											
Red-faced Warbler[a]	1	0	—	—	0	1	25 Aug	25 Aug —	1 25 Aug 92	0	0
Cardellina rubrifrons											
Yellow-breasted Chat	90	34	14 Apr–22 Jun	12 May ±14	2 20 May 76[b]	56	12 Aug–25 Oct	13 Sep ±16	3 26 Aug 97[b]	0	0
Icteria virens											
Hepatic Tanager[e]	2	1	22 May	22 May —	1 22 May 77	1	11 Nov	11 Nov —	1 11 Nov 79	0	0
Piranga flava											
Summer Tanager	29	17	15 May–14 Jul	8 Jun ±17	2 14 Jul 92	12	24 Sep–31 Oct	20 Oct ±11	1 22 Oct 98[b]	0	0
P. rubra											

Scarlet Tanager[a]	6	1	18 Jun	18 Jun	1	5	29 Sep–	27 Oct	1	0	0
P. olivacea				—	22 Jun 80[b]		26 Nov	±21	24 Oct 91[b]		
Western Tanager	713	214	15 Apr–	18 May	30	499	18 Jul–	10 Sep	12	0	0
P. ludoviciana			8 Jul	±13	8 May 69		25 Nov	±17	8 Sep 72		
Green-tailed Towhee	31	8	3 May–	23 May	1	23	24 Aug–	19 Sep	1	0	0
Pipilo chlorurus			26 Jun	±19	13 May 92[b]		11 Nov	±20	8 Nov 99[b]		
Spotted Towhee	582	37[f]	23 Feb–	15 Apr	4	545	29 Aug–	6 Oct	125	0[f]	0
P. maculatus			13 Jun	±23	4 Apr 73		20 Dec	±12	4 Oct 72[b]		
Cassin's Sparrow[a]	11	4	2 Jun–	18 Jun	1	7	13 Sep–	26 Sep	2	0	0
Aimophila cassinii			11 Jul	±17	6 Jul 82[b]		15 Oct	±11	30 Sep 85[b]		
Rufous-crowned Sparrow	1	0	—	—	0	1	29 Nov	29 Nov	1	0	1
A. ruficeps								—	31 Dec 99[b]		
American Tree Sparrow	76	17	28 Mar–	20 May	2	58	28 Sep–	25 Oct	3	1	0
Spizella arborea			28 Jun	±27	24 May 77		28 Nov	±16	21 Oct 83[b]		
Chipping Sparrow	1920	298	16 Mar–	10 May	55	1621	15 Jul–	18 Sep	50	1	0
S. passerina			13 Jul	±20	30 Apr 71		30 Nov	±21	2 Oct 72		
Chipping × Clay-col. Sparrow[d]	1	0	—	—	0	1	13 Sep	13 Sep	1	0	0
S. passerina × pallida								—	16 Sep 91[b]		
Chipping × Brewer's Sparrow[d]	1	0	—	—	0	1	26 Oct	26 Oct	1	0	0
S. passerina × breweri								—	28 Oct 88[b]		
Clay-colored Sparrow[e]	547	43	29 Apr–	30 May	3	504	15 Aug–	30 Sep	10	0	1
S. pallida			22 Jun	±13	31 May 75		8 Dec	±19	28 Sep 89		
Brewer's Sparrow	186	38	21 Apr–	26 May	2	148	22 Jul–	18 Sep	8	0	0
S. breweri			10 Jul	±17	21 May 78		15 Nov	±21	29 Sep 74[b]		
Field Sparrow[a]	1	1	17 Jun	17 Jun	1	0	—	—	0	0	0
S. pusilla				—	9 Jul 69[b]						
Black-chinned Sparrow	3	1	7 May	7 May	1	2	30 Aug–	6 Sep	1	0	0
S. atrogularis				—	7 May 94		13 Sep	±10	13 Sep 93[b]		
Vesper Sparrow	330	25	4 Apr–	23 May	1	305	21 Jul–	28 Sep	7	0	0
Pooecetes gramineus			23 Jun	±19	16 Jun 95[b]		18 Nov	±16	6 Oct 72		
Lark Sparrow	315	30	9 Mar–	23 Apr	2	284	29 Jul–	15 Sep	8	1	0
Chondestes grammacus			28 Jun	±26	9 Apr 82[b]		13 Dec	±21	1 Oct 74		
Black-throated Sparrow	32	8	17 Apr–	20 May	2	24	18 Aug–	14 Sep	2	0	0
Amphispiza bilineata			18 Jun	±19	22 May 77		10 Oct	±14	8 Sep 84		

(continued)

Table 1 *(Continued)*

Species	Spring					Fall				Winter	
	Total	Seasonal Total	Date Range	Mean ± S.D.	High Count and Date	Seasonal Total	Date Range	Mean ± S.D.	High Count and Date	Total	Residents
Sage Sparrow *A. belli*	8	5	24 Mar– 22 Apr	9 Apr ±11	1 22 Apr 82[b]	3	18 Aug– 25 Oct	24 Sep ±34	1 1 Oct 81[b]	0	0
Lark Bunting *Calamospiza melanocorys*	72	1	24 May	24 May —	1 24 May 77	71	5 Aug– 20 Oct	13 Sep ±14	3 18 Sep 93[b]	0	0
Savannah Sparrow *Passerculus sandwichensis*	7993	215[f]	22 Feb– 19 Jun	22 Apr ±25	15 4 Apr 73	7778[f]	16 Jul– 23 Dec	29 Sep ±14	1500 29 Sep 68	0[f]	1
Grasshopper Sparrow *Ammodramus savannarum*	145	26	25 Mar– 2 Jul	27 May ±22	1 7 May 92[b]	119	20 Jul– 29 Nov	6 Oct ±23	4 27 Sep 96[b]	0	0
Baird's Sparrow[a] *A. bairdii*	2	0	—	—	0	2	7 Sep– 28 Sep	18 Sep ±15	1 7 Sep 91[b]	0	0
Le Conte's Sparrow[a,d] *A. leconteii*	8	0	—	—	0	8	11 Sep– 27 Oct	1 Oct ±16	1 27 Oct 95[b]	0	0
Nelson's Sharp-tailed Sparrow *A. nelsoni*	2	0	—	—	0	2	4 Oct– 27 Oct	16 Oct ±16	1 4 Oct 98[b]	0	0
Fox Sparrow *Passerella iliaca*	2483	110	3 Mar– 26 May	18 Apr ±16	6 2 Mar 99[b]	2354	2 Sep– 17 Dec	5 Oct ±17	225 18 Sep 93	19	58
Song Sparrow *Melospiza melodia*	79	21[f]	29 Feb– 26 Jun	18 Apr ±28	2 1 Apr 90	58	7 Sep– 13 Dec	10 Oct ±20	5 2 Oct 84	0[f]	4
Lincoln's Sparrow *M. lincolnii*	2304	531[f]	23 Feb– 16 Jun	19 Apr ±15	40 21 Apr 87	1773	2 Sep– 4 Dec	29 Sep ±12	450 3 Oct 72	0[f]	0
Swamp Sparrow *M. georgiana*	95	6	21 Apr– 25 Jun	22 May ±29	1 2 Jun 86[b]	89	20 Sep– 16 Nov	17 Oct ±12	5 15 Oct 87	0	0
White-throated Sparrow *Zonotrichia albicollis*	312	11	22 Apr– 10 Jul	27 May ±26	1 14 Jun 98[b]	301	8 Sep– 17 Dec	20 Oct ±15	7 15 Oct 87	0	0
Harris' Sparrow *Z. querula*	21	2	2 May– 16 May	9 May ±10	1 2 May 73[b]	19	17 Oct– 4 Dec	5 Nov ±14	2 25 Oct 77[b]	0	0
White-crowned Sparrow[d] *Z. leucophrys*	10,642	1389	4 Mar– 1 Jul	19 Apr ±13	75 18 Apr 88	9229	15 Jul– 19 Dec	6 Oct ±12	3000 3 Oct 72	24	26

White-cr. × Golden-cr. Sparrow *Z. leucophrys* × *atricapilla*	2	0	—	—	0	2	2 Oct– 13 Oct	8 Oct ±8	1 16 Oct 87[b]	0	0
Golden-crowned Sparrow *Z. atricapilla*	10,599	495	7 Mar– 12 Jun	27 Apr ±12	65 1 May 71	10,081	11 Sep– 19 Dec	7 Oct ±12	3500 2 Oct 72	23	100
Dark-eyed Junco[d] *Junco hyemalis*	4950	1356	2 Mar– 8 Jul	5 Apr ±16	420 4 Apr 73	3554	25 Jul– 19 Dec	15 Oct ±16	700 3 Oct 72[b]	40	3
Oregon Junco[d] *J. h. oreganus* subspecies group	4825	1319[e]	2 Mar– 8 Jul	5 Apr ±16	420 4 Apr 73	3466	25 Jul– 19 Dec	15 Oct ±15	700 3 Oct 72[b]	40	3
Slate-colored Junco *J. h. hyemalis* subspecies group	125	37	1 Mar– 14 Jun	1 May ±26	2 2 May 90[b]	88	24 Sep– 18 Dec	24 Oct ±18	3 15 Oct 87[b]	0	0
Lapland Longspur *Calcarius lapponicus*	552	5	4 May– 24 Jun	31 May ±22	1 5 May 87[b]	547	20 Jul– 9 Dec	16 Oct ±17	16 28 Oct 91	0	0
Chestnut-collared Longspur[e] *C. ornatus*	61	3	18 May– 16 Jul	20 Jun ±30	1 18 May 80[b]	58	20 Sep– 3 Dec	18 Oct ±14	7 14 Oct 87	0	0
Snow Bunting[a] *Plectrophenax nivalis*	25	0	—	—	0	25	22 Oct– 18 Nov	31 Oct ±8	4 28 Oct 91	0	0
Rose-breasted Grosbeak[e] *Pheucticus ludovicianus*	274	169	13 May– 14 Jul	8 Jun ±12	6 9 Jun 77[b]	105	17 Jul– 13 Nov	20 Sep ±22	3 19 Sep 93[b]	0	0
Rose-br. × Black-hd. Grosbeak *P. ludovicianus* × *melanocephalus*	4	1	8 Jun	8 Jun —	1 8 Jun 70	3	18 Sep– 21 Oct	2 Oct ±17	1 21 Oct 88	0	0
Black-headed Grosbeak *P. melanocephalus*	315	137	2 Apr– 14 Jul	12 May ±18	10 9 May 69[b]	178	16 Jul– 20 Nov	4 Sep ±20	4 9 Sep 80	0	0
Blue Grosbeak *Passerina caerulea*	72	11	9 May– 18 Jun	27 May ±14	1 10 Jun 94[b]	61	14 Aug– 6 Oct	7 Sep ±13	2 21 Sep 99[b]	0	0
Lazuli Bunting *P. amoena*	369	78	6 Apr– 12 Jul	16 May ±19	5 9 May 90	291	22 Jul– 8 Nov	8 Sep ±16	20 18 Sep 71	0	0
Indigo Bunting[e] *P. cyanea*	141	93	7 May– 14 Jul	8 Jun ±15	6 20 Jun 82	48	18 Jul– 13 Dec	13 Sep ±42	2 3 Sep 86	0	0
Painted Bunting[a] *P. ciris*	8	0	—	—	0	8	10 Sep– 21 Oct	25 Sep ±13	1 21 Oct 97[b]	0	0
Dickcissel *Spiza americana*	30	14	13 May– 7 Jul	4 Jun ±16	1 7 Jul 91[b]	16	24 Aug– 14 Oct	17 Sep ±17	2 3 Sep 88[b]	0	0
Bobolink *Dolichonyx oryzivorus*	216	13	24 May– 4 Jul	10 Jun ±14	1 30 Jun 95[b]	203	16 Aug– 15 Nov	22 Sep ±13	6 24 Sep 74[b]	0	0

(continued)

Table 1 *(Continued)*

Species	Spring					Fall				Winter	
	Total	Seasonal Total	Date Range	Mean ± S.D.	High Count and Date	Seasonal Total	Date Range	Mean ± S.D.	High Count and Date	Total	Residents
Red-winged Blackbird *Agelaius phoeniceus*	822	49	4 Mar–11 Jun	25 Apr ±23	6 22 Apr 97[b]	769	20 Jul–18 Dec	7 Oct ±19	65 30 Sep 68	4	0
Tricolored Blackbird *A. tricolor*	99	7	8 Mar–14 Jul	30 Apr ±51	2 12 Jun 75[b]	91	21 Sep–21 Nov	14 Oct ±13	40 7 Oct 92	1	0
Western Meadowlark *Sturnella neglecta*	2516	52	9 Mar–5 Jul	27 Apr ±30	45 10 Mar 87[b]	2447	23 Jul–16 Dec	14 Oct ±17	125 4 Oct 72[b]	17	224
Yellow-headed Blackbird *Xanthocephalus xanthocephalus*	100	25	27 Apr–12 Jun	12 May ±9	3 13 May 75[b]	75	27 Jul–21 Oct	12 Sep ±20	2 11 Sep 98[b]	0	0
Rusty Blackbird[e] *Euphagus carolinus*	11	3	15 Apr–22 Apr	20 Apr ±4	1 15 Apr 85[b]	8	17 Oct–19 Nov	29 Oct ±11	1 31 Oct 91[b]	0	0
Brewer's Blackbird *E. cyanocephalus*	1246	173	16 Mar–30 Jun	25 Apr ±18	20 27 Apr 71	1060	17 Jul–18 Dec	14 Oct ±17	63 19 Oct 96	13	1
Brown-headed Cowbird *Molothrus ater*	2802	554	26 Mar–14 Jul	5 May ±14	20 7 May 78	2248	15 Jul–1 Dec	29 Aug ±21	53 26 Aug 87[b]	0	0
Orchard Oriole[e] *Icterus spurius*	53	2	11 Jun–9 Jul	25 Jun ±20	1 11 Jun 88[b]	51	14 Aug–25 Oct	18 Sep ±15	5 11 Sep 99	0	0
Hooded Oriole *I. cucullatus*	18	1	16 Apr	16 Apr —	1 18 Apr 90[b]	17	20 Jul–19 Nov	3 Sep ±29	3 21 Aug 87[b]	0	0
Bullock's Oriole *I. bullocki*	682	133	19 Mar–20 Jun	28 Apr ±17	7 21 Apr 87	549	3 Jul–27 Nov	19 Aug ±20	15 9 Aug 73	0	0
Bullock's × Baltimore Oriole *I. bullocki* × *galbula*	4	1	4 Jun	4 Jun —	1 4 Jun 70	3	20 Sep–28 Sep	23 Sep ±4	1 29 Sep 79[b]	0	0
Baltimore Oriole *I. galbula*	42	10	26 May–11 Jun	3 Jun ±6	2 26 May 70	32	5 Sep–30 Nov	2 Oct ±20	2 7 Sep 89[b]	0	0
Scott's Oriole[d] *I. parisorum*	3	0	—	—	0	3	12 Sep–10 Nov	17 Oct ±31	1 10 Nov 93[b]	0	0

Purple Finch	899	111	9 Mar–	20 Apr	7	782	18 Aug–	13 Oct	250	6	1
Carpodacus purpureus			31 May	±17	12 Apr 88		14 Dec	±14	4 Oct 72		
Cassin's Finch	9	3	12 Apr–	6 May	1	6	5 Oct–	30 Oct	2	0	0
C. cassinii			14 Jun	±34	21 Apr 87[b]		11 Dec	±23	27 Oct 96		
House Finch	771	360	9 Mar–	20 Apr	23	401	19 Jul–	21 Oct	18	10	0
C. mexicanus			1 Jul	±24	26 Apr 83		19 Dec	±23	16 Nov 90		
Red Crossbill	57	1[f]	18 Jun	18 Jun	1	55[f]	8 Sep–	26 Oct	12	1	0
Loxia curvirostra				—	18 Jun 98		6 Nov	±16	4 Nov 87		
Pine Siskin	1984	46	7 Mar–	23 Apr	8	1893	16 Jul–	14 Oct	400	45	1
Carduelis pinus			14 Jul	±36	17 Apr 74		19 Dec	±18	3 Oct 72		
Lesser Goldfinch	1414	49	29 Feb–	27 Apr	6	1357	15 Jul–	29 Sep	70	8	0
C. psaltria			11 Jul	±37	9 Mar 79		19 Dec	±21	17 Sep 99		
Lawrence's Goldfinch	25	3	8 Apr–	4 May	1	22	16 Sep–	8 Oct	6	0	0
C. lawrencei			26 May	±24	8 Apr 77		31 Oct	±13	1 Oct 74		
American Goldfinch	379	30	16 Apr–	18 May	5	349	21 Aug–	13 Oct	50	0	0
C. tristis			13 Jun	±15	15 May 75[b]		15 Nov	±15	22 Oct 96		
Evening Grosbeak	4	1	27 May	27 May	1	3	20 Sep–	30 Sep	1	0	0
Coccothraustes vespertinus				—	27 May 74		3 Oct	±9	22 Sep 79[b]		
House Sparrow[d]	247	237	9 Mar–	23 Apr	18	9	16 Jul–	14 Sep	15	1	2
Passer domesticus			1 Jul	±18	22 Apr 96		10 Dec	±43	19 Oct 97[b]		
Total	6,570,133	2,446,727				4,068,051				55,809	18,525

[a]Species formerly or currently reviewed by the CBRC. Except as noted[e] here or in the annotations following this table, all records within the CBRC's review period for the species have been accepted by the CBRC or are under review. It is possible that some records presently under review will not be accepted.

[b]Seasonal high count duplicated on more than one date; the date given is the most recent.

[c]Patterns of arrival appear to overlap two or more seasons. See notes for reinterpretations of seasonal data.

[d]See notes following the table for information on race, unusual patterns of patterns of occurrence, or individual records of interest.

[e]The totals may include one or more record not reviewed by the CBRC during the period in which the species was on the CBRC review list.

[f]Small numbers of individuals were reclassified to season using our definitions, are anomalously late or early within season, or are known immature dispersants included in the spring totals. See notes for specification of these records and, in some cases, reinterpretations of seasonal data.

WILDERNESS MANAGEMENT PLAN

FARALLON NATIONAL WILDLIFE REFUGE

FARALLON WILDERNESS

WILDERNESS MANAGEMENT PLAN

U. S. DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

FREMONT CALIFORNIA

JUNE 1978

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REVIEW AND APPROVAL PAGE

I. INTRODUCTION

A. Refuge Establishment

In 1909, President Theodore Roosevelt signed Executive Order 1043 creating the Farallon Reservation, "... a preserve and breeding ground for native birds." Included were Middle Farallon, the North Farallons and Noonday Rock. Southeast Farallon and adjacent rocks were added by secondary withdrawal in 1969.

B. Brief Refuge Description

About 30 miles west of San Francisco, the vastness of the Pacific Ocean is interrupted by several small islands. These are the Farallons -- "little pointed islets of the sea".

Southeast Farallons are 18 miles from Point Reyes, and 23 miles from Point Benita at the entrance of San Francsico Bay. Several rocks are included in this group, the total area being about 120 acres. The main island reaches a height of 340 feet above sea level, is approximately 70 acres in size, and has the only major horizontal area.

Two miles northwest is Middle Farallon, a single rock 50 yards in diameter and 20 feet high. The North Farallons are 4 miles north, and consist of 2 clusters of bare, precipitous islets and rocks. They reach a height of 155 feet above sea level. The total refuge area is 211 acres.

Geologically the Farallon Islands are a granitic formation of a decomposing type. There are some pockets of shallow soil, particularly on the less vertical portions of Southeast Farallon.

The climate is characterized by frequent, strong winds and dense fog. Rainfall occurs mainly during winter, with summer moisture usually limited to damp fogs. Annual precipition is approximately

10 inches. Temperatures are almost constant year-round, seldom falling below 40°F, or rising above 60°F.

C. Refuge Objective

The major objective is to provide continued protection against human disturbance and to gain additional information about the islands' wildlife to insure optimum wildlife use and productivity.

D. Relationship of Wilderness to Refuge Objectives

Wilderness designation of the suitable portion of the refuge is entirely compatible with the purpose for which it was established and enhances the existing objective of preserving physical and biological qualities in a natural condition for optimum wildlife use and productivity.

E. Wilderness Area Establishment

The Wilderness Act of September 3, 1964 (Public Law 88-577), directed the Secretary of the Interior within 10 years to review every roadless area of 5,000 or more acres and every roadless island (regardless of size) within national wildlife refuges and game ranges and to recommend to the President the suitability of each such area or island for formal preservation as wilderness.

The Farallon National Wildlife Refuge, excluding Southeast Farallon, was given wilderness status on December 26, 1974, with passage of Public Law 93-550 (Appendix 1).

Title 1, Section 101, states in part,"... certain lands in the Farallon National Wildlife Refuge, California, which comprise about one hundred and forth-one acres and which are depicted on a map entitled 'Farallon Wilderness--Proposed' and dated October 1969, and revised March 1970, are hereby designated as wilderness.

II. DESCRIPTION OF THE WILDERNESS AREA

A. The Farallon Wilderness Area is comprised of small rocks and islets adjacent to Southeast Farallon Island lying approximately 18 miles from Point Reyes and 23 miles from Point Benita at the entrance of San Francisco Bay. Two miles northwest is Middle Farallon, a single rock 50 yards in diameter and 20 feet high (Photo 1, Appendix 2). The North Farallons are 4 miles north, and consist of 2 clusters of bare, precipitous islets and rocks extending over about 1 mile of ocean (Photo 2, Appendix 2). They reach a height of 155 feet above sea level. Noonday Rock is the westernmost rock, located about 3 miles northwest of the North Farallons. It is almost completely submerged and is awash most of the time.

B. Map (from Wilderness Proposal and refuge brochure, Appendices 3 and 4).

III. MANAGEMENT

Isolation and inaccessibility have kept people off the northern island groups. These same factors plus agreements with the Point Reyes Bird Observatory (Appendix 5) and the Coast Guard (Appendix 6) have limited visitation to Southeast Farallon. The Observatory mans Southeast Farallon year-round to ward off unauthorized human visitors as well as to take census counts and to conduct research.

Wildlife management is confined to periodic inventories of wildlife resources of the islands and the accumulation of information having an influence on these resources.

Appendix 7 provides the detailed rules and regulations regarding refuge wilderness preservation and management.

IV. PUBLIC USE

A. General

The northern three groups are inaccessible and

landing on Southeast Farallon is safe only during calm seas. Use is restricted to Southeast Island and this is controlled by a cooperative agreement between the Service and Point Reyes Bird Observatory.

1. The current volume of visitation for those islands and islets within the Wilderness Area is zero. Visitation over the next ten-year period will remain at the zero level due to the inaccessibility of the islands. Therefore there will be no impact on wilderness values.

2. Current visitor control is limited to the Southeast Island and is handled under cooperative agreements with Point Reyes Bird Observatory and the United States Coast Guard.

   Firearms are not permitted on the islands.

3. Permits are issued from the San Francisco Bay NWR Complex for landing, scientific research, collecting and other activities on Southeast Island.

B. Specific Activities

Bay Area Chapters of the National Audubon Society sponsor annual bird-watching charter boat tour trips around the southern islands, and similar excursions are likely to remain the only possible type of public use.

V. PUBLIC HEALTH AND SAFETY

A. Potential Threats or Hazards

Radioactive waste which was dumped 7 miles southwest of the Farallon Islands 22 years ago is now

leaking into the water. The Pacific dumpsite, in about 5,000 feet of water, was used to dispose of 47,500 drums. Scientists have said that about 25 percent of the drums are now leaking. The Service is concerned about the proximity of the Farallons to the radioactive waste disposal site because the Southeast Island is inhabited and supports abundant birdlife and marine mammals.

B. Search and Rescue

Search and rescue operations would be coordinated with the U.S. Coast Guard. The actual operations would be conducted by the Coast Guard as they are properly equipped to carry out high-sea searches and rescues.

Because the islands are isolated and virtually inaccessible, helicopters would have to be used to remove individuals from all but Southeast Farallon. Except in the cases of severe injury or serious illness, U.S. Coast Guard boats would be utilized only on Southeast Farallon.

VI. RESEARCH

At present there are no ongoing research projects. Access to the islands is not possible most of the time thus limiting the kinds of projects that can be undertaken. Visual observations and censuses of birds and marine mammals on the North Farallons have been made from ships some distance from the islands. This type of information may be obtained sporadically throughout the year.

VII. OTHER CONSIDERATIONS

A. Placement of hydrological, meteorological, seismic, navigational, or other instrumentation.

Sales are now pending (Sale 53) on OCS lands

adjacent to the islands. The islands will remain inviolate to use as triangulation points, targets, navigational aids or any other kind of intrusion or development associated with the exploration and development of the gas and oil resources.

B. Oil Spills and Other Catastrophies

Detected oil spills will be handled according to USFWS's guideline, "Pollution Response Plan for Oil and Hazardous Substances" (revised June, 1977). All spills will be reported to the National Response Center which will then contact the appropriate Regional Response Center for action. Refuge personnel will assist oiled bird rescues by providing land transportation to local rehabilitation centers.

C. Entry for Official Purposes

Because of inaccessibility of the wilderness area, entry will not generally be possible. If occasion warrants it, entry may occur after permission has been obtained from the Refuge Manager.

VIII. FUNDS AND PERSONNEL

Additional funds and personnel for the administration of this wilderness should not be necessary because of the infrequent number of visitations anticipated.

IX. PLAN CURRENCY

Periodic review may occur on an annual basis if necessary. This could be done concurrently with review of refuge research goals for the Farallon National Wildlife Refuge.

APPENDIX LIST

1. The Act Establishing Farallon National Wildlife Refuge
2. Photographs of Middle Farallon and the North Farallons
3. Wilderness Study Brochure
4. Southeast Farallon National Wildlife Refuge Brochure
5. Cooperative Agreement - FWS/PRBO
6. Cooperative Agreement - FWS/USCG
7. Refuge Wilderness Regulations (50 CFR 35)

REVIEW AND APPROVAL PAGE

Concurrence: _____ Date: _____

Concurrence: _____ Date: _____

Concurrence: _____ Date: _____

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Farallon NWR

Use: Research and Monitoring

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?	✓	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✓	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✓	
(g) Is the use manageable within available budget and staff?	✓	
(h) Will this be manageable in the future within existing resources?	✓	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✓	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✓	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ✓ No ___

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate ___ **Appropriate** ✓

Refuge Manager: _____ Date: 10/1/08

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

FWS Form 3-2319
02/06

Appropriate Use Justification: Research and Monitoring

Refuge staff relies heavily on partners to conduct research activities on the Refuge that we may not have the staffing, resources, or expertise to undertake. Existing and future research activities must address our management needs such that it supports the conservation of the unique habitat and wildlife on the Refuge. Research that can be done off the Refuge is generally discouraged. Researchers are also prescribed protocols to reduce disturbance on Refuge resources and habitat.

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Farallon NWR

Use: Remote Camera Systems for Environmental Education and Monitoring

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?	✓	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✓	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✓	
(g) Is the use manageable within available budget and staff?	✓	
(h) Will this be manageable in the future within existing resources?	✓	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✓	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✓	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ✓ No ___

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate ___ **Appropriate** ✓

Refuge Manager: _____ Date: 10/1/08

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

FWS Form 3-2319
02/06

Appropriate Use Justification: Remote Camera System

The remote camera system will serve the Refuge two-fold by improving management needs and expanding environmental education. A camera system will provide daily monitoring in areas where staff would like to reduce presence or where wildlife and/or habitat are sensitive to human disturbance. For example, currently data is only collected intermittently (not more than once per week during the breeding season) from seabird and pinniped populations in wilderness areas on the Refuge. Further, this information is gathered only from a distance by boat (staff do not access the wilderness areas where breeding is occurring). A camera system can provide more detailed information such as eggs per clutch or fledge rates.

Environmental education is one of the six priority public uses of the Refuge System. A camera system can also be used as a tool to connect this remote Refuge to the mainland. The real-time video and the data collected from the camera can be used in an environmental education program for local schools. This web-based system would be accessible to the public as well.

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Farallon NWR

Use: Media Access (not more than 1-3 journalists and up to 3 visits per year)

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?	✓	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✓	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✓	
(g) Is the use manageable within available budget and staff?	✓	
(h) Will this be manageable in the future within existing resources?	✓	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✓	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✓	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ✓ No ___

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate ___ **Appropriate** ✓

Refuge Manager: _____ Date: 10/1/08

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

FWS Form 3-2319
02/06

Appropriate Use Justification: Media Access

Media access is appropriate because it will serve as an environmental education tool that contributes to the public understanding and appreciation of the refuge's unique natural resources and cultural assets. Media access will facilitate environmental education, which is one of six priority public uses (the other uses are hunting, fishing, environmental education, and interpretation) promoted in the National Wildlife Refuge System Improvement Act of 1997. The Refuge is difficult to travel to and with limited infrastructure, can only accommodate a limited number of persons at one time. By providing media representatives supervised access to the Refuge, the staff can outreach to a larger audience.

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Appendix J. Compatibility Determination for Research on the Farallon National Wildlife Refuge

Use: Research & Monitoring

Refuge Name: Farallon National Wildlife Refuge, San Francisco County, California

Establishing and Acquisition Authority:
Farallon National Wildlife Refuge (NWR) was established under Executive Order 1043 (February 27, 1909) and Public Land Order 4671 (June 23, 1969). The approved Refuge boundary contains 211 acres which the Service manages in entirety.

Refuge Purpose(s):
Farallon NWR purposes include:

> "…as a preserve and breeding ground for native birds." (Executive Order 1043).
>
> "...for the development, advancement, management, conservation, and protection of fish and wildlife resources..."(16 U.S.C. 742f(a)(4)) and "...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude..." (16 U.S.C 742f(b)(1), Fish and Wildlife Act of 1956).
>
> "...suitable for (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, and (3) the conservation of endangered species or threatened species..." (16 U.S.C. 460k-l, Refuge Recreation Act).
>
> "…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." (16 USC 715d, Migratory Bird Conservation Act of 1918).

National Wildlife Refuge System Mission:
The mission of the National Wildlife Refuge System (System) is "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-668ee])

Description of Use(s):
Existing/Ongoing
PRBO Conservation Science (formerly Point Reyes Bird Observatory) has been conducting wildlife monitoring and research on Southeast Farallon Island (SEFI) since 1969 under a cooperative agreement with the Service. PRBO activities take place year-round, on a continuing basis in conjunction with duties to care take the island and provide a human presence that deters unauthorized landings and human disturbance.

Seabird Research: PRBO monitors population size, breeding success and conducts other long-term population and diet studies on the 12 species of breeding seabirds on SEFI. Population information from West End is obtained from SEFI vantage points or from boats. Methods

include: 1) Population counts on or around the Refuge from ground and boat; 2) Estimates of productivity through nest monitoring, which include natural sites, boxes and artificial habitat; 3) Re-visiting monitored breeding sites to check for eggs, hatching, weighing/measuring chicks, and banding chicks and incubating adults; 4) Searches for new breeding sites through visual scanning or tape playback; 5) Diet monitoring through visual observation from blinds, mistnetting or spotlighting, and collecting diet samples from birds; 6) Banding with aluminum leg bands and/or color bands adults and chicks of selected species including Ashy and Leach's storm-petrels (adults only), Cassin's and rhinoceros auklets, common murre, Brandt's cormorants, western gull, pigeon guillemot, and black oystercatcher; 7) Mistnetting and banding of storm-petrels and rhinoceros auklets for diet and population studies; and 8) Use of burrow cameras to detect Cassin's and rhinoceros auklets.

Marine Mammal Research: PRBO conducts weekly pinniped counts of five species year-round, throughout the South Farallon Islands. These surveys are non-disturbing, since they are conducted from blinds or high vantage points such as Lighthouse Hill. Northern fur seals are monitored by making weekly survey excursions to West End during September and October because their breeding/haul-out site cannot be viewed from SEFI or the water.

PRBO conducts more intensive research on productivity and survival of northern elephant seals. Methods include: 1) Temporarily marking cows and pups during the breeding season (December to early March) with hair dye to determine phenology and breeding success; 2) Tagging all young of the year with permanent flipper tags; 3) Weighing and measuring accessible, weaned seals on SEFI to determine general body condition; and 4) Monitoring West End breeding sites by making weekly or fewer surveys during January and February.

Non-breeding Bird Research: PRBO monitors arrivals and length of stay of landbirds and shorebirds on SEFI year-round. Methods include: 1) Conducting daily visual surveys and timed area searches using binoculars to count and identify all species of landbirds; 2) Conducting daily "shorebird walks" to intertidal areas on SEFI; 3) Mistnetting and banding landbirds during migration; and 4) Maintaining daily records of all birds (and banded individuals) observed on SEFI. Banded birds are released shortly after banding. Burrowing owls captured after December 1 are translocated to the mainland, because their food supply (non-native mice) crashes in the late-winter/early-spring resulting in unnaturally high Ashy storm-petrel predation or owl starvation.

Other PRBO Existing/Ongoing Research: PRBO conducts daily observations of white shark attacks from Lighthouse Hill September through November to estimate population size and feeding activity. PRBO also conducts surveys of several areas that are used as bat roosting sites during the fall migration period (mid-August to November) for hoary bats. Population trends of arboreal salamanders are assessed by checking auklet boxes and coverboards for the presence of salamanders every two weeks from September to March; animals are measured and toe clipped. Every living thing seen on or from the island, from butterflies to whales, is also noted and recorded in the daily journal by PRBO. PRBO also collects water samples for Scripts Institute, reports weather data to the National Weather Service (NWS), and reports sea and weather conditions to mainland fishermen and boaters.

Gulf of the Farallones National Marine Sanctuary Research: Since 1992, Sanctuary personnel have monitored intertidal species at six permanent plots on SEFI, including two plots on West

End. Visits for up to 4 people to collect point and photo quadrant data are authorized by Special Use Permit (SUP) three times annually (February, August, and November). Visits to West End are not allowed in August.

University of Berkeley Research: Since the early 1990s, UC Berkeley Seismology Lab has monitored movement of the Pacific Plate through two of their seismographic instruments located on the extreme eastern side of SEFI. These instruments are a unique contribution to the worldwide monitoring system of seismic activity, since the Farallon Islands are the only land mass on the eastern side of the Pacific Plate. Periodic maintenance of the instruments, which have a footprint of less than 3 square meters, is authorized by SUP generally once every 2-3 years.

National Weather Service Research: NWS maintains and accesses some small weather instruments (total footprint less than 5 square meters) on the Marine Terrace 1-2 times yearly by SUP. The weather data collected by these instruments is also used by PRBO and the Service for interpreting wildlife responses and research results, and island operations (i.e., making weather-based decisions for boat landings).

Future/Proposed
Based on past experience, we expect to receive two to four requests per year (in addition to the research conducted by the institutions identified above) to conduct research on SEFI from institutions and independent researchers. Although research is not identified as a priority public use by the National Wildlife Refuge System Improvement Act of 1997, the Act does contain a provision to "conduct inventory and monitoring." The scope of this determination includes research conducted by all agencies, individuals and institutions other than the Service.

Additional research studies may be approved by USFWS after submittal/evaluation of a research proposal. These may include blood collections from a small number of seabirds for genetics, aging, sexing, or contaminants work; egg, feather or carcass collection for contaminant studies or other wildlife health studies; diet energetics studies; and more intensive population estimation studies of seabirds or marine mammals. We are particularly interested in increasing our knowledge of less-studied fauna including arboreal salamanders, migratory bats, insects, and invasive intertidal species. We will support and encourage these studies provided they fit the following criteria and do not detract from the Refuge purpose of protecting seabirds and pinnipeds.

Generally on-site research would be limited to SEFI. Research applicants must submit a proposal that would outline: 1) study objectives; 2) justification for the study in relation to the Refuge's purpose and/or the mission of the Refuge System; 3) detailed methods and project description; 4) relationship to refuge resources, including potential impacts; 5) expected products and results; 6) timeframe, personnel required, other logistical considerations; and 7) other collaborators. Proposals would be reviewed by Refuge staff and other specialists, as appropriate. Access for all studies other than those conducted by PRBO would be authorized by SUP. Research proposed by PRBO would be authorized following provisions in the cooperative agreement: PRBO submits annual research plans for ongoing work and research proposals for new research. These are approved by the refuge manager.

Each research proposal would be evaluated to determine its relative contribution to improved management or protection for refuge wildlife. Criteria that must be met before granting approval for a study include:

- Research must contribute to protection, enhancement or management of native Farallon wildlife populations or their habitats;
- Research that would answer a priority information or management need would have priority over other studies;
- Research must not conflict with ongoing management, monitoring, or research. Monitored populations that are used to fulfill Service requirements of estimating population size and reproductive access will not be affected by other research;
- Research that can be done elsewhere off-Refuge is less likely to get approved;
- Research that involves access to West End or other designated wilderness is not likely to get approved;
- Research which causes undue disturbance that is intrusive or manipulative would be discouraged. All requests would be carefully considered because most seabirds and marine mammals are very sensitive to disturbance, and soil habitats that support burrowing seabirds are prone to burrow crushing and compaction.
- Every effort must be made to minimize disturbance to wildlife and habitat through study design, including adjusting timing, number of study sites, location, scope, number of permitteees, etc. Consideration would be given to whether existing island staff can collect data or samples, thereby avoiding the need for additional people.
- Existing staffing and island resources (e.g., water supplies, power, transportation and other logistics) must be available to monitor and support the research.
- The length of the project would be considered and agreed upon before approval. Projects would not be open-ended, and at minimum, would be reviewed annually.
- Researchers would be required to submit a report, including interim reports if applicable, and credit the Refuge in any reports or publications.

Availability of Resources:
Research proposals would be approved contingent upon adequate funding and staff to oversee projects. Oversight and review of PRBO and independent researcher proposals, study plans, and report takes an estimated .10 FTE annually. The cost per year is $11,875 based on the fiscal year 2007 pay scale of a GS-12 (with San Francisco locality pay adjustment).

Anticipated Impacts of the Use(s):
Scientific research can benefit Refuge resources and support the purposes of the Refuge and mission of the System. Monitoring is an important component of adaptive management. PRBO's monitoring and research provides essential information on population levels and breeding success of most seabirds and marine mammals. Information is summarized in annual and monthly reports. Population demography and food habit studies provide information useful in assessing the status and trends of a particular species. Biological research/monitoring data, combined with information on weather, sea conditions (including food availability), and human disturbance can lead to conservation efforts to protect species. For example, diet studies and documented seabird impacts from commercial fishing have led to gill net and other regulations that have reduced seabird mortality. Monitoring and collection of oiled wildlife has led to the identification and clean-up of sources of petroleum spills/leaks. PRBO also monitors for sources of human disturbance, such as boats approaching too close to the shoreline or aircraft flying too low. They

either immediately intervene to stop the disturbance or report it to Refuge law enforcement staff who issue a warning or citation. Overall benefits of PRBO's researchers on the island outweigh impacts summarized above.

Monitoring and research causes minimal impacts when conducted from blinds or remote vantage points. Individual seabirds are temporarily disturbed during nest checks, mistnetting, banding, or diet sample collections. Elephant seals are temporarily disturbed during tagging and marking. Access to West End can flush marine mammals, common murres or Brandt's cormorants. Human traffic increases during the seabird nesting season because more researchers are present April through August. Potential impacts include flushing of birds from breeding sites, increasing vulnerability of eggs or chicks to western gull predation, crushing of Cassin's auklet burrows by trampling, depriving chicks of a single meal to obtain diet samples, or in the most intrusive studies, affecting the productivity of a low number of individuals in a single breeding season.

Some level of disturbance is also expected from research activities conducted by institutions/independent researchers other than PRBO because they could occur in sensitive areas, during sensitive time periods, and may involve collecting samples or handling wildlife. Travel to West End has the potential for flushing Steller's sea lions and common murres, and introducing weed seeds. However, minimal impact to Refuge resources are anticipated since research studies would be carefully screened before issuing a Special Use Permit (SUP) and contain conditions to minimize disturbance to wildlife and habitat. Based on past experience, independent research is expected to have conservation benefits to Farallon wildlife in the long term that outweigh short-term impacts. For example, data collected on hoary bats has led to a better understanding of migratory patterns and identified possible impacts of mainland wind turbines.

Public Review and Comment:
Public review and comments will be solicited in conjunction with distribution of the Draft CCP/EA for Farallon NWR. The public will be provided at least 30 days to review and comment upon the CCP and this CD. Following the public review and comment period, comments and Service responses will be summarized here.

Determination (check one below):

_____ Use is Not Compatible

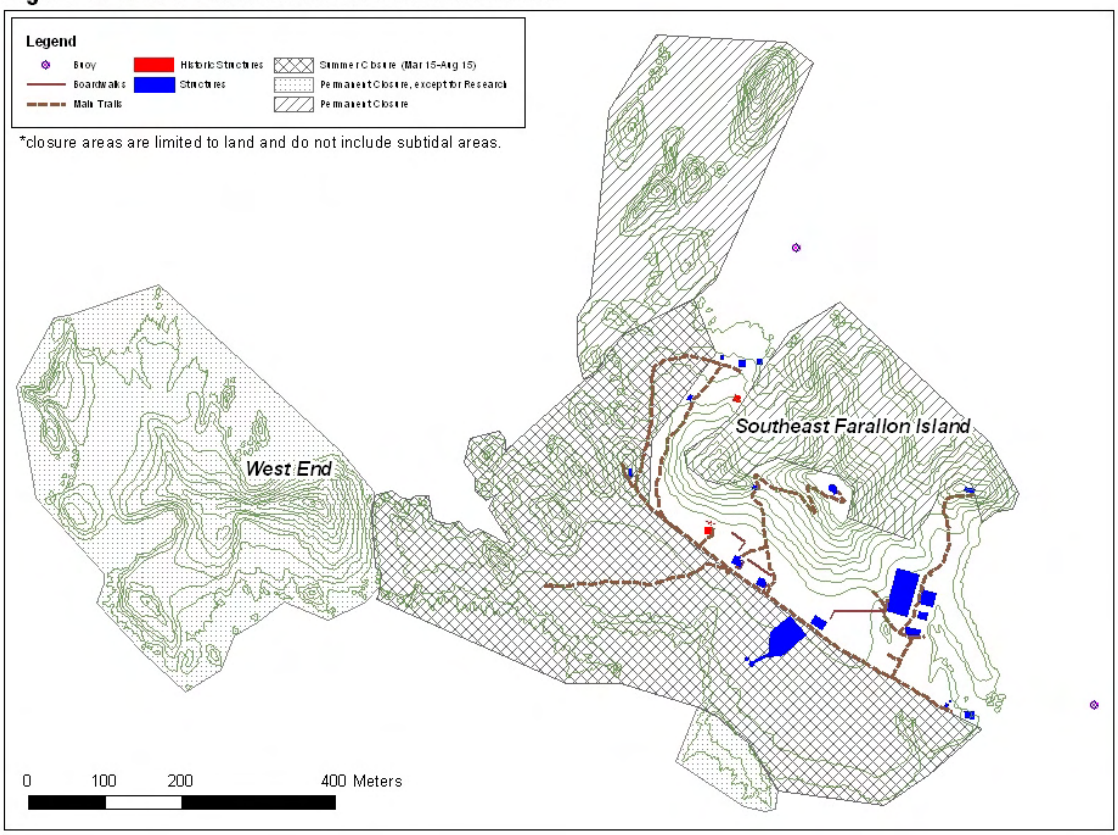
__X__ Use is Compatible with the Following Stipulations

Stipulations Necessary to Ensure Compatibility:
The following stipulations would be followed in order to minimize the impacts of research/monitoring by PRBO (incorporated in the cooperative agreement) or others (through SUP Special Conditions) granted access for studies.

- Human traffic is only allowed on specific walkways and a small portion of the Refuge (see Figure 1, Closure Areas Map) during the breeding season beginning March 15.
- The north side of Lighthouse Hill and islets are closed to research. Mussel Flat is closed except for sampling inter-tidal plots.

- Limit research access to West End to those surveys needed to assess pinniped population levels and pup numbers: six visits between September and October to assess the expanding fur seal colony, and six visits between January and February to monitor elephant seals.
- The West End Wilderness Area is closed from March 1 to August 31. No more than one six visits between September and October will be allowed to monitor fur seal populations and no more than six visits between January and February will be allowed to monitor elephant seals. GFNMS intertidal monitoring must be combined with one of these visits. No flushing of murres or Steller's sea lions is allowed. All visitors to West End will engage in phyto-sanitation procedures: rubber boots, freshly rinsed in bleach water, will be worn and all outerwear shall be brushed free of seeds.
- The trail between the weather station and Sand Flat will be closed on April 15, and not re-opened until foot traffic can take place without disturbing cormorants. The timing of closures for this and other trails will be periodically re-evaluated to determine if additional closures are needed to protect nesting seabirds or marine mammals.
- The maximum number of overnight researchers (which includes PRBO staff and interns) is 8.
- Independent researchers will be scheduled outside of the seabird breeding season whenever possible.
- PRBO and research permittees are required to minimize disturbance to seabirds, other wildlife, and habitat whenever possible.
- Most seabird mistnetting, banding, and diet collections are conducted at night to minimize disturbance and predation.
- Mistnetting and banding locations are limited to existing paths and boardwalks in order to minimize disturbance.
- PRBO and independent researchers are responsible for maintaining all permits necessary, including migratory bird and incidental harassment to pinnipeds.
- The Service and PRBO will hold an annual meeting to discuss all issues, including disturbance concerns. If research or monitoring studies are adversely affecting Refuge resources, the activity will be modified or stopped to avoid impacts.
- PRBO is required to train all new volunteers on Refuge restrictions and procedures.
- Crushing of burrows is prohibited. If accidentally damaged, they are to be reported and repaired immediately.
- All research permittees will be under the direct guidance of the PRBO biologist-in-charge or a Service staff person, who is authorized to stop or reduce the permitted activity if to continue the activity would cause undue disturbance to wildlife or habitat.
- Highly intrusive or manipulative research is generally not permitted, in order to protect depleted native bird populations and allow them to recover from historic human impacts.
- All visitors including PRBO staff and interns, will be required to engage in phyto-sanitation procedures that will limit transport of non-native species onto the Refuge.

Figure 1. South Farallon Islands Closure Areas



Justification:
Well-defined research projects developed in consultation with Service staff, would contribute directly to the conservation, enhancement, protection, and management of native Refuge wildlife and their habitats. On the other hand, human activity from monitoring and research activities causes wildlife disturbance. When the Refuge field station was established in 1969, we acquired a site heavily impacted by continuous human occupation by individuals fulfilling missions other than protection and management of wildlife. In order to reverse the long history of human disturbance and minimize impacts of humans living on the island, we have had a policy of non-manipulative and non-intrusive research/monitoring, and limited access, to give populations the greatest chance to recover. West End is managed much more strictly than is required by its Wilderness Area designation, as a wildlife sanctuary that is primarily free even from research and management impacts.

Our policy of minimizing disturbance has had desired results. In the last decade, breeding populations of common murres have more than tripled and northern fur seals have re-colonized as a breeding species. In fact, seabirds are expanding into certain areas such as Mirounga Beach and Sea Lion Cove causing us to limit or screen our activities further. We are closing the Sand Flat trail earlier in the breeding season, and building a rock wall near "the gap" on North Landing Trail to screen human foot traffic from incipient breeding colonies.

The use described here continues the past policy with two exceptions: 1) Additional visits would be allowed to West End during September and October to monitor fur seals, and 2) Studies on lesser-understood fauna such as salamanders, bats, and insects would be encouraged. The growing fur

seal colony cannot be tracked in any other way because it is not visible from SEFI vantage points or the water. We are just beginning to learn that the Farallon Islands may play an important role in conservation of hoary bats, because it is the only place where they can be studied with any regularity during migration, and migrating bat populations may be threatened by wind power development.

Conditions in Cooperative Agreements and Special Use Permits for research projects will ensure that short- and long-term impacts on Refuge resources are minimized. Only research that is compatible with the purposes of the Refuge and mission of the System would be permitted on the Refuge.

Mandatory Reevaluation Date (provide year):

_____ Mandatory 15-year Reevaluation Date (for priority public uses)

__X__ Mandatory 10-year Reevaluation Date (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

_____ Environmental Impact Statement and Record of Decision

Refuge Determination

Prepared by:	_____ (Signature)	_____ (Date)
Project Leader Approval:	_____ (Signature)	_____ (Date)
Concurrence Refuge Supervisor:	_____ (Signature)	_____ (Date)
Assistant Manager, Refuges, California Nevada Operations:	_____ (Signature)	_____ (Date)

Appendix K. Compatibility Determination Environmental Education and Monitoring on the Farallon National Wildlife Refuge

Use: Real-time Remote Camera Systems for Environmental Education and Monitoring

Refuge Name: Farallon National Wildlife Refuge, San Francisco County, California

Establishing and Acquisition Authority:
Farallon National Wildlife Refuge (NWR) was established under Executive Order 1043 (February 27, 1909) and Public Land Order 4671 (June 23, 1969). The approved Refuge boundary contains 211 acres which the Service manages in entirety.

Refuge Purpose(s):
Farallon NWR purposes include:

> "…as a preserve and breeding ground for native birds." (Executive Order 1043).
>
> "...for the development, advancement, management, conservation, and protection of fish and wildlife resources..." (16 U.S.C. 742f(a)(4)) and "...for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude..." (16 U.S.C 742f(b)(1), Fish and Wildlife Act of 1956).
>
> "...suitable for (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, and (3) the conservation of endangered species or threatened species..." (16 U.S.C. 460k-l, Refuge Recreation Act).
>
> "…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." (16 USC 715d, Migratory Bird Conservation Act of 1918).

National Wildlife Refuge System Mission:
The mission of the National Wildlife Refuge System (System) is "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-668ee]).

Description of Use:
Environmental education, interpretation, wildlife observation, and photography are priority public uses of the National Wildlife Refuge System. A real-time camera system would provide an opportunity for the public to observe wildlife and participate in environmental education activities off the Refuge. The camera system would also allow the Service to monitor species close up in areas where monitoring would not normally be possible due to the sensitivity of wildlife.

As proposed, a camera system would be installed prior to the breeding season at locations that are difficult to access by foot during the breeding season. The system would not be accessed during

the breeding season in order to reduce disturbance to wildlife and will be removed after the breeding season. The camera system would be linked to the Refuge website and a mainland visitor center for public viewing, in addition to being available over the Internet. This use would facilitate monitoring efforts of wildlife on the Refuge.

The Refuge is also proposing this use to promote compatible wildlife observation and environmental education. Access to the island is unpredictable and hazardous; furthermore, access can result in damage to wildlife habitat or introduction of non-native species. By providing the public with an opportunity to view the Refuge, awareness of and appreciation for this remote natural resource will be increased.

Availability of Resources:
A camera system, internet connection, and maintenance of this system are necessary to support this use. Installation and any needed repairs will be conducted by the camera system outfitter. Costs to administer this proposed use are staff time and operational costs. Adequate staff and funds are not available to provide this use with the current budget.

Materials and maintenance costs:

	One-Time Costs	Annual Costs
Camera system and installation	$ 50,000 (2006 estimate)	$ 9,000
Salary- Wildlife Refuge Specialist	$ 5,000	$ 5,000
Salary- Refuge Manager	$ 5,000	$ 3,000
TOTAL	$ 60,000	$ 17,000

Anticipated Impacts of the Use:
This use is intended to garner and maintain public support for preservation and protection of the wildlife and plant species on the Refuge. However, breeding and nesting birds tend to be very sensitive to human disturbance, whether from scientific research, recreation or ecotourism. Studies have shown that scientific research can have major impacts, causing nest abandonment (Anderson and Keith 1980), increased depredation (Tremblay and Ellison 1979), fewer nests near active areas (Burger and Gochfeld 1993), lower productivity (Anderson and Keith 1980), and increased flight (Erwin 1989). Wildlife on and surrounding the Refuge may incur temporary disturbance from the installation of the camera system, but should not be impacted during the sensitive breeding season. The camera system will require a small amount of habitat, but will not be located on a nesting or pupping site. The wildlife is expected to acclimate to the passive equipment as experienced at other wildlife sites such as the Common Murre Restoration Program in central California.

Public Review and Comment:
Public review and comments will be solicited in conjunction with distribution of the Draft CCP/EA for Farallon NWR. The public will be provided at least 30 days to review and comment upon the CCP and this CD. Following the public review and comment period, comments and Service responses will be summarized here.

Determination:

___ Use is Not Compatible

_X_ Use is Compatible with the Following Stipulations

Stipulations Necessary to Ensure Compatibility:
The wildlife populations will continue to be monitored. In fact, the camera system itself will be used as a monitoring tool and increase our ability to detect disturbance to wildlife in remote portions of the Refuge that cannot be viewed from land vantage points. Declines in wildlife populations or negative responses that can be attributed to the camera system will result in review and potential modification of this use on the Refuge. Should the system fail during the breeding season, access or repairs will not likely be made until after the sensitive breeding season.

If installed on West End (a designated Wilderness area), the system will not be maintained or accessed between March 15 and August 31). Steller sea lions and common murres must not be flushed when traveling to West End.

Installation of a camera system on West End or other "closed" or restricted access areas will require that all personnel engage in phyto-sanitation procedures: Rubber boots, freshly rinsed in bleach water, will be worn and all outerwear shall be brushed free of seeds.

Justification:
Conducted with aforementioned stipulations the proposed use will likely enhance the ability of the Refuge to fulfill the Refuge System mission and the purpose of the Refuge by providing the opportunity for remote wildlife observation to the public. The Refuge would remain closed to protect the sensitive wildlife and habitat while the use would increase public awareness of the Refuge and its resources.

Mandatory Re-Evaluation Date:

__X_ Mandatory 15-year Re-Evaluation Date (for priority public uses)

_____ Mandatory 10-year Re-Evaluation Date (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision:

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

_____ Environmental Impact Statement and Record of Decision

Reference Cited:

Anderson, D.W. and J.O. Keith. 1980. The human influence on seabird nesting success: Conservation implications. Biological Conservation 18: 65-80.

Burger, J. and M. Gochfeld. 1993. Tourism and short-term behavioral responses of nesting masked, red-footed and blue-footed boobies in the Galapagos. Environmental Conservation 20:255-259.

Erwin, R.M. 1989. Responses to human intruders by birds nesting in colonies: experimental results and management guidelines. Colonial Waterbirds 12:104-108.

Tremblay, J. and L.N. Ellison. 1979. Effect of human disturbance on breeding of Black-Crowned Night Herons. Auk 96:364-369.

Refuge Determination

Prepared by:	_____	_____
	(Signature)	(Date)
Project Leader Approval:	_____	_____
	(Signature)	(Date)
Concurrence Refuge Supervisor:	_____	_____
	(Signature)	(Date)
Assistant Manager, Refuges, California Nevada Operations:	_____	_____
	(Signature)	(Date)

Appendix L. Compatibility Determination for Media Access on the Farallon National Wildlife Refuge

Use: Media Access

Refuge Name: Farallon National Wildlife Refuge, San Francisco County, California

Establishing and Acquisition Authority:
Farallon National Wildlife Refuge (NWR) was established under Executive Order 1043 (February 27, 1909) and Public Land Order 4671 (June 23, 1969). The approved Refuge boundary contains 211 acres which the Service manages in entirety.

Refuge Purpose(s):
Farallon NWR purposes include:

"…as a preserve and breeding ground for native birds." (Executive Order 1043).

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

"...suitable for (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, and (3) the conservation of endangered species or threatened species..." (16 U.S.C. 460k-l, Refuge Recreation Act).

"…for use as an inviolate sanctuary, or for any other management purpose, for migratory birds." (16 USC 715d, Migratory Bird Conservation Act of 1918).

National Wildlife Refuge System Mission:
The mission of the National Wildlife Refuge System (System) is "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-668ee])

Description of Use(s):
Allow limited access to Southeast Farallon Island for media personnel in order to further public education and provide outreach opportunities. Media personnel are defined as journalists and associated photographers working for an established newspaper, magazine, journal, publication, radio or television station, or other broadcaster (other than free-lancer). Media visits would occur in one of three ways, listed in order of most common (or preferred) to least common:

1. Day-use visit by 1-3 individuals representing a single media entity. These would be authorized under a Refuge Special Use Permit (SUP) evaluated on a case-by-case

basis, preceded by a written request that included their affiliation, purpose, general focus of their story, transportation arrangements, and other pertinent details.

2. Multi-day visit by 1-3 individuals representing a single media entity. Authorized as above.

Both types of media visits must meet the following criteria:

- The visit would result in a published or broadcast story that would educate the general public about the Farallon Islands' wildlife and habitat, conservation, management of its resources, or the importance of the Refuge. Other important messages include the Service's role in protecting this unique public land, how the Farallon Islands fit into a national system of wildlife refuges, and the importance of partnerships with PRBO Conservation Science (PRBO) and others in managing wildlife resources and protecting habitats. Copies of broadcasted or printed stories must be provided to the Service.
- Any story resulting from the visit will state that the Farallon Islands is a National Wildlife Refuge managed by the U.S. Fish and Wildlife Service.
- The visit would not conflict with other ongoing management, monitoring, research programs, or media visits.
- The visit could be monitored by the Refuge within existing staffing or logistical constraints.
- Transportation between the mainland and the island would be on a scheduled boat trip (either Farallon Patrol, or Refuge boat chartered for operational activities or a media tour). In certain situations, media may be allowed to charter their own boat, but only when an "extra boat day" could be accommodated by island staff without impacting other ongoing projects and operational activities.
- Visitors must be employed by a print or broadcast media entity. Free-lancers that are formally affiliated with a journal, newspaper, magazine, radio/TV station, etc. may be provided a one-day visit if they are "on-assignment" or have some other written agreement with a media entity or institution involved with public education, and their communication will be far-reaching.
- The resulting publication/broadcast is not a commercial venture.
- The visit will not result in damage to habitat or undue disturbance to wildlife.
- The visit can be accommodated safely, which means that certain weather/sea conditions or facilities circumstances (e.g., boats or equipment breakdowns) may result in a denial or cancellation of an approved request.

In addition, multi-day visits must meet the following criteria:

- The project will educate a national (or broader) audience about Farallon resources.
- There is a compelling reason why the media objectives cannot be accomplished in a one-day visit. Examples of reasons include: unfavorable weather patterns during a particular time of year may require longer than a one-day window to assure favorable photographic conditions or; reporting on a particular wildlife behavior may require sufficient observation time for the behavior to occur or; some wildlife are only observable at night, dawn, or dusk.
- No more than one multi-day permit will be issued per calendar year. Because of

this limit, a proposal that otherwise meets the above criteria may be denied or postponed to a later year in order to achieve a balance of stories. For example, if several multi-day visits have focused on pinnipeds, the next pinniped-related request may be denied to provide the opportunity for a different subject.

Media access requests would be reviewed by the refuge manager, and other specialists as appropriate to see if it met the above criteria. This evaluation includes coordinating with PRBO island staff to judge the sensitivity of island wildlife/habitat and availability of resources to support the visit, including having sufficient personnel to escort and monitor visitors. The refuge manager would draft the SUP and discuss with the applicant the level of physical ability needed to safely get onto the island and rules s/he would be required to abide by to protect Refuge wildlife and habitat. Only after the refuge manager feels secure that the applicant understood and agreed to the conditions, which include being escorted and supervised by island staff, would a SUP be issued. The SUP would include conditions to minimize resource impacts and insure compatibility (see stipulations below). Visitors would be required to take measures to ensure that they don't bring non-native seeds or plants to the island. The permittee signs the SUP, and the conditions are therefore enforceable by citation. Once on the island, the visitor(s) would be accompanied by a PRBO or FWS staff person who would assure that purposes of the visit were achieved safely without compromising wildlife, habitat or other operations.

Availability of Resources:
Adequate funding and staff exist to manage this use at the Farallon National Wildlife Refuge.

Materials and maintenance costs:

	Annual Costs
Salary- Outdoor Recreation Specialist	$ 2,200 (2007 dollars)
Salary- Refuge Manager	$ 5,000
Per Diem	$ 1,000
TOTAL	$ 8,200

Anticipated Impacts of the Use(s):
The Refuge is closed to general public use to protect seabird and pinniped populations from human disturbance. Visitor disturbance has been shown to reduce hatching success, cause population declines and preclude nesting in certain locations by gulls and terns (Carney and Sydeman 1999). Past human use on Southeast Farallon Island severely decreased seabird and marine mammal populations, extirpating some species (Ainley and Boekelhide 1990). Breeding populations have taken decades, or in the case of elephant seals and northern fur seals over a century to recover, and many species are still much lower than they were historically. Visits during the seabird breeding season (March 15 to August 15) have the most potential for causing impacts because this is the time period when the largest numbers of seabirds are present on the island. Seabird nesting occurs on virtually every square foot of Southeast Farallon Island during the breeding season; therefore human transit anywhere on the island has the potential to flush birds from their nests. Flushing disturbance causes the greatest impacts to colonial nesting species such as

common murres. When flushed from their nests, murres leave eggs and chicks exposed to predators (mainly gulls). Repeated flushing can lead to abandonment of the nest, or if it occurs year after year, abandonment of the entire colony.

The island is mostly exposed granite rock. Soil deep enough for burrowing seabirds (rhinoceros and Cassin's auklets) to construct burrows is rare and limited to flat areas of the Marine Terrace. Human foot traffic anywhere on the Marine Terrace can crush burrows. During the breeding season, this can lead to the death of an individual bird or the loss of its reproductive effort for the year. Even during the non-breeding season, crushing a burrow can result in extra energy expenditure for the bird to dig a new burrow, since auklets re-use burrows from year to year.

Walking too close to groups of seals or sea lions that are hauled up on the shoreline can cause them to stampede into the water. This results in extra energy expenditure, and can cause injury to young animals (crushing). Steller's sea lion, listed as a threatened species, is one of the species that could be impacted by a flushing event.

Generally, between three and six media requests per year are received by the refuge manager per year. Approximately half do not meet the criteria listed above and are denied. Therefore, it is estimated that 1-3 media visits would occur during any calendar year. Based on our experience in accommodating a similar intensity of visits over the past 20 years, we anticipate that most of the impacts to wildlife and habitat described above could be avoided. Media visitors would remain on paths that are screened from colonial nesting species and pinniped haul-outs, and where other species have become habituated to people walking. They would be escorted by staff familiar with sensitive areas who are trained to read behaviors that signal when an animal becomes nervous or disturbed (seabirds and marine mammals generally exhibit certain subtle behaviors before they flush).

An exception would be the gulls nesting or roosting immediately adjacent to the island's paths. They will be flushed by the media visits, but these flushing events are not expected to result in predation or abandonment of nests. Likewise, pinnipeds (primarily California sea lions) hauled-out near the boat landing(s) will be temporarily disturbed by the transfer of visitors to SEFI.

Public Review and Comment:
Public review and comments will be solicited in conjunction with distribution of the Draft CCP/EA for Farallon NWR. The public will be provided at least 30 days to review and comment upon the CCP and this CD. Following the public review and comment period, comments and Service responses will be summarized here.

Determination (check one below):

_____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility:

The following will avoid or minimize all wildlife disturbances, and will be included as stipulations to the SUP when appropriate:

1. Request for media access must be submitted in a letter or proposal and will describe the specific activity and specific tie to the Farallon NWR.
2. Media visits will be scheduled outside of the seabird breeding season whenever possible.
3. Visits will be conducted in a way that minimizes disturbance to wildlife and habitat and does not cause flushing of seabirds or pinnipeds.
4. Media visitors must stay on existing paths and walkways on Southeast Farallon Island. Access to closed or restricted areas, including West End, will not be allowed.
5. Visitors will be under the direct supervision of either a USFWS staff person or the PRBO biologist-in-charge at all times, who may limit access, stop, or reduce the permitted activity in order to minimize wildlife disturbance.
6. Access to SEFI will be by boat and arranged by the permittee.
7. Visitors will be required to comply with phyto-sanitation procedures to reduce the introduction and spread of non-native plants.
8. No more than one multi-day (overnight) visit will be allowed per year.
9. Media visits will be allowed under a special use permit which will contain special conditions to minimize disturbance to wildlife and habitat.

Justification:
Although media access is not identified as a priority public use by the National Wildlife Refuge System Improvement Act of 1997, media access can benefit Refuge resources and support the purposes of the Refuge and mission of the System by acting as a vehicle for outreach and education of such a remote Refuge. Media visits have been allowed when requested, on the Farallons for more than 20 years under a well-developed visitation protocols.

Numerous excellent articles and broadcasts have been done on the Refuge, including many that were in-depth pieces on conservation issues and wildlife stories unique to this Refuge. Literally millions of people, including local, national, and international audiences, have been reached by media stories. Recent print media that have featured articles on the Farallons (with circulation in parentheses) are: Los Angeles Times (815,723), San Francisco Chronicle (386,564), and Sacramento Bee (279,032). Broadcast media has included PBS, BBC, Discovery Channel, Animal Planet, and all major Bay Area television news programs. Media coverage has fostered appreciation of Farallon wildlife by the public, as evidenced by the public opposition received in response to a Congressional proposal in 2005 that would have opened the Refuge to limited public access.

Several aspects of the Refuge make it unique in being able to tell a one-of-a-kind success story of the Refuge System: 1) it is the largest seabird breeding colony in the continental United States; 2) its history of past human exploitation and recovery of wildlife populations after protection sends a positive conservation message; 3) Southeast Farallon Island has infrastructure to land and support members of the media; 4) wildlife observation blinds allow close-up photography of seabirds without causing disturbance.

On the other hand, a significant effort is required to support a single media visit. A SUP

must be issued, conditions of the permit discussed with the media representative and agreed upon, advice given on what to expect and conditions of travel, transportation arranged and rescheduled if the boat is canceled. In addition, a full day of time by all personnel on the Refuge to accomplish a "boat day", including a PRBO biologist staff person to transport media personnel on and off the island and host/escort them while they are on the island, (occasionally, depending on profile of the visit), and a FWS staff person to accompany media personnel from mainland to island and throughout the entire visit.

The above criteria were arrived at to allow a level of use that can be supported by refuge resources and staff. Freelance requests are not granted due the volume of commercial requests that would be received if freelancers knew of this opportunity, the difficulty in trying to apply such access fairly, the uncertainty that freelance visits would result in a story, and because it seems unfair to allow a commercial use of closed public land that has such limited access.

The above-described media policy has been in operation on the Refuge for at least 20 years with very minimal impacts to Refuge resources. The only documented impacts have been the crushing of a western gull nest, flushing of western gulls along the paths, and flushing of California sea lions during the boat landing. Collapse of a few auklet burrows is also expected to have occurred. These minor negative impacts are a worthwhile trade-off for informing the public about unique resources and scientific discoveries on the Farallon Islands, and thereby fostering appreciation and support of this Refuge and the Refuge System.

Based on the above described biological impacts and the stipulations, I determined that media activity (one-day requests and multi-day requests) as described above will not materially interfere with or neither detracts from the Farallon National Wildlife Refuge's purposes nor the Refuge System mission.

Mandatory Re-Evaluation Date (provide month and year for "allowed" uses only):

_____ Mandatory 15-year Re-Evaluation Date (for priority public uses)

__X__ Mandatory 10-year Re-Evaluation Date (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

_____ Environmental Impact Statement and Record of Decision

Literature Cited:

Ainley, D.C. and R.J. Bockelheide. 1990. Seabirds of the Farallon Islands: Ecology, Dynamics, and Structure of an Upwelling-System Community. Stanford Univ. Press, Stanford, CA.

Carney, K.M. and W.J. Sydeman. 1999. A review of human disturbance effects on nesting colonial waterbirds. Waterbirds 22:68-79.

Refuge Determination

Prepared by:	_____	_____
	(Signature)	(Date)
Project Leader Approval:	_____	_____
	(Signature)	(Date)
Concurrence Refuge Supervisor:	_____	_____
	(Signature)	(Date)
Assistant Manager, Refuges, California Nevada Operations:	_____	_____
	(Signature)	(Date)

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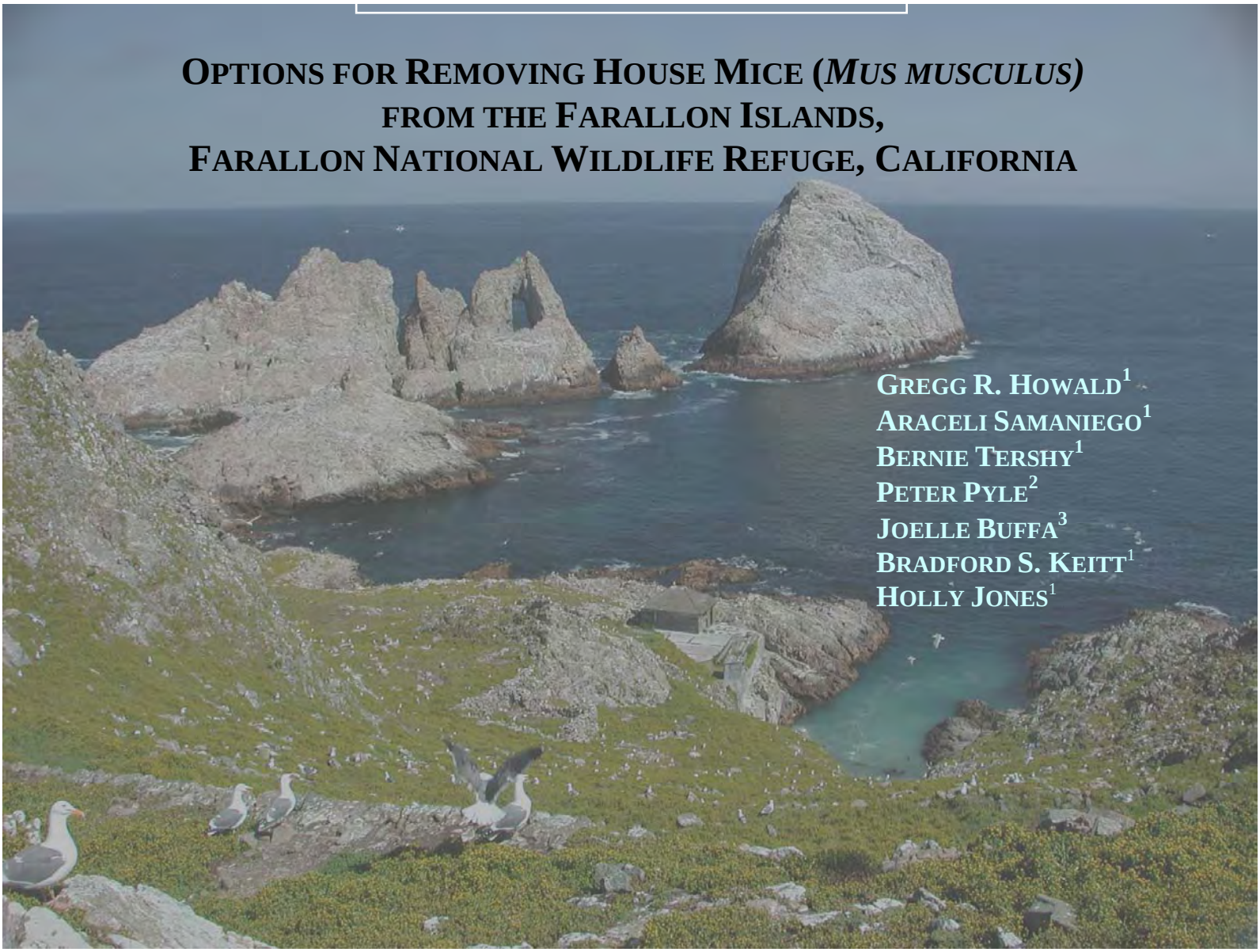
OPTIONS FOR REMOVING HOUSE MICE (*MUS MUSCULUS*) FROM THE FARALLON ISLANDS, FARALLON NATIONAL WILDLIFE REFUGE, CALIFORNIA



GREGG R. HOWALD[1]
ARACELI SAMANIEGO[1]
BERNIE TERSHY[1]
PETER PYLE[2]
JOELLE BUFFA[3]
BRADFORD S. KEITT[1]
HOLLY JONES[1]

1. ISLAND CONSERVATION AND ECOLOGY GROUP, 100 SHAFFER RD., SANTA CRUZ, CALIFORNIA, 95060.
2. POINT REYES BIRD OBSERVATORY,
3. FARALLON NATIONAL WILDLIFE REFUGE, NEWARK, CA.

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BACKGROUND INFORMATION

INTRODUCED SPECIES AND IMPORTANCE OF ISLAND ECOSYSTEMS

Island ecosystems, like the Farallon Islands (managed by the US Fish and Wildlife Service as the Farallon National Wildlife Refuge), are key areas for conservation because they are critical habitat for seabirds and pinnipeds that spend most of their lives in the open ocean, but depend on islands for breeding and resting. In addition, islands are rich in endemic species (islands make up about 3% of the earth's surface, but are home to 15-20% of all plant, reptile, and bird species).

Unfortunately, islands have been disproportionately impacted by humans. Approximately 70% of recorded animal extinctions have occurred on islands, and most of these extinctions, including more than half of all seabird extinctions, were caused by invasive species (Fig.1a). Today, more than half of all IUCN red listed birds are threatened by introduced species (Fig. 1b). Feral cats and rodents are the most devastating introduced species to island ecosystems, where they frequently impact native species through direct predation, competition or changes in the food web. House mice have been introduced onto islands worldwide, causing ecosystem-wide perturbations, including profound effects on the distribution and abundance of native flora and fauna (eg. Crafford and Scholtz 1987; Crafford 1990; Copson 1986).

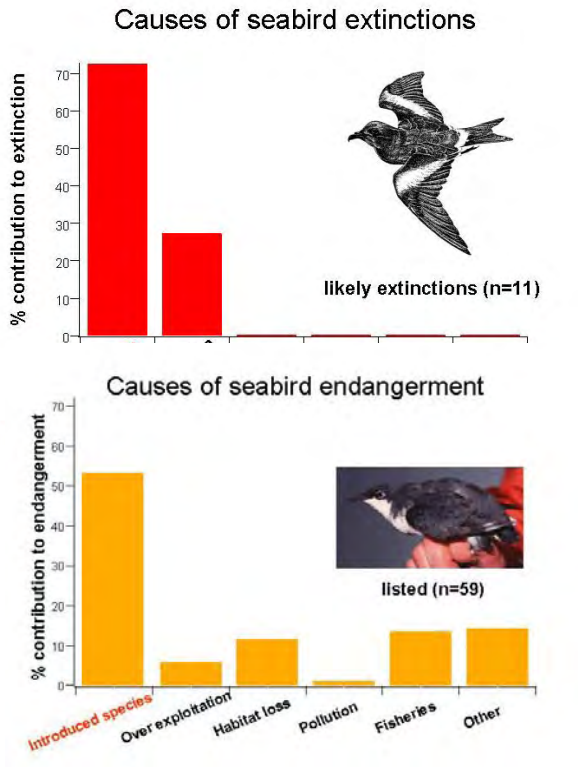


Figure 1. Causes of seabird extinction (a) and endangerment (b) based on IUCN global red list data.

INTRODUCED HOUSE MICE

The house mouse (*Mus musculus*) is among the

most widespread of all mammals, a result of its close association with humans and the relative ease with which it can be transported and introduced to new locations. House mice are among the vertebrates considered to be "significant invasive species" on islands of the South Pacific and Hawaii, having probably reached all inhabited islands in the Pacific as well as some uninhabited islands (Atkinson and Atkinson 2000). The resourcefulness of house mice is evident from their global distribution and their broad habitat range including buildings, agricultural land, coastal regions, grasslands, salt marshes, deserts, forests and subantartic areas (Efford *et al.* 1988, Triggs 1991 and Atkinson and Atkinson 2000).

IMPACTS OF HOUSE MICE AND OTHER RODENTS ON ISLAND ECOSYSTEMS

House mice eat a variety of seeds, fungi, insects, other small animals, reptiles and eggs of small birds. Their diet directly contributes to and has the potential to harm terrestrial ecosystem functions such as the decomposer subsystem of islands (Rowe-Rowe *et al.* 1989, Crafford 1990, Amarasekare 1994, Newman 1994, Cole *et al.* 2000). For example, Newman (1994) found that increased predation by house mice caused the capture rate for McGregor's skink (*C. macgregori)* to decline on Mana Island, New Zealand. After successful mouse eradication, the population of McGregor's skink, the gecko (*Hoplodactylus maculatus*), and the endemic giant cricket (*Deinacrida rugosa*) increased significantly.

SUMMARY OF KNOWLEDGE OF HOUSE MICE ON THE FARALLON ISLANDS

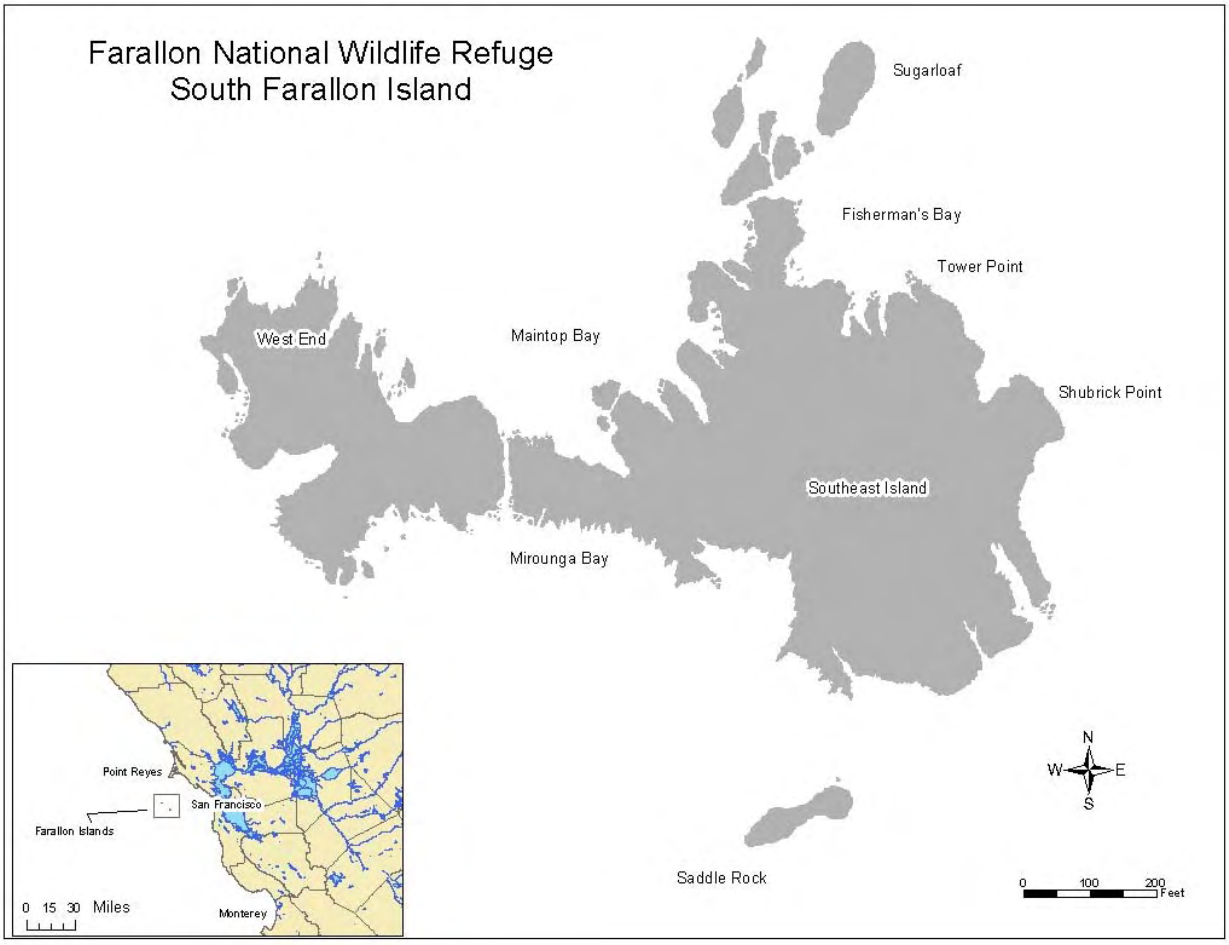
The Southeast Farallon Island (SEFI) (Figure 2) supported introduced rabbits, cats and house mice. Like rabbits and cats (that were successfully eradicated), house mice were introduced by previous human occupants of the island before it became part of the Farallon National Wildlife Refuge in 1969.

Information collected to date on the house mouse of SEFI indicate they:

1. Are distributed evenly on Southeast Farallon Island (SEFI) and have been observed on the West End (FNWR unpub. data).

2. Have not been observed on other islands (e.g., North or Middle Farallon Islands), nor are they suspected to occur on these islands since they have no history of human occupation.
3. Breed from April through November (FNWR unpub. data – based on increasing number of mice captured).
4. Feed on native plants, invertebrates and seabirds (A. Hagen, unpub. data, Ainley and Bockelheide, 1990).

Figure 2. South Farallon Islands and offshore rocks.



Impacts of House Mice on the Farallon Islands

Introduced species on islands often have ecosystem-wide impacts. However, once the distribution and abundance of native species has changed in response to competition or predation from the introduced species, the impacts of introduced species may difficult to detect. Consequently, there are four ways to estimate the impact of introduced species on island ecosystems:

1) comparisons from before and after the introduction or removal of an introduced species;

2) comparisons of exclosure plots, from which introduced species are removed, with similar plots from which introduced species are not removed;

3) comparisons of similar islands with and without the introduced species;

4) logical inference based on the diet of the introduced species and its impact on other island ecosystems.

There are no data from before the house mouse was introduced to the Farallons, and mouse exclosure plots are not technically feasible. Thus, to understand the likely impact of introduced house mice on SEFI one must make comparisons with other similar islands, use logical inference and models.

Seabirds

Hypothesis 1: The eradication of mice will result in increases in one or more of the small hole-nesting seabirds on the refuge islands

On South Farallon Island, introduced house mice appear to be directly and indirectly impacting the breeding success of burrow nesting seabirds, particularly the Ashy Storm-Petrel. Approximately 50-70% of the world's population of Ashy Storm-Petrel (Fig. 3)

breeds on the Farallon Islands. While the Ashy Storm-Petrel has probably always had a restricted distribution and small global population size, recent data suggest this species is in danger of being extirpated from Southeast Farallon Island. Between 1972 and 1992, biologists documented a 42% decline in Ashy Storm-Petrel populations on the Farallons (Sydemann et al 1998). Mortality rate of Ashy Storm-Petrel on the Farallons also appears to be increasing. Recent population viability analyses predict Ashy Storm-Petrel populations will continue to decline at 3% per year (Sydemann et al 1998). Similar declines have been observed in populations of the Cassin's Auklet on the Farallons (Pyle 2001).

House mice are known predators of eggs and chicks of the Ashy Storm-Petrel with potentially as many as 12% of eggs and chicks lost to house mice (Ainley and Boekelhide 1990). Furthermore, mice may be important seed dispersers of non-native weeds that are known to degrade quality nesting habitat for seabirds such as Cassin's Auklet and Rhinoceros Auklet (*Cerorhinca monocerata*) (FNWR, unpub.data.). More importantly, however, the exotic mice appear to be indirectly responsible for declining breeding populations of Ashy Storm-Petrel (and to a lesser extent the Cassin's Auklet) on Southeast Farallon Island due to *hyperpredation* by non-resident, predatory owls. This form of *apparent competition* (see Holt 1977; Roemer et al. 2002) occurs when a local prey species (Ashy Storm-Petrel or Cassin's Auklet) declines due to predation pressure from a predator (owls that normally are not resident on the Farallons) sustained by an alternative prey, in this case the exotic house mice. This type of interaction is now thought to be an under-reported mechanism of biodiversity loss. An example of this phenomenom has recently been documented on Santa Cruz Island, California, where apparent competition and prey switching has led to the restructuring of the food web and near extinction of the island fox (Roemer et al. 2002). A similar pattern has been seen on islands where feral cats can maintain high population densities between seabird breeding seasons because they are subsidized by introduced house mice or rabbits (see Atkinson 1985, Keitt et al. 2002).

Figure 3. Ashy Storm-Petrels are in danger of extinction on the Farallon Islands

On Southeast Farallon Island, over-wintering owls are thought to cause significant mortality to the Ashy Storm-Petrel population and have a similar, but less severe impact on the Cassin's Auklet population. Each October, young Burrowing Owls (a species of special concern in California) arrive on the Farallons during migration (Pyle & Henderson 1991), at a time when the house mouse population peaks. Because of the abundant food source provided by the mice, the owls choose to stay at the island for the winter; - without mice on the island, the owls would continue migrating to more favorable wintering locations. Once winter rains set in the mouse population crashes and the owls are forced to seek other prey. Winter coincides temporally with the arrival of Ashy Storm-Petrels and Cassin's Auklets to excavate ground nest sites, causing the owls to switch their prey preference to seabirds. But the storm-petrels and auklets do not seem to provide enough nutrition for the owls, and most wintering owls die before the spring migration period occurs in April-May (emaciated owl carcasses are routinely found on the island by staff biologists). Up to 10 Burrowing Owls have been recorded wintering per year on Southeast Farallon Island, and biologists have found wings of up to 20 storm-petrels and 2-3 auklets at an owl roost site. The breeding population of Ashy Storm-Petrels on Southeast Farallon Island was estimated at only about 2660 birds in 1992and declining at an estimated 3% per year (1972-1992) (Sydeman et al. 1998) and suspected to be continuing to decline. This devastating scenario for both storm-petrels and owls, has been confirmed through the collection of owl pellets (~65 % of which contain storm-petrel and auklet feathers in late winter and spring) and an analysis of the occurrence patterns of raptors that do and do not prey upon mice (Mills *et al.* 2001).

Without mice, the South Farallon Islands are unlikely to support a wintering population of owls thus greatly reducing adult Ashy Storm-Petrel mortality on the colony. The less severe Cassin's Auklet mortality would also be reduced. The removal of mice will almost certainly encourage population recovery of the Ashy Storm-Petrel and other seabirds. In addition, the entire island ecosystem, including terrestrial invertebrates, the native salamander (*Aneides lugubris farallonensis*), landbirds, and native plants, will benefit from the removal of the non-native mice. The eradication will prevent seed dispersal by mice and will make it easier to manually control exotic weeds.

Salamander

Hypothesis 2: The eradication of house mice will result in a long-term increase in the population size of the Farallon arboreal salamander (*Aneides lugubris farallonensis*), which is considered to be an endemic subspecies**.**

There is likely on overlap in the diet of mice and salamanders, and mice likely prey on salamanders. House mice removal has led to increases in lizard and amphibian numbers on other islands (see Newman 1994).

Terrestrial Invertebrates

Hypothesis 3: Removal of house mice will result in an increase in the population size of terrestrial invertebrates.

House mice are known to prey on local invertebrates (A. Hagen, unpub. data). Removal of house mice has led to significant increases in local invertebrate populations (see Newman 1994). It is expected native invertebrates will show similar increases after house mouse removal from the South Farallon Islands.

Native Plants and Weed Dispersal

The native flora of the Farallon Islands has evolved in the absence of rodents, while most of the island's introduced plants have evolved with rodents. Consequently, house mice are likely to benefit introduced plants more than native plants. House mice feed on native plants and likely disperse seeds of non-native plants on the South Farallon Islands. In season, Farallon Weed (*Lasthenia maritime*) flower receptacles have been found in 45.1% of house mouse stomachs (A. Hagen, unpub. data) and mice are likely limiting the productivity of this valuable native plant. Removing house mice will improve the productivity of the native plants, and reduce the dispersal of weeds. The house mouse removal will

complement the ongoing management program to control invasive plants on the Southeast Farallon Island.

OVERVIEW OF SUCCESSFUL HOUSE MOUSE ERADICATIONS WORLDWIDE

Mice have been removed from at least 20 islands worldwide, ranging in size from 0.7 ha to 700 ha (Table 1). All of the removals used a rodenticide, and none used trapping exclusively. There have been no successful eradications of rodents from islands using trapping alone (Moors 1985). Most of the mouse eradications have been done in conjunction with either rat or rabbit eradications. House mice have been eradicated by placing a rodenticide into every mouse territory on the island. This can be done by manually spreading bait, directly on the ground or into bait stations, or by aerially broadcasting bait from a helicopter equipped with an appropriate spreader.

Removing house mice from islands is significantly more challenging than removing rats from islands. Mice are much less susceptible as rats to the rodenticides, they have a much smaller home range and a complex social structure, and feed somewhat sporadically, trying a small amount of foods from many locations (Macdonald and Fenn 1994), versus rats which tend to feed regularly at a reliable food source. The behavioral and foraging differences between rats and mice indicate that to successfully remove mice from islands, a very high standard of bait quality, bait density, application style and rate must be guaranteed. In addition, there must be enough bait available to all mice in space and time.

Table 1. Successful House Mouse Removals from Islands.

Target species	Island	Size (ha)	Technique	Rodenticide	Reference
Mus musculus, rabbit	Enderby, NZ	700	Aerial	Brodifacoum	Torr 2002
Mus musculus, Rattus sp	Flat, Mauritius	253	Stations	Brodifacoum	Bell 2002
Mus musculus	Cocos, Mauritius	15	Stations	Brodifacoum and bromadiolone	Bell 2002
Mus musculus	Sables, Mauritius	8	Stations	Brodifacoum and bromadiolone	Bell 2002
Mus musculus	Mana, NZ	217	Aerial and stations	Flocoumafen and brodifacoum	Newman 1994
Mus musculus, Rattus sp	Fregate, Seychelles	219	Aerial	Brodifacoum	Merton et al. 2002
Mus musculus	Barrow, Australia	270	Stations	Brodifacoum	Burbidge & Morris 2002
Mus musculus	Varanus, Australia	80	Stations	Pindone and brodifacoum	Burbidge & Morris 2002
Mus musculus	Bridled, Australia	22	Stations	Pindone and brodifacoum	Burbidge & Morris 2002
Mus musculus	Beacon, Australia	1.2	Stations	Pindone and brodifacoum	Burbidge & Morris 2002
Mus musculus	Allports, NZ	16	?	?	Brown 1993a
Mus and Rattus norvegicus	Browns, NZ	58	Aerial	Bromadiolone	Veitch 2002a
Mus and Rattus norvegicus	Hauturu, NZ	10	?	?	D. Veitch, pers. comm..
Mus and Rattus norvegicus	Motuihe, NZ	179	Aerial	Brodifacoum	Veitch 2002b
Mus and Rattus norvegicus	Moturemu, NZ	5	?	?	I. Mcfadden, pers. comm.
Mus and Rattus rattus	Motutapere, NZ	50	?	?	D. Veitch, pers. comm..
Mus and Rattus norvegicua	Motutapu, NZ	2	?	?	Brown 1993a
Mus musculus	Mou Waho, NZ	140	?	?	McKinlay 1999
Mus and Rattus norvegicus	Whenuakura, NZ	3	?	?	Veitch and Bell 1990
Mus musculus	Papakohatu, NZ	0.7	?	?	Lee 1999
Rattus norvegicus Mus musculus	Isla Rasa, MX	59	Stations	Brodifacoum	Tershy et al. 2002

REMOVAL OF MICE FROM SOUTH FARALLON ISLANDS AND ISLETS

CONSTRAINTS

Successful eradication of house mice from islands typically have three major technical constraints: weather, island size and topography, and native species.

Weather

Temperatures on the Farallon Islands are relatively constant throughout the year, seldom falling below 45°F or rising above 65°F. Most rainfall occurs in the winter. Summer moisture is usually limited to damp fog. Offshore fog banks frequently envelope the islands in dense fog.

There are no major weather limitations between September and November each year.

Island Size and Topography

The ~50 ha South Farallon Islands are well within the size range of successful mouse eradications (Table 1). The vast majority of the island is accessible on foot except near the top of the island and the steep outer rocks, which presents a logistical problem to a ground based operation – danger to operators (ropes would have to be installed). Other potential problems to a ground-based operation include soil erosion and compaction along gridlines, and dispersing weed seeds into areas of the island that is currently weed free.

The aerial broadcast of bait would overcome all of the limitations of a ground based operation but efforts would be required to ensure that enough bait is available to all mice on the steep cliffs and offshore rocks.

Native Species

A mouse eradication program could negatively impact native species through disturbance and by unintended, direct or indirect, exposure to the rodenticide. Specific mitigation measures to minimize the risk of disturbance and exposure to the rodenticide are outlined below.

Disturbance

There are no species on the Farallon Islands that would suffer long term population level impact from disturbance due to eradication activities. Seabird nesting and marine mammal pupping on the island occurs during well-defined seasons, which will be avoided. There are no nesting landbirds on the island, however migrating passerines stopover on the few trees found on Southeast Farallon Island during spring and early fall. The project will take place during the non-breeding season, when numbers of seabirds, marine mammals and landbirds are at there lowest point. Disturbance to roosting seabirds and hauled out pinnipeds can be minimized by:

1. Timing the eradication to occur when wildlife species are using the islands minimally, and outside of the breeding season,
2. Timing the eradication to occur when the peak of landbird migration is over,
3. Phasing the field operations so that there is always alternative roosting/haul out habitat available,
4. Avoiding working for extended periods of time in vicinity of roosts, rookeries and haul outs,
5. Working cautiously and slowly around the animals using techniques that minimize disturbance.

Non-Target Rodenticide Exposure

Unintentional poisoning can also directly and indirectly impact native species. Direct or primary poisoning can occur if non-target species consume the bait directly. Indirect

(secondary) poisoning of scavengers and birds of prey can occur from consuming poisoned house mice and/or birds. However, limiting the potential exposure or choosing a lesser toxic rodenticide can mitigate the impact to these species. For example, it is possible to time the project when these species have moved off the island and are not breeding, present the bait in protected bait stations and/or formulate bait that birds and scavengers would be less attracted to or unable to consume - such as a large, wax coated, green or blue dyed pellet colors that birds tend to avoid (Buckle 1994, H. Gellerman, unpub. data).

RODENTICIDES

For the successful eradication of introduced house mice from the Farallon NWR, the fundamental requirement is that every last house mouse is removed or killed. Thus, every effort is made to get the last house mouse. The use of bait containing a rodenticide is the only known technique capable of achieving eradication. The choice of bait must have a high likelihood of achieving eradication, but must be evaluated against potential negative consequences, such as non-target poisoning.

Strictly from an eradication perspective, the choice of bait used must:

- contain an active ingredient that is known to be highly efficacious to house mice,
- be palatable and demonstrate low or no bait shyness by house mice,
- delivered into the territory of each house mouse on the island,
- be consumed in sufficient amounts by every single house mouse to receive a lethal dose.

From an efficacy standpoint, the bait must contain a rodenticide that has the ability to kill the house mice and prevent the possibility of incurring bait shyness (individuals that will intentionally avoid the bait). There are three classes of rodenticides available on the market in the US. They are the acute rodenticides, the subacute rodenticides, and the anticoagulants (Table 2).

Acute Rodenticides

Zinc Phosphide, Bromethalin

Acute rodenticides kill house mice quickly after a single feeding. The major benefit of acute rodenticides is that house mice die quickly before they build up high levels of rodenticide in their tissue. This reduces the incidence of secondary poisoning. However, there are two drawbacks to the use of acute rodenticides. First, they are often extremely toxic to humans and there are not always effective antidotes. Second, they can induce bait avoidance if animals consume a sub-lethal dose. For these reasons acute rodenticides have not, to our knowledge, been used to eradicate house mice from islands.

The acute rodenticides, such as zinc phosphide, are known to induce some degree of bait shyness due to the rapid onset of poisoning symptoms. Studies with zinc phosphide have demonstrated that rats associate the toxic symptoms with a toxic bait if the onset of symptoms occur within 6-7 hours of consumption (see Lund 1988). Thus, any individual surviving that round of exposure is likely to avoid the bait in the future (Record and Marsh 1988). To overcome this potential, it is recommended to pre-bait, where unarmed bait (i.e., bait without the toxic ingredient) is delivered into the environment and the target animal is allowed to consume the bait. After a period of time, the armed product is delivered and bait take is believed to be higher than with no pre-baiting, thus increasing efficacy. In island restoration projects, there is no guarantee that pre-baiting will increase efficacy to 100% and thus is not recommended. To improve acceptance and reduce potential of bait shyness, bait should contain an active ingredient that has a delayed onset of toxicosis.

Table 2. Characteristics of the Rodenticides Registered with the USEPA.

Rodenticide	Biological Half-Life in Tissue	Rodenticide Category	Efficacy			Public Health		Non-Target Species		
								Birds		Inverts
			Previous Success in Island Restoration	Activity	Bait Shyness	Danger to Humans	Antidote Available	**Primary**	**Secondary**	Primary
Brodifacoum	Long	Anticoagulant	High	Single-Feed	Low	Low	Yes	Very High	Very High	No
Difethialone	Long?	Anticoagulant	None	Single-Feed	Low	Low	Yes	Very High	Very High	No
Bromadialone	Long	Anticoagulant	Low	Single-Feed	Low	Low	Yes	High	High	No
Chlorophacinone	No Data	Anticoagulant	None	Multi-Dose	Possible	Low	Yes	Moderate	Low to Moderate	No
Diphacinone	No Data	Anticoagulant	None	Multi-Dose	Possible	Low	Yes	Moderate	Moderate	No
Warfarin	Short	Anticoagulant	None	Multi-Dose	Possible	Low	Yes	Very Low	Low	No
Bromethalin	Short	Sub -Acute	None	Single-Feed	Likely	High	No	Very High	Low	Yes
Zinc Phosphide	None	Acute	None	Single-Feed	Likely	High	No	High	Low	No Data
Cholecalciferol	None?	Sub-Acute	None	Single-Feed	Possible	Moderate	Yes	Very Low	Low	No Data

Subacute Rodenticides

Cholecalciferol

Subacute rodenticides have similar properties to acute rodenticides, however, death may be delayed beyond 24 hours. Cholecalciferol disrupts the calcium homeostasis mechanism, resulting in the resorption of calcium from bone, and is the only subacute rodenticide registered with the US EPA. Death results from hypercalcemia causing kidney failure and heart arrhythmias. A benefit of cholecalciferol is that the symptoms are somewhat delayed between 24 hours to several days after ingestion. However, symptoms of toxicosis can be felt after ingestion of a sub-lethal dose that could result in development of bait shyness on recovery (Prescott et al. 1992). There is very little field data from the use of this product; however, it appears that it has potential as an island restoration rodenticide. Cholecalciferol was tested successfully to remove rats from a small offshore islet of San Jorge, Mexico (Donlan et al. 2002) It is not toxic to birds. (based on LD50 data) and preliminary data suggests it does not present a secondary poisoning hazard.

Anticoagulants

The most widely used rodenticides over the last 50 years have been anticoagulants, primarily warfarin and brodifacoum. They are incredibly effective compared to other rodenticides and about a dozen varieties have been developed, of which only 6 are available in the US. All anticoagulant rodenticides act by blocking the vitamin K1 dependent oxidation-reduction cycle in the liver. They also cause capillary damage. As a result, death is due to massive internal hemorrhaging (Taylor 1993). Because illness is delayed, house mice generally do not develop bait avoidance behavior and will continue consuming bait when ill. Thus, there is no social transmission of bait avoidance and no pre-baiting is needed.

There are three first-generation anticoagulants (warfarin, chlorophacinone, and diphacinone) and second-generation anticoagulants (brodifacoum, difethialone, bromadiolone). First generation anticoagulants require house mice to feed on the bait over a period of days, decreasing the probability that all house mice will receive a lethal dose. The second-

generation anticoagulants are able to induce mortality after a single-feed, dramatically increasing the probability that all house mice will receive a lethal dose.

First Generation Anticoagulants

The most widely used first generation anticoagulant is warfarin. The main benefit of warfarin is its low toxicity to birds (Kaukeinen 1993). However, house mice must feed over several days exclusively on warfarin bait in order to consume a toxic dose. The control of house mice can be a strong selection agent, increasing the frequency of house mice that cannot be killed via the control method used. Where populations of house mice have been previously exposed to rodenticides, some house mice demonstrate bait avoidance behavior and others may be biochemically "resistant" to the anticoagulant used. Most importantly, there has been no successful eradication of house mice with a first generation anticoagulant, that we are aware of. In Australia, mice were removed from islands using pindone, a first generation anticoagulant in conjunction with a second generation anticoagulant.

Second Generation Anticoagulants

The second-generation anticoagulants will kill warfarin-resistant house mice and, if in sufficient concentration, kill house mice after a single feeding, thus dramatically increasing the probability of successful eradication. Only brodifacoum has been used successfully and repeatedly to eradicate house mice from islands worldwide. Currently, it is the primary rodenticide recommended to ensure successful eradication of house mice from islands.

Brodifacoum is the active ingredient in most off the shelf rodenticides such as DeCon. It is the rodenticide most commonly used by pest control professionals. It is the most frequently used rodenticide in successful house mouse eradication projects (Table 1).

Brodifacoum, like warfarin, is a coumarin-based anticoagulant (Chemical formula (3-[3- 4'-bromo(1-1'-biphenyl)-4-y-1]-1,2,3,4-tetrahydro-1-naphthalenyl]-4-hydroxy-2H-1-benzopyran-2-one)). Coumarin is a common substance in green plants that was discovered when moist and molded clover hay caused internal bleeding and mortality in cattle (Lund 1988a, in Taylor 1993). It is also found in high concentrations in *Gliricida sepium*, a Central

American plant widely used as a natural form of rodent control (Hochman 1966, in Taylor 1993). Unlike warfarin, brodifacoum is a second-generation coumarin that can kill house mice after a single feeding.

Detailed descriptions of brodifacoum and its effects on non-target species can be found in Taylor (1993), Kaukeinen (1993), and Howald (1997). The following discussion comes primarily from Taylor (1993) unless otherwise cited.

Absorption & Degradation in Soil

The half-life of brodifacoum in soil is from 84-170 days and it is less stable in alkaline soils. Degradation of brodifacoum by soil microbes results in non-toxic metabolites in microorganisms, and eventual reduction to its base components of CO_2 and H_2O.

Half Life in Living Organisms

The half-life of brodifacoum in the tissue of living organisms is about the same as that in soil 150-200 days. However, there is some evidence that it may be somewhat longer. In house mice, and perhaps other mammals, 75% of a lethal dose is maintained in the liver, the rest is absorbed into other tissue at a variable rate.

Soil Mobility of Brodifacoum

Brodifacoum is not soluble in water, and will not migrate from the land to the water supply or ocean. Because brodifacoum remains absorbed to soil, only erosion of the soil will result in it reaching the water. However, it would remain absorbed to organic material and settle out into the sediment, which would be widely dispersed and diluted by waves and currents.

Uptake by Plants

Field tests have shown no significant transfer of brodifacoum from soil to grass, even at applications rates 15 times higher than normal rates of application on rangelands. No

brodifacoum was detected in samples of grasses collected post eradication on East Anacapa Island (Howald et al., in prep.)

Effects on Humans

Brodifacoum is potentially toxic to all mammals including humans. Although there may be some skin irritation caused by contact with bait, poisoning is only likely if ingested. The lethal dose of brodifacoum for a human is likely between 0.28 – 25 mg/kg (based on the range of toxic doses in five species of mammals). Assuming the bait used on the **South** Farallon Islands would be 5 g pellets with 25 ppm brodifacoum, spread at 10 kg/ha, a 70 kg adult would have to find and consume a minimum of 140 pellets, which would be spread over a 700 square meter area to consume a lethal dose.

Even if a person did consume a lethal dose of bait, death is extremely unlikely because brodifacoum is slow acting and the symptoms are treated with the antidote vitamin K1. In fact, there are no recorded cases of accidental poisonings of humans caused by brodifacoum, even though brodifacoum is the most widely used second-generation anticoagulant rodenticide in the world (Taylor 1993).

Effects on Marine Mammals

Because of the insolubility of brodifacoum (see above), and the large waves, strong winds and currents, it is highly unlikely that brodifacoum will in any way affect marine animals. Previous eradication programs using brodifacoum in New Zealand, the Mauritius Islands, and Canada, have not considered the threat to marine mammals as warranting serious consideration.

The pinnipeds using the island are piscivorous and will not consume any bait or dead and/or dying mice. They will be unable to find enough dead mice or bait pellets to warrant any concern. Fish will likely not consume any pellets that may enter the marine environment. Studies in New Zealand and California have documented no evidence of fish consuming the bait or brodifacoum moving through the marine ecosystem (ICEG 2000). No brodifacoum

was detected in shore crabs, hermit crabs, mussels or tidepool sculpins after rat eradication from Anacapa Island (Howald et al, in prep). Brodifacoum does not accumulate in tissues, or affect land crabs (Paine et al. 2000).

Effects on Marine and Terrestrial Invertebrates

Anticoagulant rodenticides are not known to affect invertebrates**,** likely because of their different blood clotting systems. Extensive field and lab trials have shown that tinibrionid beetles (Tershy et al. 1992), land crabs (Pain et al. 2000), snails, slugs (Howald 1997), and ants (B. Tershy, unpubl. data) can survive on a diet of 20-50 ppm brodifacoum. In addition, invertebrates do not appear to accumulate residues, minimizing the transport of brodifacoum into the ecosystem.

Effects on Amphibians

Salamanders may feed directly on bait or on invertebrates that have fed on bait. However, this is unlikely to result in significant salamander mortality. There are, to our knowledge, no published studies on the toxicity of brodifacoum to amphibians or reptiles. Unpublished data suggests that snakes fed brodifacoum killed house mice (R. Marsh pers. comm.), and lizards force fed 50ppm brodifacoum survived for at least several weeks (Tershy unpubl. data). Eason and Spurr (1995) reported brodifacoum poisoned skinks, testing positive for brodifacoum residues and apparent hemorrhaging. However, neither study tested the ability of these individuals to breed. More conclusive is empirical experience from large-scale rabbit and rat eradication campaigns using brodifacoum. None of these have resulted in detectable mortality to endemic and native lizards, or declines in populations (Merton 1987). In fact, lizard and amphibian populations typically increased after house mice were eradicated using brodifacoum (e.g. Towns 1991, Cree et al. 1992, T. Comendant, pers. comm..), indicating that no extensive mitigation is necessary.

Effects on Native Birds

Brodifacoum is toxic to birds. However, the toxicity is highly variable among species. The bird species using the island that are most likely to directly consume bait or poisoned house mice are granivorous sparrows and predatory birds (Table 3). We were unable to find published LD50's for non-target birds found on the Farallons, but published LD50's for several different Passerine birds range from 3.0-6.0 mg/kg. For an untested bird species there is a 95% probability that its LD50 will be above 0.56mg/kg (Howald 1997).

Table 3. Native Species at risk of primary and secondary exposure to the rodenticide.

Species	Primary	Secondary	Population Significance	Mitigation
Golden-crowned Sparrow	High	Low	None	None or Translocate
White-crowned Sparrow	High	Low	None	None or Translocate
Fox Sparrow	High	Low	None	None or Translocate
Burrowing Owl	None	High	None	Translocate
Barn Owl	None	High	None	Translocate
American Kestrel	None	High	None	Translocate

GROUND VS. AERIAL OPERATION

Bait can be delivered by one of three ways: hand distribution to bait stations, broadcast by hand or aerially, and a combination of the two.

Hand Spreading to Bait Stations

This technique was developed in New Zealand, and has been used successfully on a number of islands (Table 1). Typically, for mouse eradication, bait stations are placed along a 10 x 10

m or 20 x 20 m grid and filled with pelleted bait or wax coated grain blocks with 50 ppm brodifacoum. Bait stations are checked daily until the bait take slows or ceases, then checked weekly and monthly. The bait stations remain on the island for 9-10 months. Rat eradication requires stations to remain in place for up to two years and is strongly recommended for mouse eradication.

The main advantages of using bait stations are: 1) it can limit access to bait by non-target species such as birds, and larger mammals; 2) it is possible to quantify bait consumption and to remove much of the bait that is not consumed. The main disadvantages are: cost, inability to deploy bait stations on cliffs, and trampling, erosion, and other disturbances caused during frequent visits to bait stations.

The vast majority of the South Farallon Islands are accessible on foot, except for the steep slopes, cliffs and peaks near the center of the island, and the majority of the islets, **w**hich preclude the use of bait stations without the installation of safety ropes and personnel who are good climbers. Additionally there could be unacceptable disturbance to marine mammals and other wildlife from repeated visits to bait stations over time.

Aerial Application

On larger islands or islands with steep cliffs a broadcast of bait from a helicopter with an under slung bait spreader can be very effective. Pelletized bait is spread using differential GPS or ground markers to ensure even spread. Aerial broadcast of pesticides is a common practice in agricultural areas, and the technology has been adapted successfully to island eradications. The key to successful eradication is working with a good pilot and ensuring that bait is available in every mouse territory.

Removal of house mice by aerial broadcast has only been successfully implemented on two islands, in contrast with the numerous successful rat eradications. Mouse eradication was a secondary goal of the projects and it is unclear as to what factors were responsible for the successful mouse removed. On discussion with specialists involved with these projects, the reason for successful removal is unclear. There has been speculation that the social

hierarchy of mice is more structured than rats, and thus, requires a minimum of two pulses, at least 2-3 weeks apart for successful removal.

The main advantages of an aerial application are relatively low cost, safety for operators, short amount of time bait is available to non-target species, and minimum disturbance to vegetation, soil and wildlife. The main disadvantage is the inability to quantify bait consumption and to retract bait once it has been deployed.

Mixed Station and Aerial

This technique was applied on Mana Island, NZ where bait was aerially applied to steep, inaccessible cliffs, and manually applied in bait stations to the remainder of the island. This was first used successfully on Codfish Island, New Zealand during a rat eradication, to minimize risks to non-target birds in 1997 (McClelland 2002). Stations were used on ~ 40 ha of the island to prevent birds from gaining access to the bait. The remaining island was treated using aerial broadcast. This approach was also used on a very limited scale on East and West Anacapa Island in 2001/2002, with apparent success.

The vast majority of the South Farallon Islands are accessible and could be treated with bait stations. However, the steep cliffs and unstable slopes on near the center of the island and offshore rocks necessitates an aerial or hand broadcast, without putting personnel in some degree of danger.

ERADICATION OF HOUSE MICE FROM THE SOUTH FARALLON ISLANDS

ISSUES CONSIDERED

For the development of the recommended approach and mitigation needs, we identified the significant environmental issues to consider after a site visit to the island, discussions with the Farallon National Wildlife Refuge (FNWR) staff, and discussion with Point Reyes Bird Observatory (PRBO) biologists. We considered:

- Probability of successfully eradicating house mice from the island.

- Potential non-target impacts to birds and mammals – disturbance, exposure to the rodenticide and potential distribution of weed seeds into pristine areas of the island.
- Potential impacts to seabird nesting habitat and soil erosion.

The project must be successful in eradicating house mice from the South Farallon Islands, have minimal impacts to non-target birds and mammals, and the fragile island habitat.

RECOMMENDED APPROACH

Overview

We believe that a minimum 2-3 pulse aerial broadcast of bait containing 25-50 ppm brodifacoum, 2-3 weeks apart, is the most feasible approach to remove house mice from the FNWR, while balancing the environmental issues considered above. The refuge will need to conduct a feasibility study to test and refine the techniques for house mouse removal prior to the final eradication attempt. We recommend following the techniques currently used in California, Hawaii, New Zealand and elsewhere.

We suggest that bait be broadcast from a hopper suspended under a helicopter. The island should be blocked into two sections, perimeter and interior. We recommend the perimeter and offshore rocks be treated with the hopper fitted with a deflector (bait spread out one side of the hopper) to prevent bait spread into the marine ecosystem. The interior of the island can be treated with the deflector removed from the hopper and bait spread in a 360 degree pattern. The application rate will need further research, and will be determined by the density of mice on the island. House mice can have a very small home range (DeLong 1967) and it is absolutely critical that bait be delivered into every mouse home range in sufficient quantity. To ensure adequate application, the helicopter should be fitted with an onboard Differential GPS and computer and verified with ground plots, to ensure even bait application on the island.

Bait Application

Successful eradication of rodents from islands by aerial broadcast requires the cooperation and dedication of experienced agricultural pesticide applicators or pilots experienced in eradications. There are many potential applicators in northern California that should be identified and assessed on their abilities to complete the eradication. The applicator used on Anacapa Island is located in Southern California, and is familiar with the high standard needed to eradicate rodents from islands.

A series of calibration trials will need to be conducted prior to the aerial operation on the FNWR. The hopper will need to be calibrated for flow rate and swath width – how fast and how far the bait is propelled out of the hopper. The flow rate, swath width and desired application rate together will determine the speed that the helicopter should fly. It is recommended that an aerial application calibration trial with non-toxic bait (bait with everything except the active ingredient) be conducted prior to the application. Monitoring of bait application should be ongoing while baiting to ensure that the hopper is operating correctly.

Timing

Rodent eradications from islands are more likely to be successful if they take place when the population is declining or at its low point in the annual cycle. The mice at this time are food stressed and more likely to eat the bait presented. Population monitoring of house mice on Southeast Farallon Island indicate that December through April is when house mice are at the most favorable point in their population cycle for eradication (FNWR unpub. data).

The timing of the eradication will need to balance the ideal biological timing of the eradication with weather conditions, operational logistics, and the potential disturbance to breeding marine mammals and seabirds. We recommend that the bait application take place at the tail end of the annual mouse breeding cycle, before the winter rains set in and to avoid pupping sea lions and elephant seals, most migratory landbirds and nesting seabirds.

Bait

Pesticide use in the US is highly regulated by the US EPA. The bait used on South Farallon Island will need to be registered by the US EPA under FIFRA. The process to register a bait product is complex and requires an in depth analysis of the regulations and consultation with other conservation practitioners using rodenticides in the field. There are three registration options –a Section 3 registration, Experimental Use Permit (EUP), or an exemption (Emergency or Quarantine). The Section 3 registration is not viable for the purpose of the project without an extensive data set that is currently unavailable. Unfortunately there are no baits registered with the US EPA authorized for aerial broadcast to remove house mice from islands. Either a new bait must be developed and registered with the EPA or the FNWR can build upon an aerial broadcast bait used on Anacapa Island, California (CI-25 containing 25 ppm brodifacoum) or Hawaii (Ramik Green containing 50 ppm diphacinone).

The bait should be formulated so that it is on the ground long enough for all mice to be exposed to it, but degrade rapidly to minimize the temporal risk of primary exposure. The bait should be formulated to prevent premature degradation in the wet, maritime climate, and dyed green/blue minimize the risk of primary exposure to birds. In addition, the bait should not contain bitrex (a bittering agent added to baits to prevent humans from consuming the bait), which will reduce palatability to the mice.

Buildings

Human activity on the island is the weakest link to successfully removing mice from the FNWR. The staff occupied houses provide ideal nesting and protection cover, with easy access to food such as crumbs, garbage and compost. Prior to the baiting, the garbage, compost and hygiene protocols should be evaluated and changed to further reduce the attractiveness of human foods and waste. In particular,

1. Garbage should be placed in sealable containers or barrels, not plastic bags, open containers or cardboard boxes.
2. All food containers should be rinsed prior to being placed into the garbage.

3. The compost should be removed and not used 3 months prior to the bait application and not re-activated until the mouse eradication is declared successful.
4. Several months before the baiting, the overall cleanliness should be improved, especially in the kitchen area, ensuring crumbs, spills, and dirty dishes etc. are cleaned up immediately.
5. Foodstuffs should be stored in protected cupboards or containers inaccessible to mice.

All of the buildings will need to be treated with bait stations. We suggest that the FNWR develop protocols after consulting with a rodent control specialist experienced in urban rodent control. We recommend, Bruce Badzik, National Park Service IPM regional coordinator based out of the Golden Gate National Wildlife Refuge. Bruce has broad background in urban rodent control and experience in island rodent eradications.

MITIGATION NEEDS

Marine Mammals

The South Farallons are utilized by five species including Harbor Seal *Phoca vitulina*, California Sea Lion *Zalophus californianus*, Steller's Sea Lion *Eumetopias jubatus*, Northern Elephant Seal *Mirounga angustirostris* and the Northern Fur Seal *Callorhinus ursinus* throughout the year, with the vast majority of activity in late winter through early summer. Only the Steller's Sea Lion and the Northern Elephant Seal regularly breed on the island. Steller's Sea Lion pup May – July and Elephant Seals pup ~ December 25 to early March. (A few California sea lions and harbor seals occasionally pup on the during the summer months.) Therefore, field operations can take place from September through mid- December each year without disturbing breeding pinnipeds.

Seals and sea lions will likely be hauled out on the island during field operations and human activity at these treatment sites may disturb individuals causing them to temporarily relocate to an alternate haul out, away from the activity or return to the haul out after the disturbance has passed. Impacts to the pinnipeds may be displacement during aerial bait placement or

visits to bait stations and post-application monitoring. To lower the risks of disturbance, field operations should be conducted outside of the breeding season, and when the lowest numbers of individuals are using key beaches.

An aerial broadcast approach would cause minimal disturbance by overflights at haul outs. There would only be one to two overflights, the disturbance would pass quickly, and the animals would return to the haul out quickly (G. Howald, pers. obs.). Field crews can minimize disturbance at haul outs by working slowly and cautiously, and, if necessary, allowing for individual animals to move off key beaches slowly..

There would be no direct effect of the rodenticide bait on the pinnipeds since they are piscivorous. It is unlikely that they would ingest any bait directly, or secondarily from contaminated prey. A deflector mounted under a hopper used in aerial broadcast would be used to prevent bait spread in the marine environment. Any bait that may drift into the marine environment would not likely be consumed by fish (ICEG, unpublished data) or disintegrate rapidly due to wave action on the shoreline. The pinnipeds will not eat dead and poisoned mice. There is no likelihood that the seals and sea lions would consume enough of the rodenticide to cause any symptoms of exposure (National Park Service 2000).

Seabirds

There is a well defined seabird breeding seasons on the Farallons. Seabirds breed on the islands generally between mid-March and mid-August each year. Therefore, baiting on the island can take place from September through February with low risk of disturbing breeding seabirds.

Landbirds

Most landbirds arriving on the island are migratory and ~~most~~ seek out shelter at one of the three treed locations of the island. The majority of arriving landbirds stay for 1-3 days before moving on at the next favorable weather window. Peak fall migration occurs September through October. A maximum of ~5-10 granivorous Fox Sparrows, Golden-

crowned Sparrows and White-crowned Sparrows may overwinter on the island. There is no risk at the species level for any of these birds, however, there is a risk that individual birds may attempt to pick up and eat the bait. The bait pellets should be dyed green, a color that small birds tend to avoid, and the pellets should be large enough to prevent the birds from swallowing the pellets. Mist-netting and removing the individual birds from the island, or holding them in aviaries until the risk period has passed, ~3-4 weeks post application is a mitigation option that has been used successfully elsewhere for granivorous Passerines (Merton 2002). There is no need to mitigate for impact to insectivorous species as the risk of exposure to the rodenticide is much lower and not very likely to have an affect

Predatory Birds

Birds of prey that feed on mice are particularly susceptible to the secondary exposure of brodifacoum from consuming poisoned mice after the application. Therefore, to prevent the loss of individual birds of prey, we recommend a mitigation program to live trap and remove the birds of prey that may potentially feed on mice, prior to the baiting and translocate to the mainland. This mitigation was successfully implemented on Anacapa Island in 2001-2002, with ~65 % of the local raptor population removed prior and just after the eradication effort. The overwintering raptor population on the South Farallon Islands is fairly small (~ <10 individuals) represented by ~0-1 barn owls, ~2-5 burrowing owls, ~0-1 American Kestrel, and 1-3 peregrine falcons. The loss of the individual birds of prey would not affect any of the species at the population level. The Burrowing Owl is a California state species of special concern, and live trapping and translocating burrowing owls would benefit the mainland population as individual birds that overwinter on the South Farallon Islands generally do not survive the winter.

Threatened/Endangered Species

Brown Pelicans

Brown Pelicans do not breed on the Farallon Islands, but roost on cliff faces during the fall. Although at least a few pelicans are present throughout the year, pelican use of the Farallon Islands is greatest in September through November, after birds disperse from their breeding

sites in Southern California and Mexico. Roosting pelican numbers peak in October, and begin to decline in November when the birds start returning to their breeding grounds. The majority of pelicans leave by February in most years. Pelicans may be roosting on the island during field operations, helicopter activity at these treatment sites may cause them to temporarily relocate to an alternate roost site away from the activity. Helicopter activity would be limited to one to two passes and phasing the aerial operation such that there would always be alternate roosting habitat available would minimize disturbance. There would be no direct effect of the rodenticide bait on the pelicans since they are piscivorous. There is no likelihood that they would ingest any bait directly, or secondarily from contaminated prey. The bait would be in a pellet form and is not expected to adhere to bird feet or feathers, therefore, it is unlikely that pelicans will inadvertently ingest the pellets during preening activities. Pelicans are not scavengers and will not eat dead and poisoned rodents. Pelican prey species are schooling fish such as anchovies and sardines, species which would not come into contact with the bait.

The implementation of this project will not have an adverse impact on the roosting or breeding population size, their fledging success or survival. Impacts to Brown Pelicans are limited to temporary displacement of roosting pelicans during aerial bait placement, and post-application monitoring activities. After the aerial application of bait onto East Anacapa Island in 2001, the numbers of roosting pelicans increased on the island (H. Carter, pers. comm.), suggesting that any disturbance would be temporary and not likely to adversely affect the federally endangered Brown Pelican.

Steller's Sea Lion

Steller's Sea Lion is the only federally listed species that breeds on the Farallon Islands. It is a threatened species and the South Farallon Island rookery and waters around the Refuge are designated critical habitat. Steller's sea lion breed in small numbers on the South Farallon Islands and pupping occurs from late May through mid-July. Ten or less pups are born each year. Peak numbers of Steller's sea lions occur during the summer. Another influx of

Steller's, usually occurs in the fall from September to December, when mother-pup pairs move from Ano Nuevo to haul-out on the Farallon Islands.

The project would occur during the non-breeding season, so impacts to Steller's sea lion would be limited to temporary disturbance to hauled-out animals during bait placement. Animals would be expected to move from their haul-out locations into the water, and return once the disturbance has passed. Even though this is not expected to have a long-term adverse affect on populations or individual animals, it would still likely be considered a "taking" under the Endangered Species Act, so a Section 7 consultation would need to be done with the National Marine Fisheries Service.

There would be no direct effect of the rodenticide bait on Steller's sea lions since they are piscivorous. There is no likelihood that they would ingest any bait directly, or secondarily from contaminated prey. Steller's sea lions will not eat dead and poisoned mice.

Water CollectionSystem

The source of drinking and wash water on the islands is collected rainwater. All water used on the island is collected from surface runoff during rainfall events. Water is collected on an 18,000 square foot cement catchment pad during the rainy season (November-March). The water from the first few rainfalls are diverted to "wash" the buildup of guano before water is diverted into the settling tank. A wooden plank (flashboard) is used to divert water from the settling tank to the drain. On collection, water flows into a 8,000 gal. settling tank. Water is pumped from the settling tank to a 160,000 gal. storage cistern after each rainfall. Once a month, water is pumped from the cistern to the 10,000 gal. water supply tank which sits mid-way up lighthouse hill above the main house. Between the settling tank and the potable water spigots in the house, water passes through 11 different filter/treatment devices, in the following order: 50 micron, 25 micron, 5 micron and 1 micron GAF sediment filters, 2 ozone purifiers, two 5-micron sediment filters, 1 UV filter/light, nitrogen filtering medium, 0.1 micron fiter medium.

The risk of rodenticides entering into and contaminating the water supply is very low. The solubility of brodifacoum is very low, and will not enter into solution, unless attached to organic matter. The 6 sediment micron (50-0.1 micron) filters would filter any particulate that brodifacoum would be attached, further reduces the risk of brodifacoum from reaching the taps in the housing to near nil. There is no likelihood that brodifacoum of any measurable concentration or biological significance will enter into the water supply with very basic precautions.

- Exclude the concrete pad and storage tanks from aerial broadcast. The concrete pad and water storage facilities offer mice very poor quality foraging or cover habitat and are not likely using them extensively.
- Use bait stations in and around water collection facility.
- Sweep the concrete pad after aerial application and remove any pellets that may have drifted into the exclusion zone.
- Ensure the flashboard does not leak, completely isolating tank from water that is being flushed off pad.
- Trench the uphill side of the concrete pad to intercept and prevent pellets from rolling onto the collection pad.
- Increase the flushing/cleaning cycles.
- Use drinking water from the mainland until water quality monitoring of collected rainwater confirms no brodifacoum residues.
- Monitor collected water for brodifacoum levels at settling tank and taps in housing.

PROJECT COMMAND STRUCTURE & ORGANIZATION

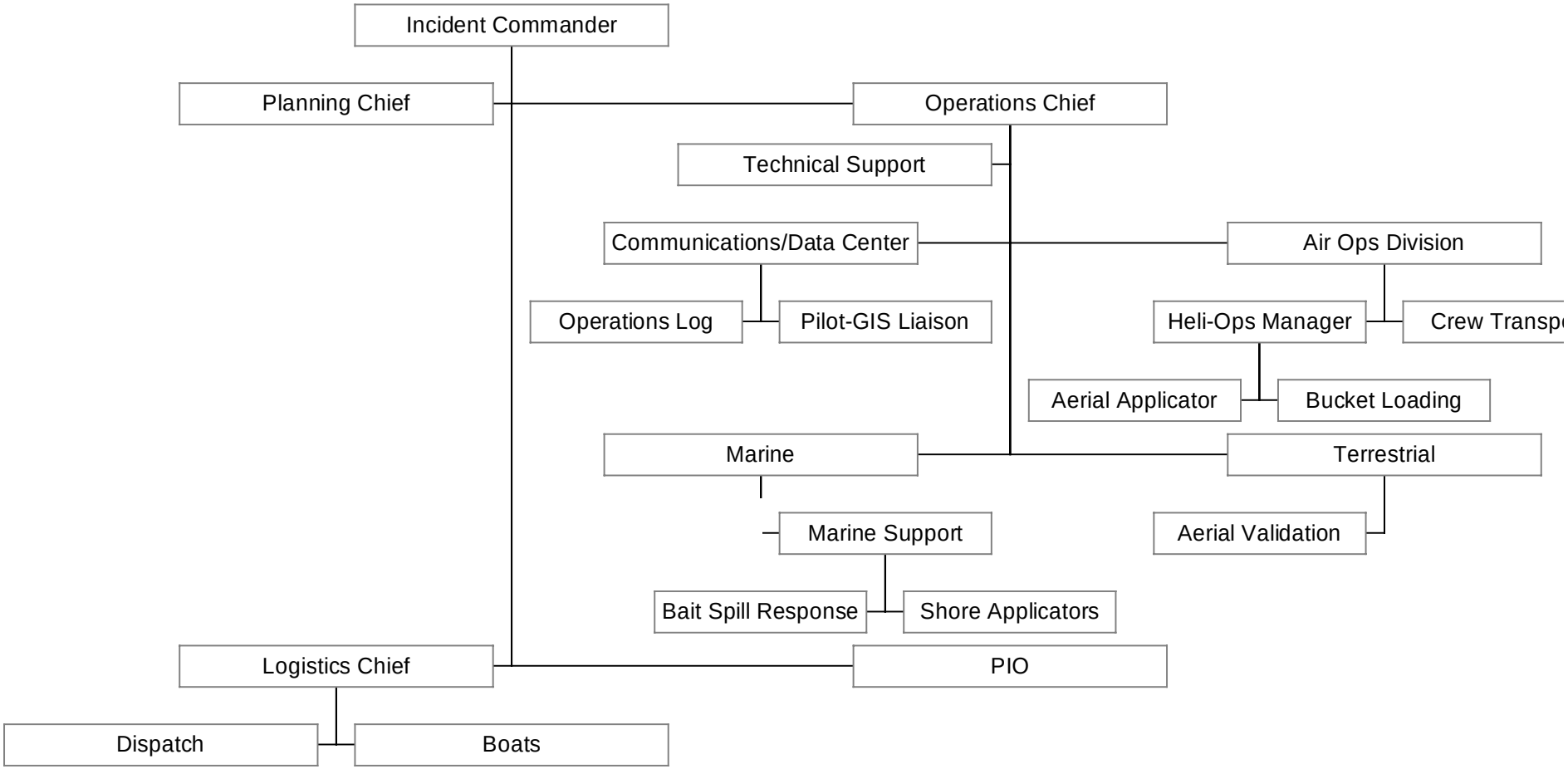
Successful implementation of the mouse eradication will require a team effort. The team should be lead by a project manager, responsible for all components of the project to ensure that all is completed. The project leader should bring together a team of people with expertise in

- USFWS requirements
- Logistics management

- Communications
- Island rodent eradication
- Environmental compliance
- Aerial bait application
- Aircraft management
- Public relations
- GIS
- Field biology
- Avian biology (raptor trapping, mistnetting Passerines, seabirds)
- Marine mammal biology
- Administrative support

The project should follow the Incident Command Structure (ICS), especially on the day of bait application (Figure 3).

Figure 3. Sample command structure for bait application onto the Farallon Islands. The actual command structure will need to be detailed and may or may not resemble the sample structure below.



ENVIRONMENTAL COMPLIANCE

Aerial broadcast of a bait containing a rodenticide onto the South Farallon Islands is a relatively new and innovative approach to conservation. Thus, the compliance process will be lengthy and in depth because of the biological and logistical complexity of the project. In addition to the internal USFWS regulations and Office of Aviation Services (OAS) requirements, the project must ensure compliance with a number of laws including the

- National Environmental Policy Act (NEPA)
- Clean Air Act (CAA)
- Clean Water Act (CWA)
- Coastal Zone Management Act (CZMA)
- Endangered Species Act (ESA)
- Federal Insecticide Fungicide and Rodenticide Act (FIFRA)
- Marine Mammal Protection Act (MMPA)
- Migratory Bird Treaty Act (MBTA)
- National Historic Preservation Act (NHPA)
- National Marine Sanctuaries Act (NMSA)
- Wilderness Act (WA)

All of the above laws can be partially addressed under NEPA, however, there are additional permits and consultations required to ensure full compliance. We conservatively estimate a period of two years between start of the process through to completion.

NEPA

The FNWR will need to prepare an environmental assessment (EA) or an environmental impact statement (EIS) to document the environmental impacts that would be associated with the eradication activities. Because of the potential controversy and the nature of the methods, i.e., aerial broadcast of a pesticide onto refuge lands, the refuge should consider

completing an EIS rather than an EA. The FNWR should consider expanding the scope of the assessment to include an emergency response plan should non-native species be introduced to the island (including rodents and other vertebrates, invertebrates, weeds and pathogens) and a prevention strategy to reduce the potential for non-native species to be accidentally introduced to the refuge islands.

CAA

Can be addressed under NEPA. The project will not affect air quality as the broadcast of pellets will not affect air quality in any way.

CWA

The CWA can be addressed under NEPA. The assessment should make clear what mitigation will be in place to prevent bait broadcast into the marine environment and any monitoring to confirm success of those measures.

CZMA

The FNWR will need to pursue a consistency determination from the California Coastal Commission.

ESA

The FNWR will need to initiate an Internal Section 7 consultation with USFWS, Ecological Services and National Marine Fisheries Service for potential disturbance to listed Brown Pelicans and Steller's Sea Lions, respectively. This written document will conclude if project activities will have an effect, and if it is likely to adversely effect threatened/endangered species. A "likely to adversely affect" determination would require that a biological opinion be prepared by the USFWS/ES or NMFS. A "not likely to adversely affect" would require concurrence by these agencies.

FIFRA

The US EPA and the states control, through licensing and registration, the use of pesticides. The FNWR will need to use an existing registered bait product for the eradication, or pursue registration of broadcast bait with the US EPA, for use on the South Farallon Islands. Registration can be a lengthy process with delays lasting from 6 week to an indefinite amount of time depending on the chosen path for registration. There are three registration options –a Section 3 registration, Experimental Use Permit (EUP), or an exemption (Emergency or Quarantine). The Section 3 registration is not viable for the purpose of the project without an extensive data set. However, by the time the FNWR is ready to remove mice, there may be a product registered and available. If no product is available, the EUP or exemption process should be considered.

Bait applicators and loaders will need to be certified and licensed applicators. California EPA can provide all the appropriate training and certification.

MMPA

The potential for project activities to disturb hauled out seals and sea lions would be considered "take" as defined to mean "to harass, hunt, capture, or kill or attempt to…" (16 U.S.C. 1362 Sec. 3). The MMPA protects marine mammals from any "take" but will allow the disturbance of a small number of marine mammals if there will be a negligible impact on the affected species. Therefore, the FNWR will need to work with the National Marine Fisheries Service to develop effective mitigation measures to minimize risk of disturbance to marine mammals, and assess if an Incidental Harassment Authorization (IHA) is needed. There is an approximately 4-6 month delay between application and authorization for an IHA permit.

MBTA

The project will present a risk of primary and secondary poisoning of the few individual birds if they are not removed from the island prior to the baiting. It is unclear if USFWS Migratory Bird Office in Portland will require a MBTA permit for this project since the

project has long term benefit to migratory birds and the agency doing the action is the USFWS. Further discussions with the Migratory Bird Office in Portland, Oregon are needed.

NHPA

Can be addressed under NEPA. Southeast Farallon Island (SEFI) was listed on the National Register of Historic Places in 1977 based on a nomination that was made to the California State Historic Preservation by the US Fish and Wildlife Service (USFWS). Its historical importance is based on its association with the exploration and discovery of the California coast and its plethora of resident marine mammal and birds. In 1998, the FWS Cultural Resource Specialist (with concurrence from the California State Historic Preservation office) determined that the two residences and rail cart were historic properties and were contributing elements to the historic designation. No construction or modification of the rail cart or residences is needed to successfully eradicate house mice. However, there will be a need to eradicate house mice from the buildings, and may require slight addition of mouse proofing materials (primarily blocking of potential mouse holes with hardware cloth) to the residences. The FNWR should consult with the Cultural Resource Specialist to ensure compliance with the NHPA.

NMSA

The waters surrounding the FNWR are within the Gulf of the Farallones National Marine Sanctuary. An overflight permit will be required to fly below 1000' and within one nautical mile of the islands (to prevent disturbing seabirds and pinnipeds). The treatment of the islands will require the helicopter to fly at 50-100', over Sanctuary waters during maneuvers for bait application. Therefore, the FNWR will need to obtain an overflight permit from the Gulf of Farallones National Marine Sanctuary.

Wilderness Act

The offshore rocks and islets, and the West End (adjacent to SEFI) are designated Wilderness and project activities must be in compliance with the WA. The WA precludes

the use of motorized equipment, landing of aircraft, or construction of any structures. All project activities, particularly aircraft landing and flight origin, will be based on SEFI. Wilderness designation does not affect airspace, so low level flights over designated wilderness to drop bait would not conflict with wilderness management direction.

USFWS *Pesticide Use Approval Process*

The Refuge would need to submit a Pesticide Use Proposal (PUP) to the regional USFWS IPM representative to ensure compliance with 50 AM 12 – Pollution Control – Pesticide Use and Disposal.

PUBLIC OUTREACH AND EDUCATION NEEDS

Mouse eradication and recovery of seabirds are tangible goals of a successful project. Another important, but less tangible goal is public support and a positive perception by the local and regional population. A negative perception by the public could result in the derailing of the mouse eradication before implementation and halting of other island restoration projects in California and elsewhere. Thus, a proactive public outreach and education program is recommended to ensure completion of a successful project.

In our and others experience, the removal of animals using any method, especially a lethal method, is unacceptable to some people and organizations. This strong moral and philosophical belief could rally individuals and animal rights organizations to try and stop the mouse eradication project using any and all methods available including disseminating misinformation through the media, challenging the project using the legal system, and even directly through sabotage and vandalism. These strategies are designed to draw negative attention to the project, and motivate the public to try and stop the eradication. Thus, the target audiences of a proactive media and education strategy are those that may be unaware of the project and issues, may be undecided about the project, and the misinformed.

The benefit of a proactive public outreach and education program is that the target audience is exposed to an accurate and complete information package, diffusing any of the damaging

misinformation that may be published in the local media or disseminated by any groups or individuals that may oppose the project.

A successful public outreach program integrates the requirements of the environmental compliance process and a well-defined educational component. The first step is to develop a strategy, followed by development of supporting materials and implementation of the plan. The basic components of a public outreach program includes:

1. a strategy that fosters a message of need and justification for the eradication plan.
2. well designed supporting materials – eg. fact sheets, impacts of house mice, pictures.
3. soliciting support from big name organizations and individuals such as the American Bird Conservancy, National Audubon Society, and internally from cooperating/permitting government agencies.
4. planned media trips to the island and press releases fostering the perception of an open and transparent project.
5. an emergency communication plan – in case something goes wrong or there is a significant challenge by animal rights advocates.
6. a legal response plan – in case there is a legal challenge to stop project.

Because of the potential controversial and emotional subject of eradication, we recommend that the FNWR work with a professional public relations organization with experience in wildlife related issues.

SUGGESTED PRE AND POST PROJECT MONITORING PROJECTS

We recommend that the following baseline studies be done prior to eradication to ensure a high probability of successful eradication:

Evaluate the abundance and movement of house mice on South Farallon Island-

Using grid and/or trap arrays, the density of mice should be estimated around the targeted application period. The density will be used to estimate an appropriate application rate of

bait. Radio telemetry and inter trap movements on the trapping grid can be used to estimate territory size. The territory or home range area will be used to estimate an appropriate bait density or number of pellets needed per ha to expose all mice on the island to the bait.

Conduct bait acceptance/palatability/efficacy trials of candidate baits –

Baits can be tested for palatability and acceptance using captive mice and field trials with a biomarker or with the active ingredient.

Establish baseline monitoring of house mice to compare to post eradication monitoring –

Baseline monitoring provides an index of activity that can be used as a predictor of activity during post eradication monitoring. The pre-eradication monitoring of mouse populations should be developed using various techniques such as chew sticks (wax chew blocks), trapping (live and snap), and tracking boards. If no mice are detected using the above techniques, there is a high probability that the eradication was successful

We recommend that the following studies be done during the eradication:

Efficacy of poisoning, and consumption of poisoned house mice by other species-

Radio-collaring 10-25 house mice prior to the eradication can measure this. The fate of radio-collared individuals will be followed and the location of dead house mice will be recorded.

Develop a GIS for "real time" monitoring of aerial broadcast activity and bait removal from monitoring plots-

Using existing technology, all baiting data should be systematically collected and entered into a GIS program for analysis. The GIS allows a "real time" view of activity of aerial baiting around the island and can be used to identify trouble areas. Permanent monitoring stations (target and non-target species) should be marked with a DGPS and placed into a GIS file for future reference.

Monitor impacts to non-target species-

Establish an ecotoxicological monitoring plan to evaluate the impact of rodenticides on the Farallon Island wildlife. There may be a regulatory requirement to collect tissue from sub samples of non-target species and analyzed for exposure to rodenticides.

Develop and initiate a monitoring program for native species on the island-

Upon removal of house mice from South Farallon Islands, it can be expected that some native species will increase in density and abundance, particularly the invertebrates, plants, seabirds, and the salamander. To detect this "release" effect those species directly or indirectly impacted by house mice should be monitored before and after the eradication This should be implemented as soon as possible to be able to detect a response of the local ecosystem to the removal of house mice.

RE-INTRODUCTION PREVENTION PLAN

A key component to the eradication is the development of a plan to prevent the re-introduction of mice or other non-native rodents, especially rats. The effort and conservation gains made from the eradication could be negated with the re-introduction of rodents or other non-native species. Invasive species, including vertebrates, invertebrates, weeds and pathogens can all be transported to the island inadvertently and have detrimental impact on breeding seabirds. The rodent re-introduction prevention program will be one component of a comprehensive program designed to prevent many non-native species from being introduced onto the island.

Preventing non-native species from reaching the islands requires that the potential introduction pathways be closed, or the risk via those pathways be reduced. Reducing the risk of introductions to the Farallon Islands National Wildlife Refuge will require a multi-faceted approach including:

- controlling invasive species at departure points,
- implementing specific management guidelines for potential vectors, and

- prohibiting certain activities and materials destined for the islands.

The prevention plan should be incorporated into a larger management strategy for non-native species. An effective management strategy should include plans for:

1) Preventing introductions
2) Early detection, responding, and eradicating if feasible,
3) Controlling if not feasible to eradicate,
4) Continuous, ongoing monitoring to evaluate progress towards goals or make necessary adjustments, and
5) Education for all stakeholders.

The successful implementation of this plan, and overall management strategy, will be dependent on a strong policy and compliance by all stakeholders including FNWR staff, cooperators, contractors and all visitors.

ESTIMATED BUDGET

Total estimated budget to develop the mouse removal plan, eradicate house mice with follow up monitoring is $729, 398.67 over four (4) years (Table 4).

TIMELINE

We conservatively estimate that the project will take approximately 4 years to complete. The first two years will be dedicated to environmental compliance and securing permits, planning and conducting necessary pre-eradication research. The remaining two years will focus on post-baiting monitoring such as ensuring that the mice have been removed, and the environmental effects are as predicted. If no mice are detected two years post bait application, the island can be declared house mouse free.

Table 4. Budget for Farallon Island house mouse removal . Note that this is a preliminary budget developed Spring 2003 and will need to be adjusted to reflect actual costs on implementation. Budget assumes managed project and contracted out.

	Year 1		Year 2		Year 3		Year 4	
	Phase I - Pre-Eradication Enviro Compliance and R&M		**Phase II - Implementation**		**Phase III - Post Eradication Monitoring**			
Salaries & Benefits								
Project Leader (GS-11)	$ 60,300.00		$ 60,300.00		$ 30,150.00		$ 19,500.00	
Principal Investigator	$ 9,040.00		$ 9,040.00		$ 4,500.00		$ 2,250.00	
Field Biologists	$ 25,425.00	**$ 94,765.00**	$ 25,425.00	**$ 94,765.00**	$ 8,475.00	**$ 43,125.00**	$ 8,475.00	**$ 30,225.00**
Equipment								
Traps	$ 2,500.00	**$ 2,500.00**	$ -	**$ -**	$ -	**$ -**	$ -	**$ -**
Travel/Transport								
Boat transport	$ 11,000.00		$ 15,000.00		$ 5,000.00		$ 5,000.00	
Helicopter Support	$ 3,500.00		$ 25,000.00		$ 3,500.00		$ 3,500.00	
Travel&Housing of Technical Experts	$ 3,500.00		$ 4,500.00		$ 2,500.00		$ 1,500.00	**$ 10,000.00**
Field per diem @15/day	$ 4,500.00	**$22,500.00**	$ 4,500.00	**$49,000.00**	$ 1,350.00	**$ 12,350.00**	$ 1,350.00	.
Materials and Supplies								
Outboard Gas/Oil/Maintenance	$ 1,500.00		$ 2,500.00		$ 500.00		$	

	Year 1		Year 2		Year 3		Year 4	
	Phase I - Pre-Eradication Enviro Compliance and R&M		**Phase II - Implementation**		**Phase III - Post Eradication Monitoring**			
Radio Collars (House Mice)	$ 3,500.00		$ 3,500.00		$ -		$ 500.00	
Research Supplies	$ 7,500.00		$ 7,500.00		$ 500.00		$ 500.00	
Bait and supplies	$ 1,600.00	**$14,100.00**	$ 11,200.00	**$24,700.00**	$ -	**$ 1,000.00**	$ -	**$ 1,000.00**
Stakeholder Coordination and Public Outreach								
Videography	$ -		$ 20,000.00					
Outreach Materials and Coordination	$ 12,500.00	**$ 12,500.00**	$ 7,500.00	**$27,500.00**	$ 2,500.00		$ 2,500.00	
Miscellaneous Costs								
Toxicological Analysis	$ 1,500.00		$ 10,000.00		$ -		$ -	
Non-Target Bird Mitigation	$ -	**$ 1,500.00**	$ 22,000.00	**$32,000.00**	$ -	**$ 2,500.00**	$ -	**$ 2,500.00**
Sub-Total		**$ 147,865.00**		**$227,965.00**		**$ 58,975.00**		**$ 43,725.00**
Operating Costs								
FWS Project Manager	$ 27,500.00		$ 27,500.00		$ 27,500.00		$ 27,500.00	
FWS Admin Support (Utilities, P-copy, salary)	$ 5,000.00		$ 5,000.00		$ 5,000.00		$ 5,000.00	
Contractor Overhead (18% of Sub-Total)	$ 26,615.70	**$ 59,115.70**	$ 41,033.70	**$ 73,533.70**	$ 10,615.50	**$ 43,115.50**	$ 7,870.50	**$ 40,370.50**

	Year 1	Year 2	Year 3	Year 4	
	Phase I - Pre-Eradication Enviro Compliance and R&M	Phase II - Implementation	Phase III - Post Eradication Monitoring		
Total	**$ 206,980.70**	**$ 301,498.70**	**$102,090.50**		**$ 84,095.50**
FWS Indirect Cost Recovery (5% of Total)	**$ 10,349.04**	**$ 15,074.94**	**$ 5,104.53**		**$ 4,204.78**
GRAND TOTAL	**$ 217,329.74**	**$ 316,573.64**	**$ 107,195.03**		**$ 88,300.28**
Estimated Project Total Year 1-4	**$ 729,398.67**				

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Appendix N. Farallon NWR Weed Management Plan

Prepared By Jesse Irwin and Joelle Buffa
February 3, 2004

Objective:
The purpose of this document is to outline the current invasive weed status on South East Farallon Island (SEFI) and provide a detailed plan of action designed to reduce or eradicate invasive weeds from the island. The island known as West End may be added to this plan in the future.

Location:
SEFI is located in the Pacific Ocean 28 miles west of San Francisco, California (37°42'N, 123°00'W"). There is no legal description using township and range. The Farallon Islands collectively make up Farallon National Wildlife Refuge which is part of San Francisco Bay National Wildlife Refuge Complex headquartered in Fremont, California.

Description:
The Farallons are a group of small, rocky islands near the edge of the continental shelf. The southern Farallons include SEFI, West End, and Saddle Rock. Middle Farallon is 2 miles northwest of SEFI and the North Farallons are northwest an additional 4 miles. Noonday rock is just north of the North Farallons. Human activity is limited to SEFI and West End, though West End access is very restricted. SEFI is the largest island at 121 acres. There are currently two houses on the island used by refuge staff and Point Reyes Bird Observatory biologists. Generally staff size is between 4 and 8 people working there at one time. The islands are a key breeding ground for 12 seabird species. Marine mammals abound at the intertidal zone and water around the islands. The soil is generally very thin and rich due to thousands of birds during the spring and summer. The topography of the island consists of a sweeping marine terrace on the southern half of the island and steep ridges and points on the north half of the island. The entire island is important nesting habitat. Vegetation on the island consists of 5 wind stunted trees (3 cypresses, 1 Monterey pine, and 1 mirror plant) and a variety of forbs and grasses. Farallon weed (*Lasthenia maritima*), *Spergularia macrotheca*, and *Spergularia marina* are the predominant native species for which we will be managing. This area is entirely devoted to wildlife uses except for structures needed to conduct field operations. There are no agricultural activities on the island.

Management Goals:
The refuge goal will continue to be restoring the historical abundance of wildlife, particularly breeding seabirds by minimizing human influence and disturbance in addition to restoring habitat. We believe the best way to restore habitat is by reducing non-native vegetation and promoting natives. Habitat improvement has taken place for years and is an ongoing process. Remnants of historical uses by the military and Coast Guard are removed each year as resources permit. The long term goal is removal of any manmade structure not needed to support current activities and is not of historical value.

Invasive Species and History of Control Efforts:

The island is infested with a variety of invasive weeds that degrade the value of habitat to wildlife. New Zealand spinach (*Tetragonia tetragonioides)* and *Malva spp*. have been the focal point of control efforts thus far. The north side of the island has been prevented from becoming infested by aggressive removal of any outlier weeds that appear in those areas and by limiting human foot traffic to the south side of the island. The north side of SEFI is accessed less than 5 times per year; to pull or spray outlier weeds and to monitor seabird index plots. The Marine Terrace has a low abundance of spinach as a result of long term control efforts. The hills that lead up to the Lighthouse have a high density of spinach, with the exception of north facing slopes. Malva occurs in dense stands around human structures such as the domes, water catchment pad, along the cart path, and single plants occur consistently around most of the island. Chenopodium, grasses, hogweed, plantain, and Erodium have received less attention.

The control strategy thus far has consisted of a big general herbicide spray effort in August of each year, intensive hand pulling in March before nesting season, and opportunistic pulling the rest of the year. In mid-August, a group 4 refuge staff biologists apply a 4% Roundup solution (active ingredient: 41% glyphosphate) or similar type herbicide with the goal of treating all spinach and Malva plants on the island. It is estimated that over 95% of the spinach plants and 75% of the Malva plants are sprayed each year. The timing requirements of nesting seabirds prevent the spray effort from taking place during the optimal time period. Some plants have mature seeds before we are able to treat them. To counteract this problem, plants are pulled throughout the year by FWS and PRBO staff. Limited spraying has also taken place in the fall. The amount of effort put forth to control weeds has varied year to year due to staffing situations.

Management Plan:

The weeds of the Farallons are controllable species if enough time and effort is put forth. Time and funding are always top considerations. Logistics of transportation and accommodations add to the problem. All control efforts are conducted using manual labor which is very time consuming. In consideration of these issues it is necessary to prioritize the workload. The degree of invasiveness and impact on seabird habitat is the criteria used for prioritization.

The top priorities of the weed control effort are 1) prevent the spread of spinach and Malva from established areas, 2) reduce the area infested with spinach and Malva as much as possible, and 3) prevent the establishment of new non-native plants.

After spinach and Malva, non-native grasses and plantain are our second priority species. Our objective for control of these species is to first eradicate outlier populations and second reduce area covered by these species. The effort devoted to these species will increase when spinach and Malva have been significantly reduced.

Third priority weeds include hogweed (*Sonchus spp.*) and *Chenopodium spp*. We have no plans to allocate resources for control efforts of these species at this time. These species have been part of the plant community for many years and do not appear to be aggressively invading new areas or crowding out natives.

In an ongoing effort the refuge operations specialist and PRBO personnel continually monitor for and eradicate new weeds species as they are detected. This is one

of the top priorities for all public land agencies in the war on weeds. For example, two individuals of *Raphanus spp.* were pulled from the North Landing area in August 2003. This is clearly the most effective method of weed control, pulling a few individuals before they have the opportunity to spread and become a more difficult problem such as the weeds that are already established.

To combat the time crunch, we will work intensively in small areas on targeted weeds in each area while continuing control of spinach and Malva on the entire island. Areas of newly disturbed soil (human caused) will be Farallon weed spread over the area to provide a seed source. Areas that have been sprayed with RoundUp are candidates for reseeding with Farallon weed because spraying it clears the vegetation. Efforts will be made to spread Farallon weed over these areas.

Partitioning the islands into weed management units to address weed problems in individual areas has been suggested. By taking this action, areas that are currently weed free or nearly weed free can be used as an anchor point for attacking infested areas by working out from the anchor point. The division of the island would create many small sections for weed management purposes. The smaller sections of the island will then be prioritized. The prioritization will act as guide to direct weed control efforts throughout the year when weed control is sporadic. The purpose of doing this is to allow a more intensive control effort in small areas. The division lines for the smaller units are based on existing features such as the cart path, ridges, cement structures, and foot paths. There are sufficient existing landmarks to divide the island into appropriately sized management area. These areas should be small enough for a single weed puller to cover in a day. The abandoned paths on the south side of Lighthouse Hill are convenient divisions and the north and east sides of the hill can be treated as one unit each due to the small number of weeds.

It is not practical to physically remove weed seeds from the soil. By continuing to spray and pull weeds before they are able to produce mature seeds, we hope to reduce the viable seed bank in the soil over time. Germination testing has been conducted on sprayed spinach plants. The results indicate about a 2% germination rate.

New Zealand spinach (*Tetragonia tetragonioides*): The technique used since 1990 has been pulling in the spring and herbicide application in mid-August (September in the early years). We recognize that applying herbicides applied earlier in the growing season would be ideal, but is not possible until after the seabird breeding activity has diminished. This technique has had mixed results. Spinach abundance has been greatly reduced on the Marine Terrace relative to the hillsides. Plants sprayed in August have been tested and have about a 2% germination rate. However, the seed bank appears to be loaded with seed that remains viable for many years. One area we are looking at is the long term viability of seeds. If we can pinpoint the number of years seeds remain viable in the soil, we will better able to determine the success or failure of the control program. This would allow us to answer this question: are we controlling weeds from the plants of 10 years ago or are we controlling weeds from last year's plants? The fall spray effort has been thorough and consistent for over 10 years. The obvious question raised by the long term spray effort is what effect has the spraying had and why is there such a dense infestation remaining? The answer likely lies with the 2% germination rate of the sprayed plants. 2% of a huge number of seeds is enough to keep the infestation going. Removing the

seeds from the soil is not practical. By pulling and spraying all plants year after year we hope to eventually exhaust the seed bank.

It may be necessary to spray spinach in the spring at the expense of Farallon weed. This would be conducted in such a way as to minimize damage to Farallon weed. For example, areas of robust spinach plants could be spot sprayed in areas where Farallon weed is sparse or absent. The amount of effort expended on pulling spinach has varied year to year based on refuge staffing and the enthusiasm of PRBO biologists, but the spray effort in the fall has been consistent. A more consistent pulling effort in the spring is the area of the control effort that has the most room for improvement. A work party consisting of 2-4 volunteers should take place in early March before seabird nesting begins. The timing of the spray effort in August can't be moved forward to kill more seeds before maturity. The best way to get around this problem is consistent pulling and spraying in the fall and winter followed by an intensive pulling effort in March. If this can be accomplished, plants which sprout later in the year are not likely to have mature seeds when they are sprayed in August.

Malva (*Malva neglecta* and *M. parviflora, Lavaterra arborea*): Malva will be controlled using similar methods to spinach. Malva begins growing earlier in the winter then spinach but combining the control efforts is a necessity due to limitations of time and personnel. As mentioned earlier, most of the Malva is sprayed in August along with spinach. Much of the Malva has mature seeds by August so a more consistent pulling/spraying effort in the fall and winter will significantly reduce the number of mature plants on the island during the August spraying.

Lavaterra arborea or tree mallow is an invasive species on the mainland that has been allowed to persist on SEFI to benefit migrating birds. It is allowed to grow in three small dense clusters which facilitate bird banding work. It spreads slowly from these areas but in small numbers and is easily pulled while young. It is the responsibility of PRBO personnel to eradicate outliers. Farallon NWR management reserves the right to eradicate all tree mallow in the future.

Grasses (*Avena fatua, Bromus diandrus, Cynodon dactylon, Festuca sp., and Hordeum murinum*): The grasses listed above are annual species. They cure long before the August spray effort. There has been sporadic efforts made at clearing grass and re-seeding with Farallon weed. These areas have been successful in the short term but re-invaded within 2-3 years. While any project on SEFI is labor intensive relative to the same project on the mainland, clearing grasses is a particularly labor intensive part of the weed control strategy. It takes many hours to clear a relatively small area.

Grasses grow in thick mats which preclude seabirds from burrowing. Significant areas of the Marine Terrace are unavailable as nesting sites because of grasses. Farallon weed is used as nesting material by the seabirds to construct nests. We can treat a larger area using a grass specific herbicide before the seabird nesting closure in late winter. This will give a competitive advantage to native Farallon weed during the peak growing season. This strategy will be applied on a limited basis until we are confident it is the best method available to control annual grasses. The areas I propose using the herbicide with the label name of POAST (active ingredient: 18% Sethoxydim) include the area between Heligoland Hill and the powerhouse, the southern base of Lighthouse Hill, and

along the cart path from East Landing to North Landing. The optimal time of the application is usually November and December because the product label specifies spraying before the grass reaches a certain height. Also note that POAST (or similar) products use a crop oil concentrate surfactant instead of the R-11 type the Refuge uses with RoundUp.

Other options include manual removal of grasses and re-seeding or burning off areas of cured grasses in late summer or early fall followed by re-seeding.
NOTE: A fire management plan for the Farallons may be added to this plan in the future. Fire may be a tool we can employ to facilitate re-seeding of Farallon weed in areas overrun by grasses and plantain.

Plantain (*Plantago coronopus*): Plantain and grasses are second priority to spinach and Malva. They may become a higher priority if Malva and spinach are successfully reduced. Plantain has spread across the Marine Terrace and up Lighthouse Hill. The infestation is serious enough to negatively impact nesting seabirds by impeding the birds' ability to dig and maintain burrows. A new infestation was pulled from the North Landing area in June 2003 with a follow up pulling in August. No plants were found when the area was checked in November 2003. Plantain is a perennial plant which can be pulled or sprayed. It produces a large number of seeds which prolong control efforts.

The management plan for controlling plantain is as follows: 1) Prevent plantain from spreading to new areas by pulling or spraying, 2) If resources allow treat selected patches of plantain during the August spray effort. As mentioned in the grasses section above, a fire management plan may be implemented if we feel fire will be an effective control method in the future. This would be noteworthy for the grasses and plantain because of the growth pattern and timing of the weeds. Grasses and plantain grow in dense mixed patches on some parts of the terrace. The grasses begin drying in April and May while the Plantain actively grows all year. By September and October the grasses are completely cured. This is when we can burn off the dry grasses and the Plantain that is mixed with grasses. Any burning would be followed by re-seeding with Farallon weed. Plantain's response to burning will determine if a burn plan should be pursued for controlling plantain on the Farallons. Any burn would require plantain to be mixed with cured annual grasses to carry the fire. This restriction limits the potential areas fire may be used to clear plantain.

Chenopodium (*Chenopodium murale*): Chenopodium can be found in small numbers across the island and is a food source for some fall migrating birds. It has been an established part of the plant community for many years and does not appear to threaten native vegetation or degrade seabird nesting habitat. No control efforts are planned for *Chenopodium* at this time.

Hogweed or sow thistle (*Sonchus aspar)*: No specific control measures are planned for hogweed at this time. We will monitor it and begin control efforts if we feel that is needed in the future. Hogweed appears as individual plants or very small groups distributed across the island. This species is either a relatively new infestation or it is only marginally suited for the habitat. Pulling plants appears to be a viable option

because of the low number of individual plants. Cutting the plant during early flowering may also be effective.

Erodium or stork's bill is abundant on the Marine Terrace and hill sides during winter and spring. Though it does not appear to be rapidly spreading, the potential is high due to the clingy nature of the seeds. We will continue to monitor Erodium and take action if necessary in the future.

Monitoring:
The above listed species will be mapped using GPS and processed into ArcMap files. This method will allow a more precise evaluation of infestation and progress of control efforts. Remapping each year will provide a database that will allow us to better determine the success or failure of control efforts and possible modification of methods. FWS digital photoorthoquads will be used as a base layer. Each species will be mapped individually. This will allow inter-species analysis when each species is a layer in the ArcMap file. After the initial vegetation mapping is completed it will be possible to precisely track the distribution of each species and will be a valuable toll in the adaptive management process. However, for this to be successful, weeds will need to be mapped each year. Photopoints will be established on the Marine Terrace and hillsides to provide visual images of changes over time.

Revisions:
This plan will be reviewed annually to evaluate progress of control efforts and adjusted as deemed necessary for improved results. The refuge operations specialist and the refuge manager will be responsible for re-evaluation of the weed management plan.

Impacts
The primary animals that could be impacted by management activities are nesting seabirds and the Farallon salamander (*Aneidus lugubris farallonensis*). The impact on seabirds of weed treatment activities will be minimal because most hand pulling and herbicide application will occur outside of the breeding season. The herbicides proposed for use are not harmful to vertebrate species. Salamanders are underground at time of application, but it is possible for exposure to occur within 12 hours of application. We use a spot spraying method of application instead of broadcasting, greatly reducing possibility of exposure. The most like impact on nesting seabirds will be the crushing of burrows. Habitat disturbance will be minimized by using only biologists and volunteers trained to avoid crushing burrows when conducting weed control operations.

Direct inquiries to:

Jesse Irwin
Farallon National Wildlife Refuge

Joelle Buffa
San Francisco Bay National Wildlife Refuge

Refuge Operations Specialist
Biologist
510-792-4275x33
jesse_irwin@fws.gov

Complex Supervisory Wildlife

Farallon NWR Manager
510-792-4275x32
joelle_buffa@fws.gov

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Appendix O: Planning Team Members and Persons Responsible for Preparing this Document

U.S. Fish and Wildlife Service

Joelle Buffa	(Former) Refuge Manager, Farallon NWR
Winnie Chan	Refuge Planner, San Francisco Bay NWR Complex
Jesse Irwin	Wildlife Refuge Specialist, Farallon NWR
Gerry McChesney	San Francisco Bay NWR Complex
Mark Pelz	Chief of Refuge Planning, CA/NV Refuge Planning Office
Mendel Stewart	Project Leader, San Francisco Bay NWR Complex

PRBO Conservation Science

Russ Bradley