

U.S. Fish & Wildlife Service

Guadalupe-Nipomo Dunes National Wildlife Refuge

*Final Comprehensive Conservation Plan
and Environmental Assessment*

August 2016



Vision Statement

Propelled by relentless ocean waves and strong onshore winds, small grains of sand scour and accumulate to form the impressive migrating dunes of the Guadalupe-Nipomo Dunes National Wildlife Refuge (Refuge). Harsh, but dynamic processes create unique habitats among the dunes for imperiled plants and animals such as La Graciosa thistle, marsh sandwort, California red-legged frog, and western snowy plover.

The Refuge lies within the Guadalupe-Nipomo Dunes Complex (Dunes Complex), an 18-mile-long stretch of coastal dunes located north of Point Sal and south of Pismo Beach. To conserve the dynamic landscape and imperiled natural resources of the Refuge and the Dunes Complex, the Service works cooperatively with other agencies, non-profit organizations, local businesses, private landowners, and private citizens. Working together, we instill stewardship through activities that include habitat restoration, protection of cultural resources, recovery of threatened and endangered species, and opportunities for high-quality visitor experiences in this unique and spectacular dunes landscape. Such cooperative efforts enable all partners to share limited resources to meet common goals, thereby achieving much more together than we could alone.

Originally envisioned by conservation-minded individuals who valued solitude and the satisfaction of spending time outdoors, we protect the Dunes Complex for everyone's enjoyment, including future generations.

Together with our partners, we coalesce like grains of sand to ensure that wildlife-dependent recreation, environmental education, interpretation, and wildlife photography opportunities exist for the public, and that these activities are balanced with our conservation goals for cultural resources, plants, and animals of this treasured landscape.

Disclaimer

CCPs provide long term guidance for management decisions and set forth goals, objectives, and strategies needed to accomplish refuge purposes and identify the Service's best estimate of future needs. These plans detail program planning levels that are sometimes substantially above current budget allocations and, as such, are primarily for Service strategic planning and program prioritization purposes. The plans do not constitute a commitment for staffing increases, operational and maintenance increases, or funding for future land acquisition.

U.S. Department of the Interior
Fish and Wildlife Service
Pacific Southwest Region

FINDING OF NO SIGNIFICANT IMPACT

**Environmental Assessment for Management of Guadalupe-Nipomo Dunes National
Wildlife Refuge**
San Luis Obispo County, California

The U.S. Fish and Wildlife Service (Service) has completed the Comprehensive Conservation Plan (CCP) and the Environmental Assessment (EA) for the Guadalupe-Nipomo Dunes National Wildlife Refuge (Refuge). The CCP will guide Refuge management for the next 15 years. The CCP and EA (herein incorporated by reference) describe the Service's proposals for managing the Refuge and their associated effects on the human environment under their alternatives, including the no action alternative.

Decision

Following comprehensive review and analysis, the Service selected a modified Alternative A for implementation. The selected alternative is consistent with the following criteria:

- Forwards the mission of the Refuge System;
- Addresses the purposes for which the Refuge was established;
- Provides guidance for achieving the Refuge's vision and goals;
- Protects the sensitive native habitats and listed species present on the Refuge;
- Adheres to scientific principles of sound fish and wildlife management and listed species recovery; and
- Complies with all applicable legal mandates.

Alternatives Considered

The following is a brief description of the alternatives for managing Guadalupe-Nipomo Dunes Refuge, including the selected alternative (a modified Alternative A). For a complete description of each alternative, see the EA.

Alternative A

Under this alternative, the current management actions, including habitat management, wildlife-dependent recreation opportunities, and environmental education, would be continued at the Refuge. Habitat and wildlife management activities would continue to be focused on conservation of listed species, invasive weed control, barrier fencing, planting native vegetation, and baseline surveys. Limited guided tours and self-guided access to support wildlife observation and photography would also continue under Alternative A. Volunteers would continue to be an important component to support refuge management. The western snowy plover breeding habitat would continue to be closed to the public during the breeding season. The Service would work with partners to support the goals of the Dunes Complex. Current staffing and operating costs would remain the same. This alternative was not selected because it does not address predator threats to listed species on the Refuge.

Alternative B

Alternative B would include those actions described in Alternative A; in addition, the Refuge would moderately expand wildlife and habitat management while incrementally increasing visitor service and environmental education activities. For this alternative, Refuge Priority Management Areas (RPMAs) were established that represent unique habitat types or provide habitat for listed or rare species on the Refuge that deserve conservation attention. Additional wildlife management activities, such as management of ponded wetlands, feral swine control, and increased monitoring, would be implemented for the purpose of improving western snowy plover hatch rate; protecting existing populations of the listed La Graciosa thistle and California red-legged frog; and aiding in the recovery of marsh sandwort and Gambel's watercress. The development and implementation of future step-down plans, an Integrated Pest Management Plan and Predator Management Plan, are also proposed. Of the Service's "Big 6" public uses, wildlife observation, photography, interpretation, and environmental education, would be enhanced on the Refuge, and an action to redirect public access around snowy plover breeding habitat would also be implemented. Refuge staff would develop a dedicated volunteer crew to support Refuge management and outreach. An invasive plant early detection and rapid response program to address the introduction of new invasive weeds on the Refuge would also be developed. This alternative also proposes the future establishment of an office at or near the Refuge. Additional staff and funding would be needed to implement this alternative.

This alternative was not selected since it would require substantial increases in staffing and funding which are not feasible in light of the Service's declining budget. Since 2010, the Refuge System budget nationally has declined by over \$20 million while costs have continued to increase. Over the same period, staffing has been reduced by about 12 percent.

Alternative C

Alternative C, which was developed to take into consideration the forecasted decline in budgets for the National Wildlife Refuge System, would reduce or eliminate many of the current management activities occurring on the Refuge, as well as close the Refuge to all public access. Under Alternative C, the Service's management actions would be limited to the minimum necessary to meet statutory responsibilities under the Endangered Species Act of 1973 and National Wildlife Refuge System Improvement Act of 1997. The Refuge would be placed in caretaker status, with wildlife and habitat management activities limited to installing and maintaining permanent Refuge closure signs at the beach, maintaining existing perimeter fencing and fencing installed to protect listed species, and inspecting site conditions and implementing sign and fence maintenance three times per year (i.e., spring, summer, fall).

This alternative was not selected because of public opposition and limited scope of managing our trust species.

Selected Action (Modified Alternative A)

The selected action is a modification of Alternative A. Under this alternative, we would continue current management activities, but also include components from Alternative B including implementing the feral swine control plan and developing and implementing a predator management plan to protect western snowy plover as well as California least tern. Because the Refuge would not be staffed locally, we would reduce seasonal western snowy plover monitoring and invasive vegetation control to when staffing resources or partnerships allow. We would annually monitor for the listed La Graciosa thistle and marsh sandwort, collecting and

outplanting seed when possible. Invasive vegetation control would be focused on Refuge Priority Management Areas and priority invasive vegetation. We would also develop and implement an invasive weed early detection and rapid response program. Public access, guided interpretive walks, and environmental education would continue to be offered. The Refuge would also continue to work actively with partners to support the goals of the Guadalupe-Nipomo Dunes Complex.

Effects of management of the Refuge on the human environment

Implementing the selected alternative is not expected to have significant impacts on any of the environmental resources identified in the EA. The selected alternative is a combination of actions in Alternatives A and B. A summary of the impacts of the modified Alternative A and our conclusions follows:

Water (hydrology, water quality)

Invasive vegetation control, maintenance of fencing near wetland areas, and feral swine control may have temporary impacts to hydrology, but are expected to have no major impacts to pond habitats and coastal waters. These activities may result in short-term erosion and increased turbidity in wetland areas. Only herbicides and pesticides approved for aquatic environments will be permitted for use near water bodies. There are expected positive long-term benefits of improved hydrology with the removal of invasive vegetation and feral swine in wetland areas. The selected alternative is not likely to result in any adverse impacts to private properties. The Service has concluded that implementation of a modified Alternative A will have no significant impact to water resources.

Geology and Soils

Invasive vegetation removal, maintenance of fencing, and installation of feral swine traps may result in minor sand disturbance. Soils are not expected to be affected by herbicides because they will be applied in low concentrations with low half-lives and would be approved for use under a Pesticide Use Proposal. The Service has concluded that implementation of a modified Alternative A will have no significant impact to soils.

Air Quality and Climate

Tailpipe emissions from use of vehicles and helicopters (aerial spraying) for invasive vegetation control, feral swine control, visitation, and volunteers under the selected alternative are expected to minimally increase air particulates in the immediate area. Localized dust may occur from manual weed-pulling. The Service anticipates that there would be a negligible increase in vehicle trips for visitation. The Service has concluded that implementation of a modified Alternative A will have no significant impact to air quality or the climate of the area.

Hazardous Materials and Safety Issues

Herbicides are the only hazardous materials that will be used on the Refuge. These materials will be only used in habitat types where they are approved. Herbicides are not expected to result in any significant impacts as they will not be stored on-site, applied according to label directions, and only applied by trained personnel. The Service has concluded that implementation of a modified Alternative A will have no significant impact to safety or from hazardous materials.

Wilderness

There is no designated wilderness at the Refuge; therefore implementing a modified Alternative A will have no impact on wilderness.

Vegetation and Habitat

Removal of priority invasive vegetation, early detection for invasive vegetation, maintenance of fencing, and control of feral swine will result in a moderate positive impact to native vegetation and coastal dune habitats. Minor negative impacts may result from trampling of native vegetation from increased management activities. Minor negative impacts may occur to non-target, native vegetation from increased herbicide use by aerial spraying. The removal of invasive vegetation will improve the dynamic nature of the coastal dune system which is a wind-driven, shifting soil environment. Non-native seeds may be introduced by visitor footwear and clothing. This effect would be minor since public access to the Refuge is limited to periodic guided tours and self-guided access. The Service has concluded that implementing a modified Alternative A will have no significant impact to native vegetation.

Wildlife

Minor daytime disturbance and flushing of wildlife may occur from invasive vegetation control, maintenance of fencing, wildlife surveys, and visitor services. Control of feral swine that threaten listed species or their habitat would result in a reduction of feral swine in the area and protection of habitat for native wildlife. Control of avian and mammalian predators that threaten snowy plovers and least tern would result in reduced numbers of predators in the area but is expected to improve nest success for snowy plovers and least tern. Minor early morning and evening disturbance to non-target species would occur from these control efforts. Management activities will be conducted during non-sensitive breeding periods when feasible; restrictions will be in place in sensitive wildlife habitat. The Service will conduct additional NEPA compliance on the step-down avian and mammalian predator management plan, which may result in additional measures to further reduce these impacts.

Surf fishing (which occurs outside the Refuge boundary and is not managed by the Refuge) would result in negligible reductions in fish populations due to low fishing pressure. Minor daytime disturbance and flushing of wildlife may occur from visitors, but the selected alternative is not expected to significantly increase the number of visitors. Also, sensitive areas will be secured from visitors.

The activities described are expected to have an overall positive impact for native wildlife by reducing invasive vegetation and predators from the coastal dune environment. Maintenance of fencing will continue protection of wildlife and surveys will improve data on species presence. The Service has concluded that implementation of a modified Alternative A will have no significant impact on wildlife.

Endangered Species

Long-term benefits for Federally-listed species are expected under the selected alternative. Moderate positive impacts to the western snowy plover, California least tern, La Graciosa thistle, and marsh sandwort are expected from monitoring, maintenance of fencing, feral swine control, avian and mammalian predator management, and invasive weed control. Minor daytime disturbances and flushing of the snowy plover and least tern may occur from Refuge management activities and visitation. Surf fishing may result in minor disturbance to roosting

snowy plover and least tern. Maintenance of fencing may result in a negligible amount of disturbance to endangered plants. Consultation with USFWS (2016) under Section 7 of the Endangered Species Act regarding effects of implementing the CCP on the western snowy plover, California least tern, La Graciosa thistle, marsh sandwort, Gambel's watercress, and California red-legged frog concluded that the proposed action is "not likely to jeopardize the continued existence" of these species. Additional protection measures may be identified through the NEPA process for the step-down avian and mammalian predator management plan. The Service has concluded that implementation of a modified Alternative A will have no significant impact to endangered species.

Recreation

Under the selected alternative, positive benefits to the local community and the general public are expected from recreational opportunities in the form of wildlife observation, photography, interpretation, and environmental education. Minor negative impact to recreation may occur from refuge management activities such as temporary closures for weed control through aerial spraying and nest protection during the snowy plover breeding season. The Service has concluded that implementation of a modified Alternative A will have no significant impact on recreation opportunities.

Economy

The selected alternative may provide a minor amount of local income in the form of contracts for invasive vegetation control, feral swine control, and avian and mammalian predator management activities. Public access, guided tours, and surf fishing may result in spending in the local area (e.g., restaurants, gas, shops). Surf fishing could also provide subsistence for local residents. The Service has concluded that implementation of a modified Alternative A will have no significant impact on the region's economy.

Cultural Resources

There are identified historic or prehistoric elements on the Refuge. Any identified cultural resource on the Refuge will receive protection guided by Federal laws including but not limited to, the Archaeological Resources Protection Act; the Archaeological and Historic Preservation Act; the Native American Graves Protection and Repatriation Act; and the National Historic Preservation Act. The Service has concluded that implementation of a modified Alternative A will have no significant impact on cultural resources.

Climate Change

The selected alternative is not expected to significantly accelerate climate change. The Service has concluded that implementation of a modified Alternative A will have no significant impact on climate change.

Environmental Justice

No minority and low-income populations or communities would be disproportionately affected by the selected alternative. Outreach efforts will be directed towards local minority and low-income populations when possible. The Service has concluded that no disproportionate adverse human health or environmental effects would result from the selected alternative.

Cumulative Effects

In conjunction with other planning and conservation within the Guadalupe-Nipomo Dunes Complex, modified Alternative A is anticipated to result in long-term benefits to the Refuge coastal dune ecosystem.

Along with other nearby projects, a modified Alternative A is anticipated to provide long-term benefits for native wildlife species, particularly endangered species and their coastal dune habitats. Actions in a modified Alternative A will reduce threats to these species and their habitats primarily by implementing predator management and invasive vegetation control. Public uses and environmental education prescribed in the CCP is intended to improve visibility of the Refuge and stewardship of habitat, in conjunction with other outreach conducted along the Dunes Complex.

Service and State policies prescribe strict regulation on cultural resources. The Service will adhere to these policies when implementing the CCP, resulting in no adverse effects to cultural resources.

Public Review

The planning process incorporated public involvement in developing and reviewing the CCP/EA. This included a public scoping meeting, two planning updates, and public review and comment on the planning documents. The Draft CCP/EA was available for public review and comment for a 45-day period from March 2 through April 18, 2016. The document was distributed to Federal, State, and local agencies; interested parties; and private groups. The Refuge received a total of 39 comment letters from these stakeholders and 50 oral comments from a public comment meeting held after the Draft CCP/EA was published. The Final CCP/EA has been modified to meet and address the concerns that were raised. Responses to specific comments received are addressed in Appendix N of the Final CCP/EA.

Compliance with the Coastal Zone Management Act

We made a determination that the CCP complies with the Coastal Zone Management Act (known as a Negative Determination) and requested concurrence from the California Coastal Commission (CCC) on Jun 30, 2016. We received concurrence from the CCC on July 27, 2016 that the CCP will not adversely affect coastal resources.

Conclusions

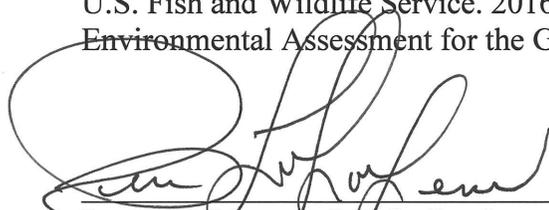
Based on review and evaluation of the information contained in the EA, I have determined that implementing a modified Alternative A as the CCP for management of Guadalupe-Nipomo Dunes National Wildlife Refuge is not a major Federal action that would significantly affect the quality of the human environment, within the meaning of section 102(2)(c) of the National Environmental Policy Act of 1969, as amended. Accordingly, the Service is not required to prepare an environmental impact statement.

This Finding of No Significant Impact and supporting references are on file at the U.S. Fish and Wildlife Service, Hopper Mountain National Wildlife Refuge Complex, Hopper Mountain National Wildlife Refuge Complex, 2493 Portola Road, Suite A, Ventura, California, 93003 (telephone 805/ 644 5185) and the U.S. Fish and Wildlife Service, California/Nevada Refuge Planning Office, 2800 Cottage Way, Sacramento, California, 95825 (telephone 916/ 414 6500). These documents can also be found on the Internet at

<http://www.fws.gov/cno/refuges/planning.html>. These documents are available for public inspection. Interested and affected parties are being notified of this decision.

Supporting References

U.S. Fish and Wildlife Service. 2016. Final Comprehensive Conservation Plan and Environmental Assessment for the Guadalupe-Nipomo Dunes National Wildlife Refuge.



Regional Director, Pacific Southwest Region
Sacramento, California

July 29th, 2016

Date

Guadalupe-Nipomo Dunes National Wildlife Refuge

Final Comprehensive Conservation Plan

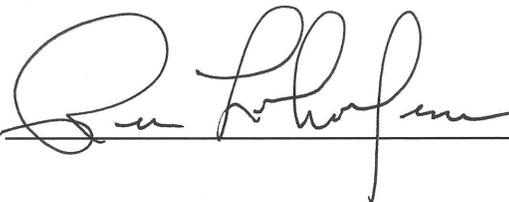
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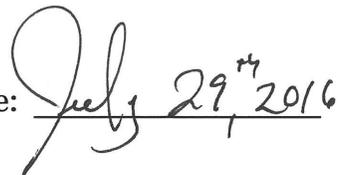
and

Hopper Mountain National Wildlife Refuge Complex
2493 Portola Road, Suite A
Ventura, CA 93003

Approved: _____



Date: _____



Implementation of this Comprehensive Conservation Plan and alternative management actions/programs have been assessed consistent with the requirements of the National Environmental Policy Act (42 USC 4321 et seq.).

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Chapter 1. Introduction and Background

1.1 Introduction

The Guadalupe-Nipomo Dunes National Wildlife Refuge (Refuge) is located along the central Coast of California within the Guadalupe-Nipomo Dunes Complex (Dunes Complex), an 18-mile-long coastal dunes landscape that occupies approximately 20,000 acres of southwestern San Luis Obispo County and northwestern Santa Barbara County (Figure 1). The Dunes Complex is one of the largest coastal dune landscapes along the west coast of North America and provides habitat for a variety of state and federally listed plant and animal species.

The Refuge is located to the west of the Santa Maria River Valley, to the east of the Pacific Ocean, to the north of the Guadalupe Restoration Project (GRP) (former Guadalupe Oil Field), and to the south of the Oso Flaco Lake Natural Area (a management unit of the Oceano Dunes State Vehicular Recreation Area [ODSVRA]) (Figure 2). The Refuge landscape consists of coastal strand and active dunes, central coast foredunes, central coast dune scrub, active interior dunes, coastal dune swale, coastal dune freshwater marshes and ponds, and coastal dune riparian woodland (Holland et al. 1995).

The 2,553-acre Refuge was established in 2000 as a satellite of the Hopper Mountain National Wildlife Refuge Complex (Refuge Complex), a branch of the U.S. Fish and Wildlife Service (Service), which is headquartered in Ventura, California. The Refuge was created to conserve central California coastal dune and associated wetlands habitats and support the recovery of native plants and animals that are federally listed as threatened or endangered. At the time of the initial acquisition, interim management goals were developed for the Refuge (USFWS 2000a). These interim management goals, which follow, have been the management priorities on the Refuge since its establishment in 2000:

- Protect, restore, and enhance native habitats to aid in the recovery of federally listed species (those species federally designated as threatened and/or endangered) and designated critical habitats on the Refuge.
- Protect, manage, and restore coastal dune habitats representative of the biodiversity in the central California coast area
- Establish and maintain conservation partnerships and provide assistance for natural resource and land management activities with federal, state, tribal, and local governments and agencies, and with academic institutions and private conservation organizations.

The Refuge was primarily established to conserve imperiled plant and wildlife habitats and species. Several specific Refuge goals include the recovery of the federally endangered La Graciosa thistle (*Cirsium scariosum* var. *loncholepis*), marsh sandwort (*Arenaria paludicola*), Gambel's watercress (*Nasturtium gambelii*), California least tern (*Sternula antillarum browni*; formerly *Sterna antillarum browni*), the federally threatened California red-legged frog (*Rana draytonii*) and western snowy plover (*Charadrius nivosus nivosus*, formerly *Charadrius alexandrinus nivosus*) (USFWS 2000b). The Refuge also serves to protect designated critical habitats for the La Graciosa thistle and western snowy plover.

Many imperiled plant species and at least 118 special status (i.e., state listed, federally listed, recognized by a special interest group, or a species of local interest) animal species occur in the Dunes Complex (Blecha et al. 2007; also see Appendix E and F of this Comprehensive Conservation Plan [CCP]). Approximately 60 of these special status species have been observed on the Refuge.

Figure 1. Vicinity Map

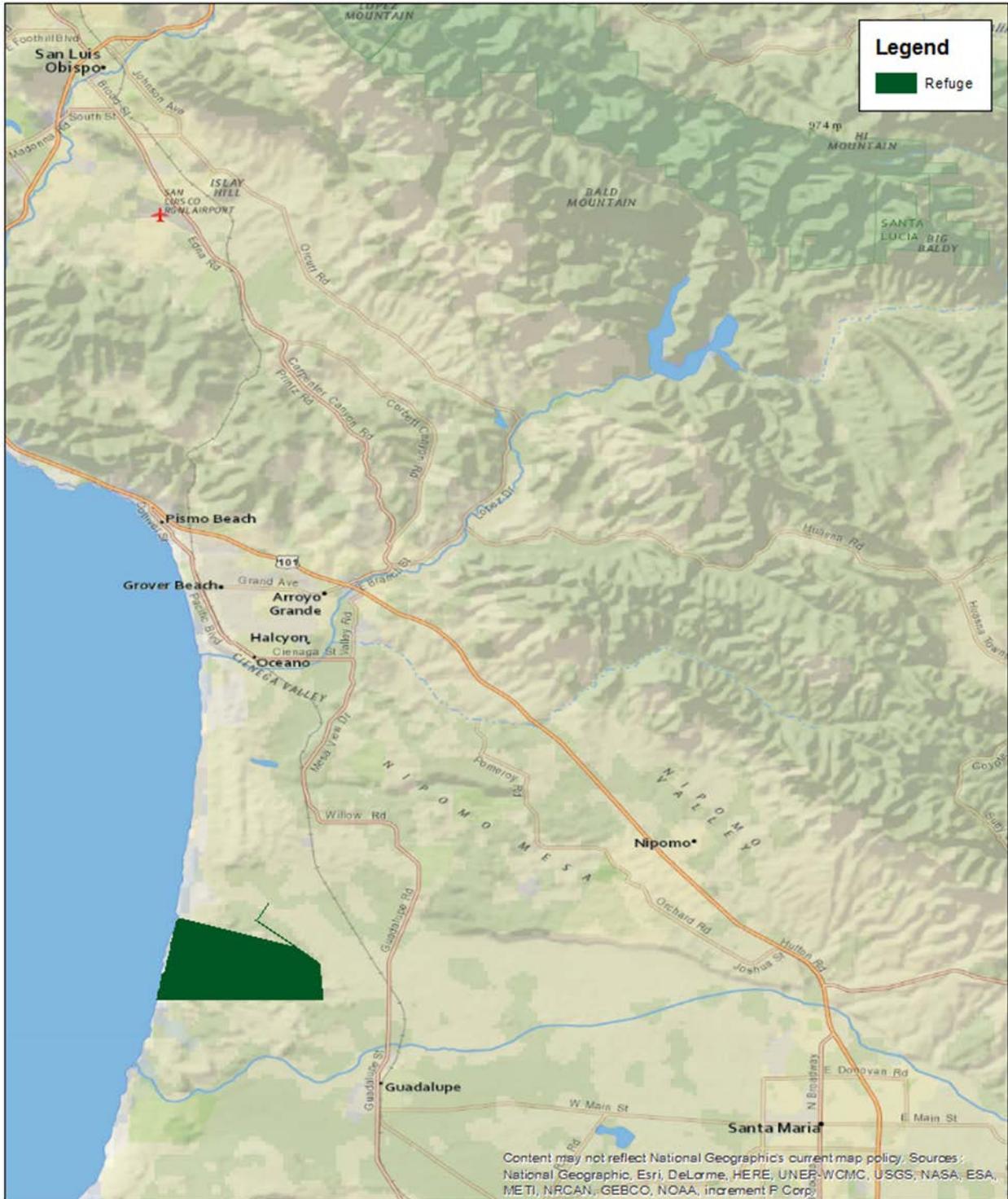
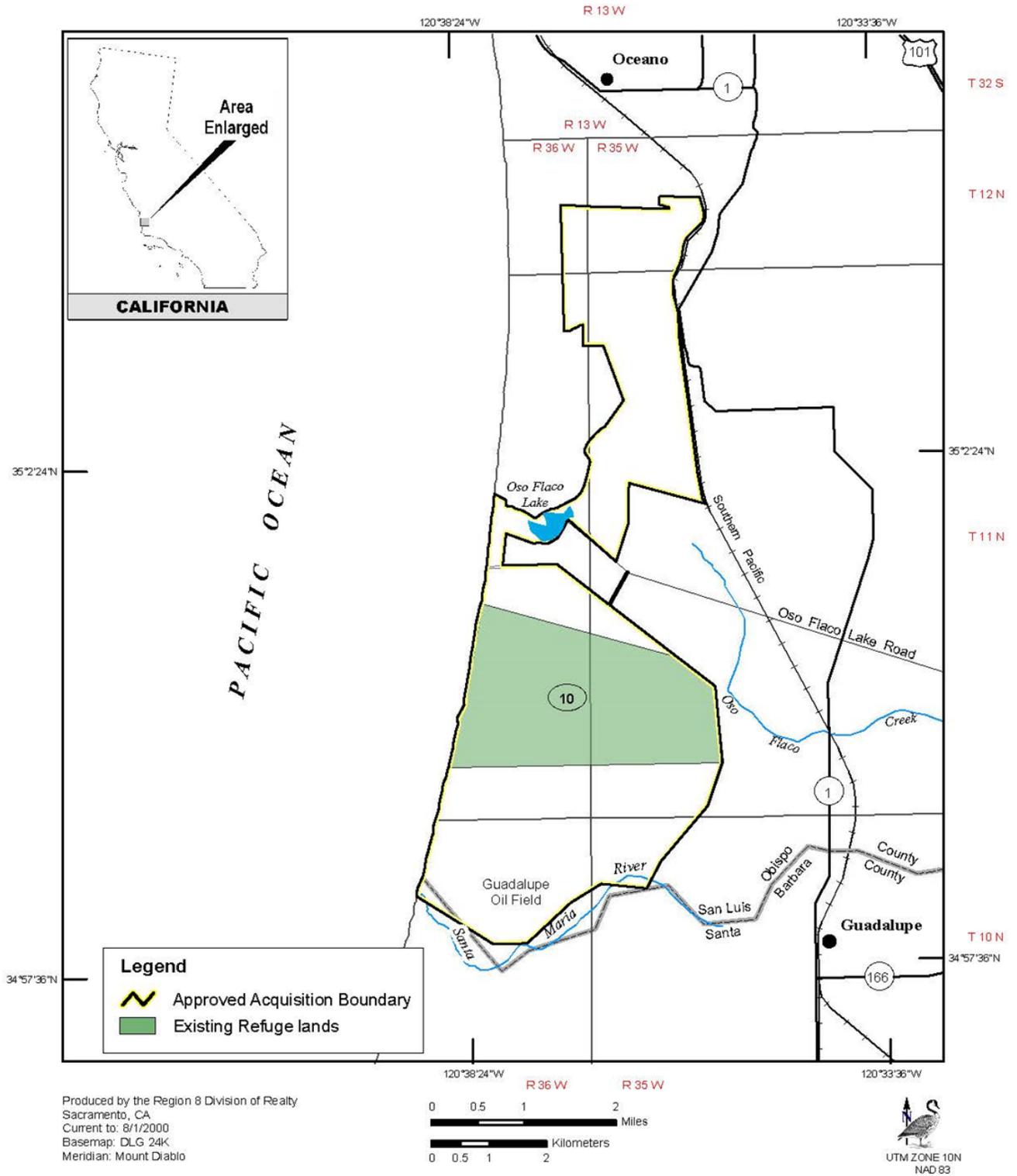


Figure 2. Refuge Location Map



1.2 Purpose and Need for a Plan

The Service is developing CCPs to guide the management and resource use for each refuge in the National Wildlife Refuge System (Refuge System). The Refuge System forms the largest network of public lands in the world managed principally for fish and wildlife. The National Wildlife Refuge System Improvement Act of 1997 (1997 Improvement Act) (16 United States Code [U.S.C.] 668dd-668ee) requires that all existing refuges are managed in accordance with an approved CCP by 2012. All refuges established after the 1997 Improvement Act was passed have 15 years to develop a CCP. A CCP is a formal management document intended to provide guidance for a national wildlife refuge for up to 15 years.

A Conceptual Management Plan was prepared for the Refuge in 2000 (USFWS 2000c) to serve as a temporary management guide until a formal management plan could be developed. The Conceptual Management Plan provided the primary management guidance for the Refuge since its creation in 2000.

Under the 1997 Improvement Act, the Refuge System is to be consistently directed and managed to fulfill the specific purpose(s) for which each refuge was established, as well as the Refuge System mission. The planning process helps the Service achieve the refuge purposes and the Refuge System mission by identifying specific goals, objectives, and strategies to implement on each refuge. The purposes of this CCP include the following:

- Provide a clear statement of direction for the management of the refuge during the lifetime of the CCP.
- Provide long-term continuity in refuge management.
- Communicate the Service's management priorities for the refuge to its neighbors and the public.
- Provide an opportunity for the public to help shape the future management of the refuge.
- Ensure that management programs on the refuge are consistent with the legal and policy mandates for the Refuge System and the purpose of the Refuge as set forth in establishing documentation.
- Ensure that management of the refuge is, to the extent practicable, consistent with federal, state, and local plans.
- Provide a basis for budget requests to support the refuge's needs for staffing, operations, maintenance, and capital improvements.
- Evaluate existing and proposed uses on the refuge to ensure that they are compatible with the refuge purpose(s); the Refuge System mission; and the maintenance of biological integrity, biodiversity, and environmental health.

The CCP is also needed to ensure that the refuge continues to conserve fish, wildlife, and habitats in the context of climate change, which affects all units of the Refuge System.

The CCP is comprehensive in that it addresses all activities that occur on the refuge; however, the noted management activities or strategies are broadly stated. The refuge staff will prepare detailed step-down plans that follow the CCP process and describe how a management strategy, such as developing an interpretive program, will be applied. These plans are adjusted based on monitoring results, available funds and staff, and current Service policy. The effects of management actions are monitored to provide information for needed modifications of management practices or activities. The CCP has flexibility and will be reviewed periodically to ensure that its goals, objectives, strategies, and time frames remain valid.

1.3 The U.S. Fish and Wildlife Service and the National Wildlife Refuge System

1.3.1 *The U.S. Fish and Wildlife Service*

The Service is the primary federal agency responsible for conserving, protecting, and enhancing the Nation's fish, wildlife, and plant populations and their habitats for the continuing benefit of the American people. Although the Service shares this responsibility with other federal, state, tribal, local, and private entities, the Service has specific responsibilities for migratory birds, threatened and endangered species, interjurisdictional fish, and certain marine mammals referred to as Federal Trust Species. The Service also manages the Refuge

System and national fish hatcheries; enforces federal wildlife laws and international treaties related to importing and exporting wildlife; assists state fish and wildlife programs; and helps other countries develop wildlife conservation programs.

The Service holds its official mission statement as:

“Working with others to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people.”

1.3.2 The National Wildlife Refuge System

The Refuge System is the world’s largest collection of lands specifically managed for fish and wildlife conservation. Unlike other federal lands that are managed under a multiple-use mandate (e.g., national forests and lands administered by the U.S. Bureau of Land Management), the Refuge System is managed primarily for the benefit of fish, wildlife, and plant resources and their associated habitats. The Refuge System currently consists of more than 560 refuge units and 38 wetland management districts that provide more than 150 million acres of important habitat for native plants and many species of mammals, birds, and fish, including threatened and endangered species.

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” (1997 Improvement Act).

The goals of the Refuge System are as follows:

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

1.3.3 Legal Policy and Guidance

Refuges are guided by the purposes of the individual refuge, the mission and goals of the Refuge System, Service policy, laws, and international treaties. Relevant guidance includes the Refuge Recreation Act of 1962, the 1997 Improvement Act, and selected portions of the Code of Federal Regulations (CFR) and the Service Manual (<http://www.fws.gov/policy/manuals>). Refuges are also governed by a variety of other federal laws, executive orders (EOs), treaties, interstate compacts, regulations, and policies pertaining to the conservation and protection of natural and cultural resources (See Appendix K and Service Manual 602 FW 1 (1.3)).

The 1997 Improvement Act’s main components include:

- A strong and singular wildlife conservation mission for the Refuge System.
- Recognition of six priority public uses of the Refuge System (hunting, fishing, wildlife observation and photography, and environmental education and interpretation).
- A requirement that the Secretary of the Interior maintain the biological integrity, diversity, and environmental health of Refuge System lands.

- A new process for determining compatible uses on refuges.
- A requirement for preparing a CCP for each refuge.

First and foremost, refuges are managed for fish, wildlife, plants, and their habitats. In addition, units of the Refuge System are legally closed to all public access and use, including economic uses, unless and until they are officially opened through an analytical process called the *appropriate use and refuge compatibility* process. All refuge uses are subservient to the Refuge System’s primary wildlife management responsibility, and they must be determined compatible to be authorized.

1.3.4 *Appropriate Use Policy*

The Appropriate Use Policy describes the initial decision process the refuge manager follows when first considering whether to allow a proposed use on a refuge. The refuge manager must find a use appropriate before undertaking a compatibility review of the use. An appropriate use as defined by the Appropriate Use Policy (603 FW 1 of the Service Manual) is a proposed or existing use on a refuge that meets at least one of the following four conditions:

- The use is a wildlife-dependent recreational use as identified in the 1997 Improvement Act.
- The use contributes to fulfilling the refuge purpose(s), the Refuge System mission, or goals or objectives described in a refuge management plan approved after October 9, 1997, the date the Improvement Act was signed into law.
- The use involves the take of fish and wildlife under state regulations.
- The use has been found to be appropriate as specified in Section 1.11 (603 FW 1 of the Service Manual).

If an existing use is not appropriate, the refuge manager will eliminate or modify the use as expeditiously as practicable. If a new use is not appropriate, the refuge manager will deny the use without determining compatibility. If a use is determined to be an appropriate refuge use, the refuge manager will then determine if the use is compatible (see Compatibility Policy in the following section). Although a use may be both appropriate and compatible, the refuge manager retains the authority to not allow the use or to modify the use. Uses that have been administratively determined to be appropriate are the six wildlife-dependent recreational uses (hunting, fishing, wildlife observation and photography, environmental education, and interpretation) and take of fish and wildlife under state regulations. An appropriate use finding for research is included in Appendix C.

1.3.5 *Compatibility Policy*

Lands within the Refuge System are different from other multiple use public lands in that they are closed to all public uses unless deemed compatible and formally allowed. The 1997 Improvement Act established the formal process for determining compatibility of wildlife-dependent recreational use or any other public use of a refuge. The Improvement Act states, “...the Secretary shall not initiate or permit a new use of a refuge or expand, renew, or extend an existing use of a refuge, unless the Secretary has determined that the use is a compatible use and that the use is not inconsistent with public safety.”

A compatible use is one that, in the sound professional judgment of the refuge manager, will not materially interfere with or detract from the fulfillment of refuge purpose(s) or the Refuge System mission. The Service strives to provide wildlife-dependent public uses when compatible. If financial resources are not available to design, operate, and maintain a priority use, the refuge manager will take reasonable steps to obtain outside assistance from the state and other conservation interests.

When a determination is made as to whether a proposed use is compatible or not, this determination is provided in writing and is referred to as a compatibility determination. Two interim compatibility determinations were developed when the Refuge was established: environmental education and interpretation, as well as wildlife observation and wildlife photography. These compatibility determinations were updated during the current CCP process (Appendix D). A compatibility determination for research signed in 2014 is also included in Appendix D.

1.3.6 Biological Integrity, Diversity, and Environmental Health Policy

The Improvement Act directs the Service to “ensure that the biological integrity, diversity, and environmental health of the Refuge System are maintained for the benefit of present and future generations of Americans...” To implement this directive, the Service has issued the Biological Integrity, Diversity, and Environmental Health Policy (601 FW 3 of the Service Manual), which provides policy for maintaining and restoring, where appropriate, the biological integrity, diversity, and environmental health of the Refuge System. The policy is an additional directive for refuge managers to follow while achieving the refuge purpose(s) and Refuge System mission. It provides for the consideration and protection of the broad spectrum of fish, wildlife, and habitat resources found on refuge and associated ecosystems. Further, it provides refuge managers with an evaluation process to analyze their refuge and recommend the best management direction to prevent further degradation of environmental conditions and restore lost or severely degraded components where appropriate and in concert with refuge purposes and the Refuge System mission. When evaluating the appropriate management direction for refuges, refuge managers will use sound professional judgment to determine their refuges’ contribution to biological integrity, diversity, and environmental health at multiple landscape scales.

1.3.7 Wilderness Review

As required by Service planning policy, a review of wilderness areas was conducted for the Refuge in the form of a Wilderness Inventory (Appendix J). None of the lands are eligible for wilderness designation.

1.3.8 Climate Change Policy

With regard to global climate change, Department of the Interior Secretarial Order 3226 (January 19, 2001) states that “there is a consensus in the international community that global climate change is occurring and that it should be addressed in governmental decision making... This Order ensures that climate change impacts are taken into account in connection with Departmental planning and decision making.” It further states that “each bureau and office of the Department will consider and analyze potential climate change impacts when undertaking long-range planning exercises, when setting priorities for research and investigations, when developing multi-year management plans, and/or when making major decisions regarding the potential utilization of resources under the Department’s purview. Departmental activities covered by this Order include, but are not limited to, programmatic and long-term environmental reviews undertaken by the Department, management plans and activities developed for public lands, planning and management activities associated with oil, gas and mineral development of public lands, and planning and management activities of water projects and water resources.”

Secretarial Order 3289 (September 14, 2009) reiterated the mandate provided in Secretarial Order 3226. Also, the Service’s strategic plan for climate change states, “We will consider actual and projected climate change impacts to fish and wildlife populations and their habitats in Service planning, decision making, consultation and evaluation, management, and restoration efforts” (USFWS 2010a:22). CCPs are explicitly listed as plans subject to this directive.

1.4 The Hopper Mountain National Wildlife Refuge Complex

The Refuge Complex is comprised of four NWRs: Hopper Mountain Refuge (established in 1974), Blue Ridge Refuge (1982), Bitter Creek Refuge (1985), and Guadalupe-Nipomo Dunes Refuge (2000) (Figure 3). Three refuges in the Refuge Complex—Hopper Mountain, Bitter Creek, and Blue Ridge—were established to protect the California condor. The Guadalupe-Nipomo Dunes Refuge was established to protect federally listed endangered and threatened species and central California coastal dune and associated wetland habitats.

1.5 The Guadalupe-Nipomo Dunes National Wildlife Refuge

1.5.1 Location

Located in the southwest corner of coastal San Luis Obispo County, California, the Refuge is approximately 10 miles west of Santa Maria, 18 miles south of San Luis Obispo, and 65 miles northwest of Santa Barbara. The southeast corner of the Refuge is located about 2 miles northwest of the incorporated city of Guadalupe,

which is located in Santa Barbara County. The northeast corner of the Refuge is located about 7 miles west of the unincorporated community of Nipomo, which is located in San Luis Obispo County (refer to Figure 1).

The Refuge occupies one contiguous area of 2,553 acres, to the west of the Santa Maria River Valley, to the east of the Pacific Ocean, to the north of the GRP (former Guadalupe Oil Field), and to the south of the Oso Flaco Lake Natural Area (a management unit of the ODSVRA). The Refuge's western boundary is the mean high tide line along 1.8 miles of the Pacific Ocean coastline. Refuge boundaries extend from the mean high tide line about 3 miles inland.

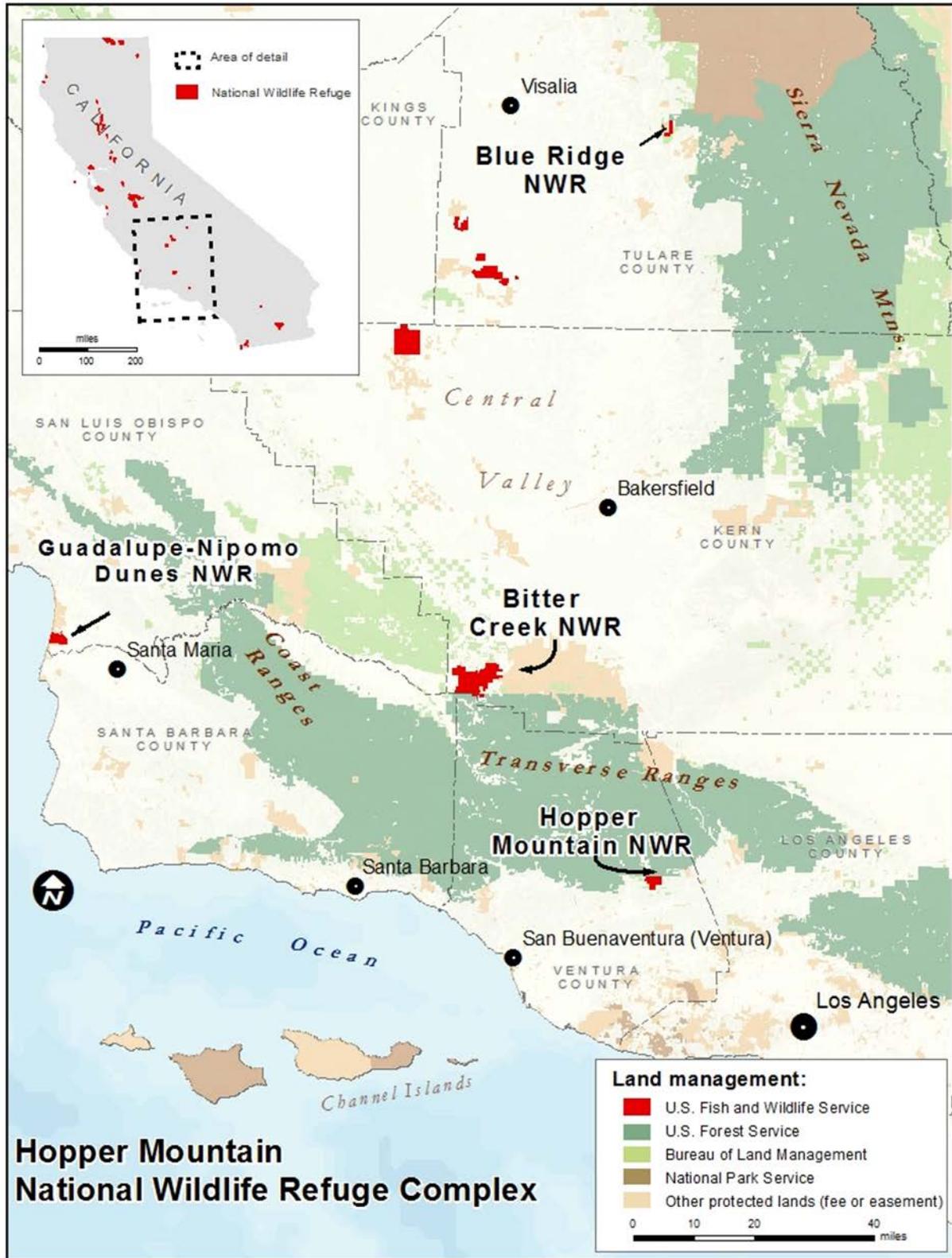
1.5.2 Refuge Setting

At 20,000 acres, the Dunes Complex is one of the largest dune landscapes on the west coast of North America. In 1974, the lands now included within the boundaries of the Refuge, as well as several neighboring Dunes Complex lands, were collectively incorporated by the Secretary of the Interior into the 11,533-acre Nipomo Dunes-Point Sal Coastal Area National Natural Landmark.

This action recognizes the Nipomo Dunes as the most extensive coastal dune tract in California. The National Natural Landmarks Program, established in 1962 by the Secretary of the Interior under the authority of the Historic Sites Act of 1935 (16 U.S.C. 461 et seq.), encourages the preservation of the best remaining examples of major biotic communities and geologic features composing the Nation's natural landscape and identifies and recognizes areas in both public and private ownership.

The 2,553-acre Refuge occupies about 13 percent of the land area of the Dunes Complex. Elevations on the Refuge range from sea level to about 175 feet above mean sea level. The Refuge landscape primarily exists as sandy beaches, unvegetated sand dunes, vegetated sand dunes, and wetlands.

Figure 3. Hopper Mountain National Wildlife Refuge Complex



The Refuge is located within the Santa Maria and Santa Ynez Valleys Subregion of the Central California Foothills and Coastal Mountains Ecoregion (Griffith et al. 2011). The primary distinguishing characteristic of this ecoregion is its Mediterranean climate of hot dry summers and cool moist winters, and associated vegetative cover comprised mainly of coastal sage scrub and of chaparral and oak woodlands; grasslands occur in some lower elevations, and patches of pine are found at higher elevations.

Most of the ecoregion consists of open low mountains or foothills, but there are areas of irregular plains in the south and near the border of the adjacent Central California Valley Ecoregion. Large parts of the ecoregion are grazed by domestic livestock; relatively little land has been cultivated, although some valleys (such as the Santa Maria River Valley located near the Refuge) are or were important agricultural centers. However, due to its coastal dunes landscape, the Dunes Complex (including the Refuge) represents a community type that is not typical of the majority of the ecoregion.

When considering vegetation zones, the Refuge is located within the Central Western California Region of the California Floristic Province. Further delineated, the Refuge is located within the Central Coast Subregion of the Central Western California Region. The Central Coast Subregion extends along the Pacific Coast (and San Francisco Bay) the full length of the Central Western California Region, from near Bodega Bay in the north to Point Conception in the south (Baldwin et al. 2012).

Although the Refuge and surrounding Dunes Complex are located within the Central Coast Subregion, there are some notable differences from most other landscapes within this subregion. In the Central Coast Subregion, coastal sage scrub and chaparral are the predominant plant communities. However, the Dunes Complex (including the Refuge) is dominated by coastal strand and active dunes, central coast foredunes, central coast dune scrub, and active interior dunes (Holland et al. 1995). Therefore, although the climatic regime of the Dunes Complex is similar to other portions of the Central Coast Subregion, the landscape and plant communities are quite different.

1.5.3 History of Refuge Establishment and Acquisition

The establishment of the Dunes Preserve began in the late 1980s through the efforts of the California State Coastal Conservancy and The Nature Conservancy (TNC). The parcel that is now a Refuge was once part of the Guadalupe-Nipomo Dunes Preserve (Dunes Preserve) located within the Dunes Complex. The former Dunes Preserve consisted of a group of properties set aside to protect the natural resources found within the (1) Mobil Coastal Preserve (now the Refuge); (2) Rancho Guadalupe Dunes Preserve County Park; (3) Black Lake; and (4) Pismo State Beach Dunes Natural Preserve (Figure 4).

On August 1, 2000, management of the four parcels within the Dunes Preserve were transferred from TNC to the current land management agencies. The Mobile Coastal Preserve was transferred to the Service, Rancho Guadalupe Dunes County Park went to the County of Santa Barbara Parks and Recreation Department, Black Lake went to the Land Conservancy of San Luis Obispo County, and the Pismo Dunes Natural preserve went to California Department of Parks and Recreation. When the management transfer occurred, the Dunes Preserve ceased to exist. The transfer of the management of 2,553 acres of the Mobil Coastal Preserve from TNC to the Service created Guadalupe-Nipomo Dunes Refuge (August 1, 2000).

1.5.4 Land Protection

During the creation process for the Refuge, three alternatives were considered in the *Environmental Assessment for Proposed Guadalupe-Nipomo Dunes National Wildlife Refuge* (USFWS 2000b): a no-action alternative and two action alternatives. Under the Preferred Alternative, a total of 8,900 acres of contiguous land was included within an approved acquisition boundary. This area includes the 2,553-acre former Mobil Coastal Preserve and another 6,347 acres of adjacent lands. These pre-approved adjacent lands include the GRP (former Guadalupe Oil Field), Oso Flaco Lake Natural Area, Phillips 66 Refinery Buffer Area (former Tosco Refinery Buffer Area), Black Lake, Dunes Lakes (an agricultural easement), and Pismo Dunes Natural Preserve. To date, the Refuge only occupies the 2,553 acres originally acquired from the former Mobil Coastal Preserve; none of the remaining 6,347 acres of approved acquisition lands have been acquired or are managed by the Service.

An approved acquisition boundary designates those lands that the Service has authority to acquire and/or manage through various agreements, based upon planning and environmental compliance processes. Approval of an acquisition boundary does not grant the Service jurisdiction or control over lands within the boundary, and it does not make lands within the acquisition boundary part of the Refuge System. Lands do not become part of the Refuge System unless they are purchased from willing sellers or are placed under an agreement that provides for their management as part of the Refuge System.

1.5.5 Land Conservation Methods

Working in cooperation with landowners and local and state agencies, the Service may use various means to conserve or manage fish and wildlife and their habitats within the approved acquisition boundary. These may include fee title acquisition, conservation easements, memoranda of understanding and cooperative agreements, financial incentives and technical assistance, and education and outreach. Landowners within the approved acquisition boundary are not required to sell their lands to the Service.

The Service acquires lands within the approved acquisition boundary when funding and/or other resources become available. It is the established policy of the Service to seek the minimum degree of interest in property needed to accomplish refuge land conservation objectives.

In fee title acquisitions, the Service acquires full ownership of property through fee simple purchase, donation, exchange, or transfer from another federal agency. Land acquired in fee title by the Service is removed from county tax rolls. To partially offset this loss, the Service provides annual payments to counties as authorized by the Refuge Revenue Sharing Act (Public Law 95-469). The Service is required under the U.S. Constitution to pay fair market value for property, and purchases are dependent on the availability of funds.

In acquiring a conservation easement, the Service purchases the minimum rights needed to conserve fish and wildlife habitat, while allowing the existing landowner to retain title to the land. Easements may include wetland or waterfowl habitat easements, upland easements, agricultural practices easements, and non-development easements. The easement interest acquired by the Service becomes part of the refuge and is subject to applicable laws and regulations pertaining to refuges. The easement is a permanent interest in the property that runs with the land, and the landowner remains responsible for all property taxes.

The Service may also assist in securing financial incentives for landowners who are not willing to sell an interest in their property but wish to explore conservation or enhancement of fish and wildlife habitats on their property. For example, through the Partners for Fish and Wildlife program, landowners may apply for financial assistance from the Service to protect, enhance, or restore wetland, riparian, or native grassland habitats on their property. In addition, the Service could assist a landowner in securing funds from Farm Bill programs available from the U.S. Department of Agriculture / Natural Resources Conservation Service. Potential Natural Resources Conservation Service programs that could benefit landowners and further refuge land conservation objectives include the Conservation of Private Grazing Land Program, Environmental Quality Incentives Program, Farmland Protection Program, Wetlands Reserve Program, and Wildlife Habitat Incentives Program.

Finally, Service staff are available to provide technical assistance and education and outreach information to willing landowners who are interested in conserving fish and wildlife habitats on their lands.

1.5.6 Refuge Purpose

Lands within the Refuge System are acquired and managed under a variety of legislative acts and administrative orders and authorities. The official purpose or purposes for a refuge are specified in or derived from the law, proclamation, EOs, agreement, public land order, funding source, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge subunit. The purpose of a refuge is defined when it is established or when new land is added to an existing refuge. When an addition to a refuge is acquired under an authority different from the authority used to establish the original refuge, the addition takes on the purposes of the original refuge, but the original refuge does not take on the purposes of the addition. Refuge managers must consider all of the purposes. However, purposes that deal with the conservation, management, and restoration of fish, wildlife, and plants and their habitats take precedence over other purposes in the management and administration of a refuge (601 FW 1 of the Service Manual).

The Refuge System Improvement Act directs the Service to manage each refuge to fulfill the mission of the Refuge System, as well as the specific purposes for which that refuge was established. Refuge purposes are the driving force in developing refuge vision statements, goals, objectives, and strategies in the CCP. Refuge purposes are also critical to determining the compatibility of all existing and proposed refuge uses.

The Refuge was established under the authority of the Federal Endangered Species Act of 1973, as amended, (16 U.S.C. §1534), which authorizes the Service to acquire lands "...to conserve fish, wildlife, and plants, including those which are listed as endangered species or threatened species..." 16 U.S.C. § 1534 (Endangered Species Act of 1973). In addition to providing a basis for making compatibility determinations, a refuge's purpose also serves as a guide for refuge management and public use. As stated in the Conceptual Management Plan for the Proposed Guadalupe-Nipomo Dunes Refuge (USFWS 2000c), the Refuge was established to protect and conserve the unique central California coastal dune and associated wetland habitats and the endangered and threatened wildlife and plants that inhabit them.

1.5.7 Related Projects and Plans

Guadalupe-Nipomo Dunes Preserve Management Program. In 1999, a management program was prescribed for the Dunes Preserve when it was under management of TNC. The 1999 management program (TNC 1999) replaced an earlier management program prepared in 1991 (Hall 1991). The 1999 management program included all lands that were managed as part of the Dunes Preserve, including the Mobil Coastal Preserve, the forerunner to the Refuge. The general purpose of this management program was to provide the public with updated information about the Dunes Preserve, including its ecological resources, permitted visitor uses, and landownership and management structure.

The 1999 management program describes the properties that comprised the former Dunes Preserve, which were the Mobil Coastal Preserve, Rancho Guadalupe County Park, Black Lake area, and Pismo Dunes Natural Preserve. Additionally, the management program identified those properties located outside of the Dunes Preserve but within the Dunes Complex, including the Oso Flaco Lake Natural Area, publicly held properties around Point Sal, and the Phillips 66 Refinery Buffer Area (formerly known as Tosco Refinery Buffer Area).

The management program established a long-term structure for the overall management and protection of the Dunes Preserve. This structure was intended for use by the land managers of Dunes Preserve parcels, interested landowners of Dunes Complex lands located outside of the Dunes Preserve, and the community at large. An intended goal of this management program was for all groups to work together to sustain the long-term viability of the Dunes Complex and its appropriate enjoyment by humans (TNC 1999).

The management program also lists several areas of management policies for the ecological resources; public access and recreation; public interpretation and education; and cultural resources of the Dunes Preserve. These policies were considered during development of management direction for the CCP.

Dunes Collaborative. Originally established in 2000 as the Guadalupe Dunes Stewardship, the Dunes Collaborative is a partnership between federal, state, private, and non-profit organizations committed to restoration of the Dunes Complex, recovery of threatened and endangered species, and providing quality visitor experiences to this unique and fragile ecosystem. In 1994, several state agencies filed a lawsuit against the Union Oil Company (Unocal; now annexed and owned by Chevron Oil Company) due to discharges of diluent (a diesel-kerosene mixture) into the environment at the Guadalupe Oil Field located immediately south of the Refuge. The parties settled in July 1998; as part of the settlement, a fund was established for projects to restore, replace, rehabilitate, and/or acquire the equivalent of the natural resources and related services that were injured, lost, or destroyed by the diluent releases. These settlement funds were placed into the Guadalupe Natural Resources Restoration Trust Account (Trust) established with the National Fish and Wildlife Foundation. As advisors to the Trust, the Restoration Subcommittee is required to authorize all disbursements for the Trust. The Restoration Subcommittee consists of one representative from the State of California Department of Fish and Wildlife Office of Spill Prevention and Response and one representative from the State of California Coastal Conservancy.

The Dunes Collaborative functions in an advisory capacity to the Restoration Subcommittee and satisfies a number of roles. Specifically, it is the Dune Collaborative's responsibility to:

- Define the needs of the Guadalupe-Nipomo Dunes in areas of natural resources and visitor serving facilities consistent with the resources and facilities identified in our area of jurisdiction;
- Collaborate and partner with individual organizations and agencies to identify projects that meet those needs;
- Recommend projects for funding to the Restoration Subcommittee that meet identified needs;
- Monitor and adaptively manage projects for the benefit of the dunes system and its visitors;
- Maintain a strategic operating procedures document that describes the Dunes Collaborative and how it operates; and
- Review task forces and other ad hoc committee recommendations.

A primary function of the Dunes Collaborative is to assist the Restoration Subcommittee with project implementation in the Dunes Complex. Projects submitted to the Restoration Subcommittee are reviewed and ranked by the Dunes Collaborative. After reviewing submitted project proposals, the Dunes Collaborative provides recommendations to the Restoration Subcommittee, which is responsible for final project approval and making sure that all activities are consistent with the settlement criteria.

A work plan was developed to describe recommendations by the Dunes Collaborative to the Restoration Subcommittee on three kinds of projects: Interim Projects, Long-Term Projects, and management of an endowment set aside for ongoing restoration activities. The Dunes Collaborative works to identify restoration, recreation, and educational needs in the dunes and to allocate funds to enhance these efforts. Designated priority projects include controlling the spread of non-native invasive plant species, recovering rare plant populations, improving and protecting sensitive coastal habitats and listed species, and enhancing visitor experiences through education, interpretation, and visitor services.

Dunes Center. The Dunes Center was conceived by a group of concerned citizens. In 1989, TNCs efforts to help preserve and restore the Guadalupe Beach and Oso Flaco Lake Natural Area helped create the stimulus for a Dunes Complex visitor center. The Dunes Center opened in 1996 in a small storefront in Guadalupe. In 1998, the Dunes Center, seeking non-profit status, was adopted by the Land Conservancy of San Luis Obispo County and became an independent non-profit 501(c)(3) organization in 1999. The mission of the Dunes Center is to promote the conservation and restoration of the Dunes Complex ecosystem through education, research, and the support of cooperative stewardship.

The Dunes Center manages an environmental education program, reaching over 4,000 students annually. It offers docent-led walks in the Dunes Complex, guest speakers, special events, and quarterly members' events. In addition, the Dunes Center serves as administrator of the Dunes Collaborative. The Service and Dunes Center have been working closely together on a wide variety of projects. From 2000-2012, Refuge headquarters was co-located as a tenant of the Dunes Center. The Dunes Center and Service have worked together on such projects as open houses, educational programs, outreach events, docent classroom and field training, preparing docent training guides, and preparing western snowy plover outreach educational materials. Further, the Dunes Center provides information to the public about Refuge access, regulations, and special events. In recent years, the Dunes Center and Service have together presented lectures about Dunes Complex-related topics and hosted interpretive hikes on the Refuge. The Service also provides technical advice to the Dunes Center regarding the preparation of educational programs, environmental regulations, and natural history exhibits.

Guadalupe Restoration Project. The former Guadalupe Oil Field is located immediately south of the Refuge. The Union Oil Company (Unocal) began production in the 2,700-acre Guadalupe Oil Field in the late 1940s. In the 1950s, diluent (a kerosene-diesel blend) was injected into wells to help the heavy, viscous Santa Maria crude oil flow better through pipelines. Over the years, the diluent leaked from pipelines in the oil field, causing contamination of numerous surface and subsurface areas. The use of diluent in the Guadalupe Oil Field was discontinued in 1990. Unocal ceased all oil production at the Guadalupe Oil Field in 1994.

In September 1998, the San Luis Obispo County Board of Supervisors approved a plan to clean up the spilled diluent. Both this plan and the former Guadalupe Oil Field became collectively known as the GRP. The GRP Team includes Chevron staff members, university and private consultants, and public and regulatory agencies. In 2005, Chevron Oil Company purchased Unocal and took over the GRP ownership and management.

Since its inception, the GRP has maintained an aggressive schedule for remediation of environmental damage caused by diluent contamination. Other activities being conducted on the GRP include site-wide ecological monitoring of sensitive wildlife species (such as California red-legged frog, La Graciosa thistle, and western snowy plover), invasive plant control activities, habitat restoration, revegetation with native plant species, development of a native plant nursery, and development of an extensive Geographic Information System (GIS).

Chevron staff members and consultants have a long history of working closely with the Service on issues regarding diluent remediation and sharing of natural resource data; most recently, they collaborated on an invasive plant control research study.

Santa Maria River Enhancement Plan. The Santa Maria River is located about 2 miles south of the Refuge. The Santa Maria River Estuary Enhancement and Management Plan was developed by the Dunes Center and a coalition of private landowners, as well as local, state and federal agency representatives. The Estuary Enhancement and Management Plan area includes the estuary, river, and adjacent lands, extending from Highway 1 to the Pacific Ocean and laterally to a distance of approximately 2,000 feet on either side of the river (SAIC 2004). The goals include the following:

- Improve water quality in the study area.
- Enhance physical and ecological processes while protecting important agricultural resources in the study reach from erosion and flooding.
- Improve habitat quality and quantity while also improving erosion protection along river terraces in the study reach that support urban or agricultural uses.
- Identify feasible management actions that public and private land managers can cooperatively implement.
- Adaptively manage the resources as conditions change over time.

- Identify regulatory and associated permitting requirements for implementation of the preferred alternative recommendations, and avoid imposing additional regulation or burden on other agencies or landowners as a result of the plan.

Additionally, landowner participation and outreach to other stakeholders during implementation would serve to:

- Foster trust and stewardship among all of the stakeholders.
- Facilitate a coordinated approach to implementing recommended actions.
- Reduce the regulatory burdens that individual landowners may face in the future with respect to existing and proposed water quality improvements, sensitive species protection requirements, and flood management activities.
- Protect agricultural land from flooding and reduce soil erosion and sedimentation.

ODSVRA Habitat Conservation Plan. A habitat conservation plan is being developed for the ODSVRA to manage recreation and monitoring activities as they impact California least tern and western snowy plover. These activities were covered under a biological opinion and conference opinion issued through a federal nexus with the U.S. Army Corps of Engineers (ACOE) that was prepared under a formal Section 7 consultation for the issuance of Regional General Permit No. 42 (Corps of Engineers File No. 95-50035-TAW), dated January 25, 1996. The biological opinion and conference opinion expired, and the ACOE later determined that the activity being conducted at the ODSVRA was no longer under ACOE jurisdiction. Therefore, ODSVRA lost the federal nexus needed to continue consultations under Section 7. In the interim, a 2013 Nesting Season Management Plan prescribes a wide variety of measures to be implemented to avoid take of any California least tern and western snowy plover.

The Refuge and ODSVRA have a history of cooperative efforts regarding natural resource management—in particular, the management of California least tern and western snowy plover. The information contained in the Nesting Season Management Plan and Habitat Conservation Plan improves monitoring and managing of these two endangered species. The information will assist with the ongoing study and management of California least tern and western snowy plover on the Refuge.

1.5.8 Conservation Priorities

The conservation and restoration plans in place to help guide the direction of the CCP are described here.

At the time of the initial acquisition of the Mobil Coastal Preserve by the Service, interim management goals, as follows, were developed for the Refuge (USFWS 2000a).

- **Listed Species/Critical Habitat.** Work to protect, restore, and enhance native habitats to aid in the recovery of federally listed species (those species federally designated as threatened and/or endangered) and designated critical habitats on the Refuge. Such activities help prevent the listing of additional species and the need to designate more critical habitats. The primary listed species that Refuge activities have focused on are the California least tern, western snowy plover, California red-legged frog, La Graciosa thistle, marsh sandwort, and Gambel's watercress. Designated critical habitat exists on the Refuge for the western snowy plover and La Graciosa thistle, and the Service has been working to enhance these areas. The Refuge activities associated with listed species and critical habitat are discussed in greater detail in Chapter 3.
- **Protecting Biodiversity.** To protect, manage, and restore coastal dune habitats representative of the biodiversity in the central California coast area, the Service has been working together with Dunes Collaborative partners to control invasive plants such as perennial veldt grass, European beachgrass, sea fig, and iceplant. Another management priority has been to conduct recovery projects on the Refuge for listed species such as California least tern, western snowy plover, California red-legged frog, La Graciosa thistle, marsh sandwort, and Gambel's watercress.

- **Cooperative Programs.** The Service has actively worked since the creation of the Refuge to establish and maintain conservation partnerships and provide assistance for natural resource and land management activities with federal, state, tribal, and local governments and agencies, and with academic institutions and private conservation organizations. As mentioned previously, a major focus of the Service’s natural resource efforts on the Refuge, and in the Dunes Complex, has been with the Dunes Collaborative. Also, the Refuge is conducting biological studies with California Polytechnic University, San Luis Obispo; University of California, Santa Barbara; and San Diego State University.

Broader, national conservation priorities are considered when developing a CCP, described as follows.

Southern Pacific Shorebird Conservation Plan. Southern Pacific Shorebird Conservation Plan also identifies California coastal habitats as especially important to snowy plovers. The Refuge’s location, within the area between Pismo Beach and the Santa Maria River Mouth, is an important area for shorebird use, particularly by snowy plovers (Hickey et al. 2003).

2008–2012 National Invasive Species Management Plan. A revision of the 2001 National Invasive Species Management Plan, the 2008 plan provides direction for federal efforts to prevent, control, and minimize invasive species and their impacts. It focuses on five strategic goals: prevention, early detection and rapid response, control and management, restoration, and organizational collaboration.



USFWS

Chapter 2. The Comprehensive Conservation Plan Process

2.1 Introduction

This CCP/ Environmental Assessment (EA) for the Refuge is intended to meet the dual requirements of compliance with the 1997 Improvement Act and NEPA of 1969 (42 U.S.C. 4321). The development of this CCP/EA was also guided by the Refuge Planning Policy outlined in Part 602, Chapters 1, 3, and 4 of the Service Manual (<http://www.fws.gov/policy/602fw1.html>). Service policy, the 1997 Improvement Act, and NEPA provide specific guidance for the planning process. For example, Service policy and NEPA require the Service to actively seek public involvement in the preparation of environmental documents such as EAs.

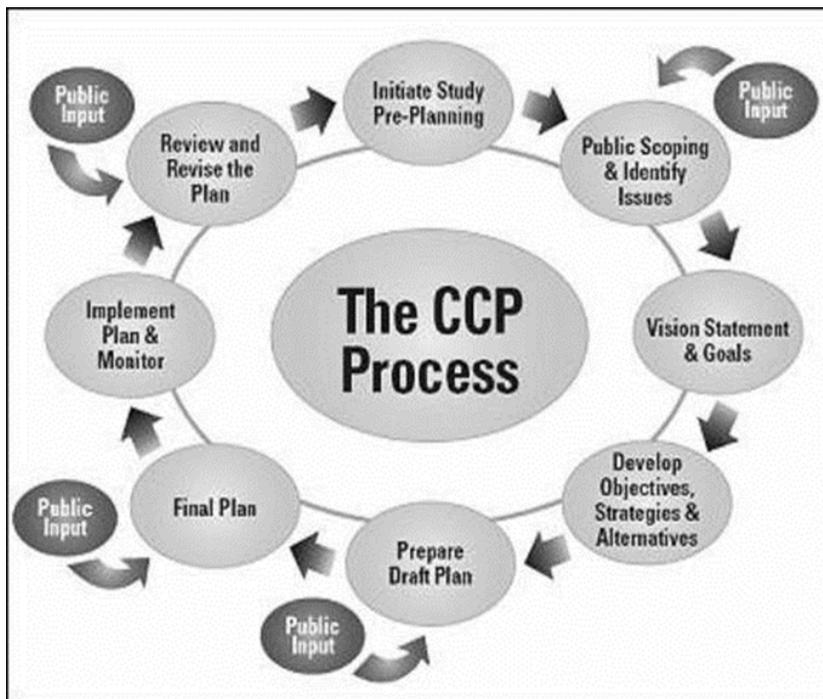
The purpose of the EA is to evaluate the environmental effects of the CCP on the quality of the human environment. NEPA also requires the Service to give serious consideration to all reasonable alternatives, including the “no action” alternative, which represents continuation of current conditions and management practices. Alternative management scenarios were developed as part of the planning process and can be found in Appendix B (Environment Assessment).

2.2 The Planning Process

Key steps in the CCP planning process are depicted in Figure 5 and include:

1. Preplanning
2. Public Scoping and identifying issues
3. Developing a vision statement and goals
4. Developing objectives, strategies, and alternatives
5. Publishing the draft plan and NEPA document
6. Documenting public comments on the draft plan
7. Selection of an alternative for implementation
8. Publishing the final plan
9. Implementing the plan

Figure 5. CCP Process



The CCP may be amended as necessary at any time under an adaptive management strategy. Major revisions, if needed, will require public involvement and NEPA review.

The planning process for this CCP began in March 2013 with preplanning, which involved the collection of pertinent data and selection of team members. A core team was formed to integrate stakeholders into the planning process. Refuge staff identified primary areas of focus—wildlife management, habitat management, public access, interpretation, and environmental education—which helped shape comments received from the public during the scoping period into potential objectives for the Refuge.

2.3 The Planning Core Team

The planning team responsible for leading the CCP effort included Service managers, biologists, a planner, and a wildlife refuge specialist from the Refuge Complex. Appendix L lists the members of the planning core team.

2.3.1 Issues, Concerns, and Opportunities Identified by Staff

The planning team identified the following issues, concerns, and opportunities to consider during the planning process; they include areas of wildlife management, habitat management, public use and environmental education, and other.

- Fluctuating groundwater levels and quality
- Trophic enrichment
- Feral swine and deer; their movement across agricultural fields and the refuge
- Invasive species: grasses (primarily perennial veldt grass, European beachgrass, *Carpobrotus* species iceplant)
- Off-road recreational vehicles (continual noise and occasional trespass onto the refuge)
- Marine debris
- Funding cuts and/or declining budgets
- Relationship with Growers Association and agriculture community
- Oil spills
- Vandalism or trespassing; need for law enforcement
- Low flying aircraft that disturb human visitors and wildlife
- Public access
- Climate change effects, including sea level rise, increased storm events, hydrological effects (drought and flooding), species range shifts, phenological changes (e.g., timing of migration), invasive species
- Dune migration (lack of space to migrate)
- Dunes migrating across trails makes management access difficult
- Continuity of services (only one staff member)
- Ability to provide emergency services in the event of accident due to remoteness
- Lack of infrastructure (no electricity, water, office, or storage)
- No infrastructure for volunteer amenities (no bathroom, no meeting space)
- Security of equipment and storage facilities

2.4 Public Involvement in Planning

Public involvement is an important and required component of the CCP and NEPA process. Public scoping meetings allow the Service to define the scope of issues that need addressed and identify significant issues that may shape the proposed action. More importantly, these meetings allow refuge staff to hear public comments and concerns. Public meetings provide a forum for important discussion and identify important issues regarding the refuge and its surrounding area.

The Service hosted a series of public meetings on December 11 and 12, 2013. Public comments were generated from the public meetings as well as the *Federal Register* notice published on December 6, 2013. A

planning update, which introduced the Refuge and the planning process, was mailed to over 400 agency and organization representatives, members of the public, media, and elected representatives of each of the Counties. Approximately 10 people attended each of the meetings.

The Service received several comments at the scoping meetings and two comments by e-mail. The following comments appear as they were submitted and are organized generally by theme.

Habitat/Wildlife Management

- The primary goal of the refuge should not be the listed taxa. The focus should be on endemics and invasive species control of plants and animals. Refuge needs more money and staff to manage biodiversity. Seek more grants and other funding opportunities. Conduct predator control.
- Baseline surveys should be conducted to document presence of endemic species.
- Place greater focus upon diversity of endemics rather than single species management.
- Threatened wildlife and lack of corridors (stabilize corridors) requires a network of management. The Dunes Center is a focal point.
- Reasons that the preserve is not wilderness.
- Feral swine should be eradicated.
- Maintain the health of all wildlife on the refuge.
- Work to improve numbers so animals and plants can be properly delisted.
- With regard to control of invasive species, when toxics are proposed for use, different approaches should be evaluated specifically (as opposed to a blanket statement that Integrated Pest Management principles will be followed).

Public Uses

- Priority uses do not include hiking into the interior of refuge.
- Install viewing area with comfort station.
- Open refuge to horseback riding.
- Accommodate school groups, offer hands-on projects.
- Consider access versus limited access and tradeoffs.
- Offer photographic opportunities.
- Permit dogs.
- What uses are not permitted.
- Offer similar level of access as when it was Mobil Coastal Preserve.
- Public access to refuge.
- Improved access.
- Organized tours.
- Allow day use.
- Include hiking/equestrian trail connectivity through the refuge, ODSVRA, and the entire Oceano Dunes Complex.
- Include long-term maintenance of equestrian/hiking trails, and requirements to build long-term relationships with all trail users and organizations to plan and maintain trails.
- Establish accessible trailheads that facilitate access and ensure adequate “pull-through” parking, or parking area with adequate turning radius for horse trailers.

Other

- Acquire other lands within approved boundary.
- Develop cooperative agreement within approved acquisition boundary, allow access.
- Tsunami debris and invasive species.
- Requirement for (monetary) donations.
- Status of poaching and Panga boats.
- Requirements related to donation of the property (from TNC)

- Expand volunteer group.
- Status of Chevron property

The Draft CCP/EA was published for public review and comment for a 45-day period from March 2, 2016 through April 18, 2016. A public meeting was held on March 22, 2016. In total for this comment period, the Service received 39 written comments and 50 oral comments from the public meeting. The Final CCP/EA has been modified to meet and address the comments raised, where feasible. A summary of the comments and the Service's responses is located in Appendix M.

2.5 Development of the Refuge Vision

As part of the CCP process, each individual refuge unit develops or reviews a vision statement. Vision statements are grounded in the unifying mission of the Refuge System, and they describe the desired future conditions of the refuge unit in the long term (more than 15 years). They are based on a refuge's specific purposes, the resources present on the refuge, and any relevant mandates. The vision statement for the refuge is in Chapter 5.

2.6 Development of the Refuge Goals, Objectives, and Strategies

Refuge goals are necessary for outlining the desired future conditions of a refuge in clear and succinct statements. The Refuge System defines a goal as a "descriptive, open-ended, and often broad statement of desired future conditions that conveys a purpose but does not define measurable units" (Service Manual 602 FW 1). Objectives and strategies are then developed to meet those goals. An objective is defined as a "concise statement of what we want to achieve, how much we want to achieve, when and where we want to achieve it, and who is responsible for the work" (Service Manual 602 FW 1). A strategy is defined as a "specific action, tool, technique, or combination of actions, tools, and techniques used to meet unit objectives" (602 FW 1). Well-written goals, objectives, and strategies direct work toward achieving the refuge's vision and purpose. Interim refuge goals were developed within the context of the authorities that established the refuge, Refuge System mission and goals, Service goals and policies, and ecoregion goals. The existing interim refuge goals listed in Chapter 1 will be modified through the CCP development process.

2.7 Development of the Alternatives

The CCP process includes developing a range of alternatives for how the refuge could be managed over the next 15 years. Each alternative must consider refuge purposes and the goals of the Refuge System. The Refuge System defines alternatives as "different sets of objectives and strategies or means of achieving refuge purposes and goals, helping fulfill the Refuge System mission, and resolving issues" (602 FW 1). The alternatives for this CCP were developed after considering comments received during the scoping period input from the planning team and other Service staff, and current and future budgetary constraints. The EA (Appendix B) describes the development of alternatives and provides an assessment of their environmental effects.

Alternative A (No Action). Under this alternative, Refuge management would continue unchanged, including habitat management, wildlife management, and public use opportunities. Habitat and wildlife management activities would focus on wildlife surveys, predator management, and invasive weed management. Guided interpretive walks would continue to be offered. The Refuge would also actively work with partners to support the goals of the Dunes Complex. Current staffing and operating costs would remain the same.

Alternative B: moderate increase in wildlife and habitat management; incremental increase in visitor services and environmental education. Alternative B includes those actions described in Alternative A; in addition, the Refuge would moderately expand wildlife and habitat management while incrementally increasing visitor service and environmental education activities. For this alternative, Refuge Priority Management Areas (RPMAs) were established that represent unique habitat types or provide habitat for listed or rare species on the Refuge that deserve conservation attention. Additional wildlife management activities, such as management of ponded wetlands, feral swine control, and increased monitoring, would be implemented for the purpose of improving western snowy plover hatch rate; protecting existing populations of the listed La

Graciosa thistle and California red-legged frog; and aiding in the recovery of marsh sandwort and Gambel's watercress. The development and implementation of future step-down plans, an Integrated Pest Management Plan and Predator Management Plan, are also proposed. Of the Service's "Big 6" public uses, wildlife observation, photography, interpretation, and environmental education, would be enhanced on the Refuge, and an action to redirect public access around snowy plover breeding habitat would also be implemented. Refuge staff would develop a dedicated volunteer crew to support Refuge management and outreach. Additional staff and funding would be needed to implement this alternative.

Alternative C: minimal wildlife and habitat management and the Refuge is closed to the public. Alternative C takes into consideration the forecasted decline in budgets for the Refuge System by reducing, and in some cases eliminating, current management activities, as well as closing the Refuge to all public uses. Under Alternative C, the Refuge would be placed in caretaker status, with wildlife and habitat management activities limited to installing and maintaining permanent Refuge closure signs at the beach, maintaining existing perimeter fencing and fencing installed to protect listed species, and inspecting site conditions and implementing sign and fence maintenance three times per year (i.e., spring, summer, fall).

2.8 Selection of the Refuge Proposed Action

The alternatives were analyzed in the EA (Appendix B) to determine the direct and indirect effects on the environment. Based on this analysis and in light of the continued decline of the Refuge System budget, we have selected a modified Alternative A as the proposed action. Under this proposed action, we would continue current management activities, but also implement the feral swine control plan as well as develop and implement an avian and mammalian predator management. Because the Refuge would not be staffed locally, we would conduct seasonal western snowy plover monitoring and invasive vegetation control when additional resources or partnerships allow.

2.9 Plan Implementation

The CCP will be reviewed by Refuge staff when preparing annual work plans and updating the Refuge Operational Needs System (RONS) database. This database describes the unfunded budget needs for each Refuge and is the basis upon which the Refuge receives funding increases for operational needs. The Plan may also be reviewed during routine inspections or programmatic evaluations. Results of the reviews may indicate a need to modify an integral part of the Plan implementation or modify management activities if the desired results are not achieved. If minor changes are required, the level of public involvement and NEPA documentation will be determined by the Refuge manager. The CCP will be formally revised approximately every 15 years.



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Chapter 3. Refuge Resources

3.1 The Refuge and Local Context

The Refuge is part of the Dunes Complex, a geologically unique area comprised of stable and unstable dunes lying within one of the larger coastal valleys of California, at the juncture between the Coast Ranges and the Transverse Ranges. The Dunes Complex is located between Mussel Rock, about a half-mile north of Point Sal (located in Santa Barbara County), and Pismo Beach (located in San Luis Obispo County). Inland, beyond the Refuge, are many agricultural fields and the small towns of Guadalupe and Nipomo.

3.2 Landscape and Ecoregion Setting

The Refuge is located within the area traditionally used by the Obispeño Chumash. The boundary between the Obispeño and the Purismeño, their Chumash neighbors to the south, is not distinct, but between them, the two groups occupied the outer shore of the California coast from what is now known as Morro Bay to the north and Point Conception to the south. The Handbook of North American Indians provides a comprehensive overview of these groups (Greenwood 1978). Several radiocarbon dates from archaeological sites in San Luis Obispo County date occupation back to 9,000-9,300 years ago.

The Obispeño occupied the narrow coastal terraces, which often included sand dunes and small valleys as well as the windswept outer shore. As Greenwood noted, “It is a habitat of great variety at an interface of northern and southern plant associations and warm-water and cold-water marine life, yielding an abundance of wild plant foods, land and sea mammals, fish, birds, molluscan resources, all of which were used from the earliest periods” (Greenwood 1978:520). There have been 28 archaeological sites recorded within the Refuge boundaries by Hoover (1990).

The first reported contact between the Chumash of this region and Europeans occurred during the early years of the Manila-Acapulco galleon trade era in the late 16th century when a Spanish galleon commanded by Pedro de Unamuno landed at Morro Bay in October 1587. This information is documented on a plaque erected by the Filipino American National Historical Society in 1995, based on an early 20th century reference (Wagner 1929). Although the details of Unamano’s landing location have been challenged (Baird 2009), more Spanish expeditions certainly followed. None stayed long in the area, however, until the late 18th century when the Mission San Luis Obispo de Tolosa was established in 1772. While the Chumash and other native people resisted Spanish control, the period took a heavy toll on their numbers and their culture as they succumbed to European diseases and forced relocation (Greenwood 1978).

The Mission Era was followed by the Rancho Era, when California was annexed by Mexico in 1822 and former mission lands such as those at San Luis Obispo were distributed to Mexican citizens, along with the mission’s cattle herds. The Refuge appears to be located primarily within the boundaries of Rancho Guadalupe, a grant bestowed by the Mexican government (Juan Alvarado, governor) on Teodoro Arellanes and Diego Olivera on March 21, 1840, (Adam v. Norris, U.S. Supreme Court, 103 U.S. 591 in 1880). The Rancho encompassed 43,682 acres running along the coast and inland to what is now the town of Guadalupe. Rancho Guadalupe was bordered on the north by Rancho Bolsa de Chamisal, and the Refuge boundary appears to occur close to the indistinct boundary between the two ranchos. There have been numerous owners throughout Rancho Guadalupe’s history, as well as ownership disputes regarding boundaries, foreclosures, and the division and selling of parcels.

In 1895, the Southern Pacific Railroad was built in the area and, as a result, several parcels of land were developed, especially near Arroyo Grande Creek. In the 1930s, the dunes became home to a group of people known as “Dunites.” The Dunites consisted of hermits, drifters, and artists who lived in isolated shacks (Smith et al. 1976; Hammond 1992). According to a survey conducted by McFarlane (1986), the Dunites formed a loose knit community of mystics, artists, migrant farmworkers, and utopians. Gavin Arthur, grandson of former U.S. President Chester Arthur, founded a utopian community in the area called Moi Mei. Many of the Dunites built crude structures of driftwood and other materials; a few homes, like Arthur’s, were more substantial. Remnants of these structures may still survive, according to local historian Norman Hammond,

who has conducted extensive research on the group. The earliest Dunite occupation dated to 1917; the last dune resident died in 1974.

More recently, Refuge lands were owned by the Mobil Oil Corporation and had a history of oil development. Of the three abandoned oil wells on the Refuge, two were producing wells and one was non-producing. All were abandoned in accordance with the regulations and standards in effect at the time of abandonment (USFWS 2000b). In 1989, the California State Coastal Conservancy purchased the lands from the Mobil Foundation and then transferred them to TNC. The transfer retained a conservation easement on the property that restricts development and prohibits certain other activities from occurring there. Under TNC's management, public uses were limited to recreational activities such as bird watching, fishing, jogging, and hiking. The site was also a destination point for hikes led by docents knowledgeable about the natural history of the area.

The town of Guadalupe is located in Santa Barbara County about 2 miles southeast of the southeast corner of the Refuge, and the unincorporated community of Nipomo is located in San Luis Obispo County, about 7 miles east-northeast of the northeast corner of the Refuge (Figure 1). The Santa Maria Valley is a major agricultural area, with cattle grazing becoming established in the late 1830s. Currently, the closest cattle grazing operations to the Refuge are located on private lands about 2 miles south of the Refuge southern boundary.

In the mid-1800s, grain and orchard crops were commonly cultivated, and irrigated crops such as beets became established by 1897 (Smith et al. 1976). Several thousand acres of land areas to the north, east, and southeast of the Refuge have a long history of farming, and some of the local farms have been in existence for more than 100 years. Broccoli, strawberries, and lettuce are the primary crops currently grown on these farmlands, which are irrigated primarily with wells that use local groundwater.

In 1938, the Mobil Oil Company acquired what are now Refuge lands for conducting oil exploration activities. Mobil Oil drilled four oil wells in this vicinity between 1956 and 1968 (Brannon 1993; USFWS 1999; USFWS 2000d) known as La Veaga Well #1, La Veaga Well #2, La Veaga Well #3, and La Veaga Well #4. In some documents, "La Veaga" is spelled "La Viaga" (Hildinger 1993).

La Veaga Well #3 was drilled in 1968 on land that is now part of the Oso Flaco Natural Area of the ODSVRA. The site of La Veaga Well #3 is about 300 yards north of the current Refuge boundary. Due to its "flying saucer" shape, many locals know this abandoned well site as the "Mothership" (M. Skinner, Coastal San Luis Resource Conservation District, personal communication, 2012). This well was non-producing and was officially abandoned in 1968 (Hildinger 1993). La Veaga Wells #1, #2, and #4 were located on land that is currently within the south-central portion of current Refuge boundaries (USFWS 1999; USFWS 2000d). These wells produced little to no oil and were subsequently abandoned (Hildinger 1993).

In 1989, the Mobil Oil Company transferred ownership of the current Refuge lands to TNC, which managed these lands as the Mobil Coastal Preserve until 2000, when it transferred ownership to the United States to be managed as lands part of the Refuge System.

3.3 Physical Environment

This section describes the abiotic resources associated with the Refuge such as topography, geology, climate, soils, water, and air. These underlying, non-living components of an ecosystem provide the framework by which plants, animals, habitat, and people interact.

3.3.1 Topography

More than 6,000 years ago during the last Ice Age, a large proportion of the interior dune sheet was formed when the sea level dropped, exposing large amounts of sand reserves to wind erosion. These older and more stable dunes lie inland and tend to be elongated and parabolic in shape. Growth of low-lying vegetation binds the sandy soil together and helps stabilize these dunes (TNC 1999).

The foredunes, which formed more recently and are more active, lie between the beach and the older dunes. Windblown sand accumulates and the dunes form long, high ridges and slacks that are typically parallel to the beach and perpendicular to the prevailing winds. The peaks of these younger foredunes move east (inland) into the older, more stable dunes at approximately 3 feet per year. The rate of dune growth inland can vary due to changes in the sand resource, climate, and vegetative cover in the foredunes (TNC 1999).

3.3.2 Climate

The Refuge and most areas of the central California coast are characterized as having a Mediterranean climate, with winters that are typically cool and wet; summers tend to be warmer and drier. More than 90 percent of the annual rainfall typically occurs from November through April (Smith et al. 1976). The approximate annual rainfall for the Guadalupe area from 1964-2010 was a minimum of 4.8 inches, a maximum of 28.2 inches, and a mean of 13.7 inches (Chevron Environmental Management Company, unpublished data). An additional important source of moisture comes from coastal fog, which can occur during any season of the year but is more prevalent during summer months (Holland et al. 1995).

Climate data nearest the Refuge is collected from a station at the nearby Santa Maria Public Airport by the Western Regional Climate Center and is described in Table 1.

Predicted Effects of Climate Change

Temperature and Precipitation

Koopman et al. (2010) reviewed several models to determine future climatic and ecological conditions for San Luis Obispo County as a result of climate change. They found that temperatures may rise for the majority of San Luis Obispo County, while precipitation predictions varied too widely to draw meaningful conclusions as a result of climate change. Annual temperature change projections could increase from 2.1 to 3.9 degrees Fahrenheit (°F) from the years 2035 to 2045 and from 4.1 to 7.6 °F from the years 2075-2085. The vegetation found on the Refuge is not expected to change as a result of climate change.

Sea Level Rise

Sea level has risen nearly 8 inches along the California coast over the past century. Climate models project further increases of 3.3 to 4.6 feet by the year 2100 (Cayan et al. 2009). The primary threats associated with sea-level rise include flooding, erosion, and loss of valuable coastal land and unique habitats.

Table 1. Climate Averages for Guadalupe-Nipomo Dunes National Wildlife Refuge, 1948-2005 (WRCC 2014)

	Average Maximum Temperature (°F)	Average Minimum Temperature (°F)	Average Total Precipitation (in.)
January	63.1	38.9	2.49
February	64.3	40.9	2.8
March	64.7	42.1	2.35
April	66.9	43.4	1.02
May	68.2	46.8	0.28
June	70.5	50	0.04
July	72.8	53	0.03
August	73.2	53.6	0.03
September	74.3	52.1	0.21
October	73.4	47.9	0.49
November	69.1	42.5	1.35
December	64.4	38.6	1.87
Annual	68.7	45.8	12.97

Heberger et al. (2009) conducted a simplistic geospatial analysis that identified some areas of potential high risk from sea-level rise along the entire California coast. Based on this analysis (which has not been ground-truthed), San Luis Obispo County supports 6.1 square miles of existing coastal wetlands. As sea level rises, these wetlands are expected to migrate inland, potentially covering 1.1 mi² of new terrain. The analysis further assessed where wetlands are expected to migrate and determined that 69 percent of the area is viable for migrating wetlands and should be protected to allow for such shifts (Heberger et al. 2009). An additional 7 percent of the area where wetlands might migrate is viable but will experience loss of other functions, such as pasture, parks, or open space. The remaining 24 percent of the area has infrastructure making it unfeasible for wetlands to migrate.

A sea-level rise modeling exercise was conducted for the Refuge lands in 2008 using the Sea Level Affecting Marshes Model (SLAMM 5.0) to determine changes in tidal marsh area and habitat type in response to sea-level rise (Clough and Larson 2008). The primary set of eustatic (worldwide change) sea-level rise scenarios used within the SLAMM was derived from the work of the Intergovernmental Panel on Climate Change (IPCC 2001). SLAMM 5.0 was run using Intergovernmental Panel on Climate Change and fixed-rate scenarios based on varying ranges of fossil fuel use.

Based on the SLAMM results, upland, freshwater marsh, and riparian woodlands—the three most common land cover classifications used by Clough and Larson (2008) on the Refuge—are predicted to be resilient to sea-level rise, even under the 1.5-meter scenario (the highest sea-level rise scenario). The high elevation of dry land and fresh marsh for this site suggests that the majority of this Refuge is not subject to the pressures of increased sea-level rise. The oceanic beach fringe to the west of the Refuge is subject to more effects, losing a minimum of 38 percent of its mass due to erosion and inundation. The small fringes of saltmarsh and brackish marsh to the south of the Refuge are also predicted to be vulnerable (Clough and Larson 2008).

A study of the effects of sea-level rise on special status plant species¹ on the central California coast was conducted by the Bren School of Environmental Management, University of California, Santa Barbara (Berlin et al. 2012). For in-depth analysis, they chose nine rare plant species that represent a diverse range of life histories, habitats, elevation, level of endemism, and listing status within the tri-county area (San Luis Obispo, Santa Barbara, and Ventura Counties). The group assessed exposure of these plant species to inundation, flooding, and erosion—which sea-level rise exacerbates.

Results from this study suggest that those plant species located at the lowest elevations above sea level would generally be most affected by sea-level rise. Four of the nine analyzed species will be exposed to at least one sea-level rise-related by the end of this century; two of those four plant species are found on the Refuge: La Graciosa thistle and beach spectacle pod.

3.3.3 *Geology and Soils*

Sand Dunes

The Refuge is located in a portion of the Dunes Complex between Oso Flaco Lake and the Santa Maria River known as the Guadalupe Dunes Sheet. The Guadalupe Dunes Sheet and several neighboring sand sheets are classified as Flandrian Dunes because they were formed during the Flandrian Transgression, a period of sea-level rise that accompanied the final waning of the continental ice sheets from the previous Ice Age, when sea level was much lower. There were two known periods of the Flandrian Transgression: Episode I and Episode II. Episode I occurred approximately 2,000-6,000 years ago; Episode II started approximately 2,000 years ago and is still occurring.

The more-inland portions of the Guadalupe Dunes Sheet were created during Episode I. Episode I sand dunes tend to now be stabilized by vegetation in this area, which appeared about 2,000 years ago. The more-seaward and shorter portions of the Guadalupe Dunes Sheet were created during Episode II (Cooper 1967; Hunt 1993).

¹ Species are considered to be special status when they have been listed by a government agency (such as CDFW or the Service) or a conservation organization (such as the International Union for Conservation of Nature or CNPS) as endangered, threatened, rare, and/or of limited geographic distribution.

Today, active masses of Episode II continue to invade the surface of Episode I in broad slip faces and tongues (Cooper 1967).

The “sea” of sand from the Guadalupe Dunes Sheet that now engulfs the Refuge is a result of dynamic interactions among wind, water, sand, topography, marine debris, and vegetation that started during the beginning of Episode I of the Flandrian Transgression. Some of these dynamic interactions are still in effect today.

The Dunes Complex exists along the coastal edge of the Santa Maria Basin, a relatively dry area that produces large amounts of sediments. These sediments are eroded downstream to the coast by several streams, such as the Santa Maria River, Arroyo Grande Creek, Pismo Creek, and San Luis Obispo Creek.

The wide, shallow continental shelf that exists offshore of the dunes collects and stores the sediments delivered by the local streams. These stored underwater sediments are mobilized by large storm waves and small sea level changes.

Along the Dunes Complex shoreline, rather than breaking laterally or diagonally to the shoreline, advancing wave trains tend to break parallel to the shoreline. These parallel-breaking waves cause sediments near the shoreline and from the continental shelf to be pushed up onto the Dunes Complex beaches rather than move the sand upcoast (northward) or downcoast (southward) (Parsons 2006).

Strong, prevailing northwest winds typically push the dry sand from the beach inland towards the southeast. Due to the lack of cliffs, mobilized beach sand tends to move in a southeast direction, continuing until it is trapped by an obstruction such as driftwood, vegetation, or a sand dune. As sand accumulates, dunes grow taller.

Several types of sand dunes are found on the Dunes Complex, with the most common ones classified as hillock, transverse, longitudinal, parabolic, and lobate. Sometimes different dune formations blend together to form combination dune types that are difficult to classify (Parsons 2006).

The Guadalupe Dunes Sheet and other portions of the Dunes Complex continue to evolve and change their appearance over time, as it has been doing for thousands of years. As the sand dunes change, the wildlife habitats change, and so do the species of plants and animals present. The sand dune dynamics and constant change are part of the natural processes in a dunes ecosystem.

However, in the past 150 years or so, humans have caused several changes to these natural dune dynamics. For example, dam construction has occurred on the Santa Maria River, Arroyo Grande Creek, Pismo Creek, and San Luis Obispo Creek, which are the main sediment sources for the beaches of the Dunes Complex. These dams severely reduce sediments loads into nearshore waters of Dunes Complex beaches. Also, humans have introduced invasive plants into the Dunes Complex; these plants tend to stabilize sand dunes to a greater degree than native plants. Finally, agriculture, invasive plants, roads, and rail lines have caused the advancing fronts of the inland dunes to be controlled and confined, which prevent the dunes from spreading inland.

Soils

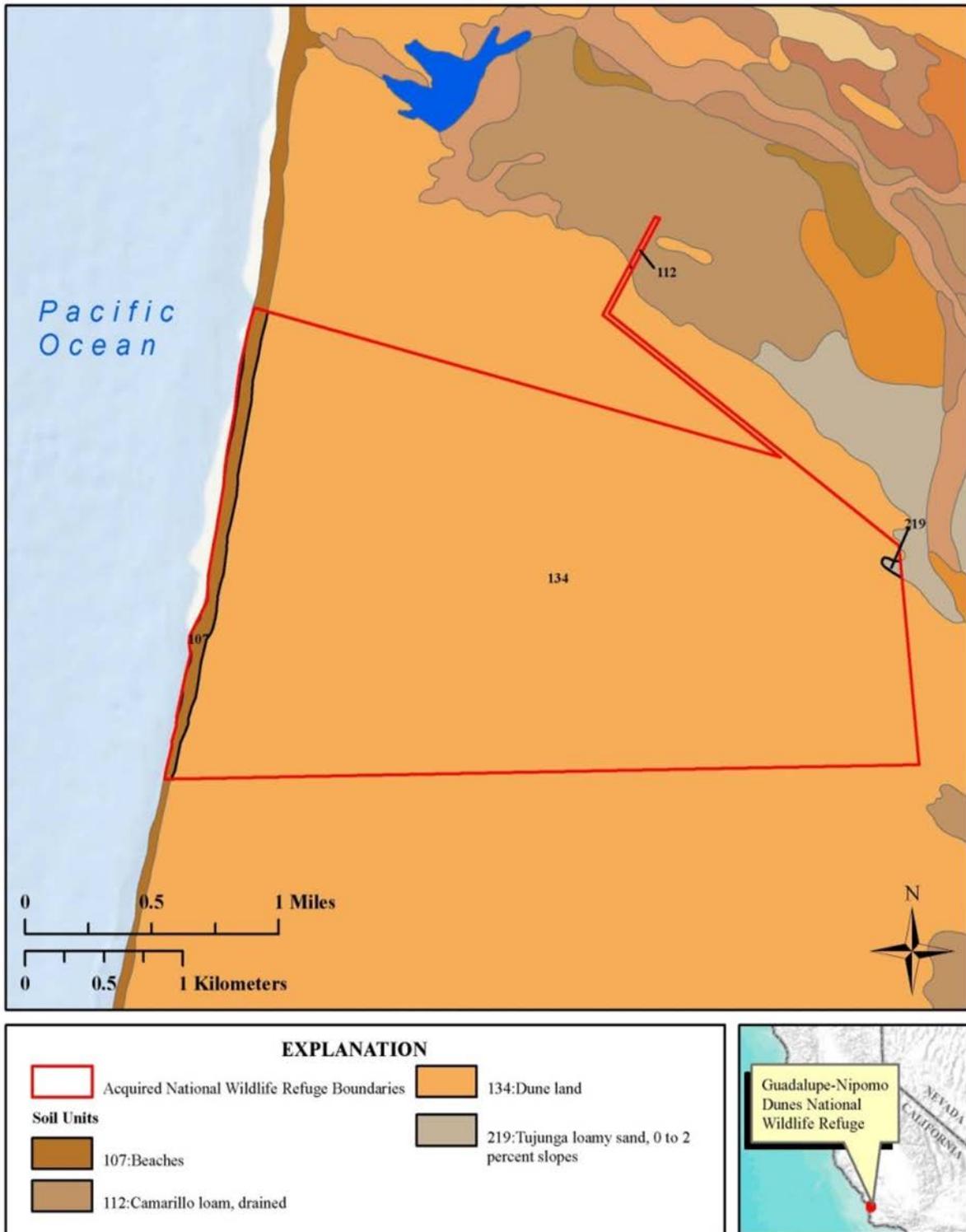
Four soil types have been identified within current Refuge boundaries (NRCS 2012). These are dune land; beaches; Camarillo loam, drained; and Tujunga loamy sand, 0–2 percent slopes (Figure 6). The drainage classes for these soils vary considerably. About 97.4 percent (2,434 acres) of the Refuge is covered by a soil type classification known as dune land. The substrate in this soil type is dominated by quartz silica sand with very little organic material present. The dune land soil is characterized as being excessively drained. However, there are at least 20 acres of wetlands and swales included in the mapped dune lands (about 0.8 percent of the Refuge). Depending on location, these wetlands and swales would be ranked with drainage classes of water: very poorly drained, poorly drained, or somewhat poorly drained (NRCS 2012). A soil type classified as

beaches occupies about 2.4 percent (60 acres) of Refuge lands along the western boundary of the Refuge. The Refuge beach area is dominated by quartz silica sand. These beach soils are very poorly drained (NRCS 2012).

Camarillo loam, drained occupies about 0.08 percent (about 2 acres) of the Refuge (NRCS 2012) in the vicinity around Beigle Road, an area that was part of the Santa Maria River flood plain more than 150 years ago. This is the only part of the Refuge that does not exist within sand dunes or beach habitat. The Camarillo loam, drained soil type is considered somewhat poorly drained and can pond for several days after periods of heavy rain. This soil type is good for growing broccoli, strawberries, lettuce, cauliflower, celery, green beans, and cabbage.

Tujunga loamy sand, 0–2 percent slopes occupies about 0.08 percent (about 2 acres) in the northeast corner of the Refuge. This soil type is considered to be somewhat excessively drained (NRCS 2012). Since Tujunga loamy sand, 0–2 percent slopes occurs in one of the only portions of the Refuge inhabited by California coffee berry (*Frangula californica* subsp. *californica*) and California sagebrush (*Artemisia californica*), the presence of this soil type is easy to detect (Table 2).

Figure 6. Soil Map



Map Projection: North American Datum 1983 Universal Transverse Mercator Zone 10; Map Production Date: June 25, 2013; Source Data: Refuge boundaries from U.S. Fish & Wildlife Service Cadastral Data, May 2012; Soils from U.S. Department of Agriculture Natural Resources Conservation Service Soil Science Geographic Database (SSURGO), 2012

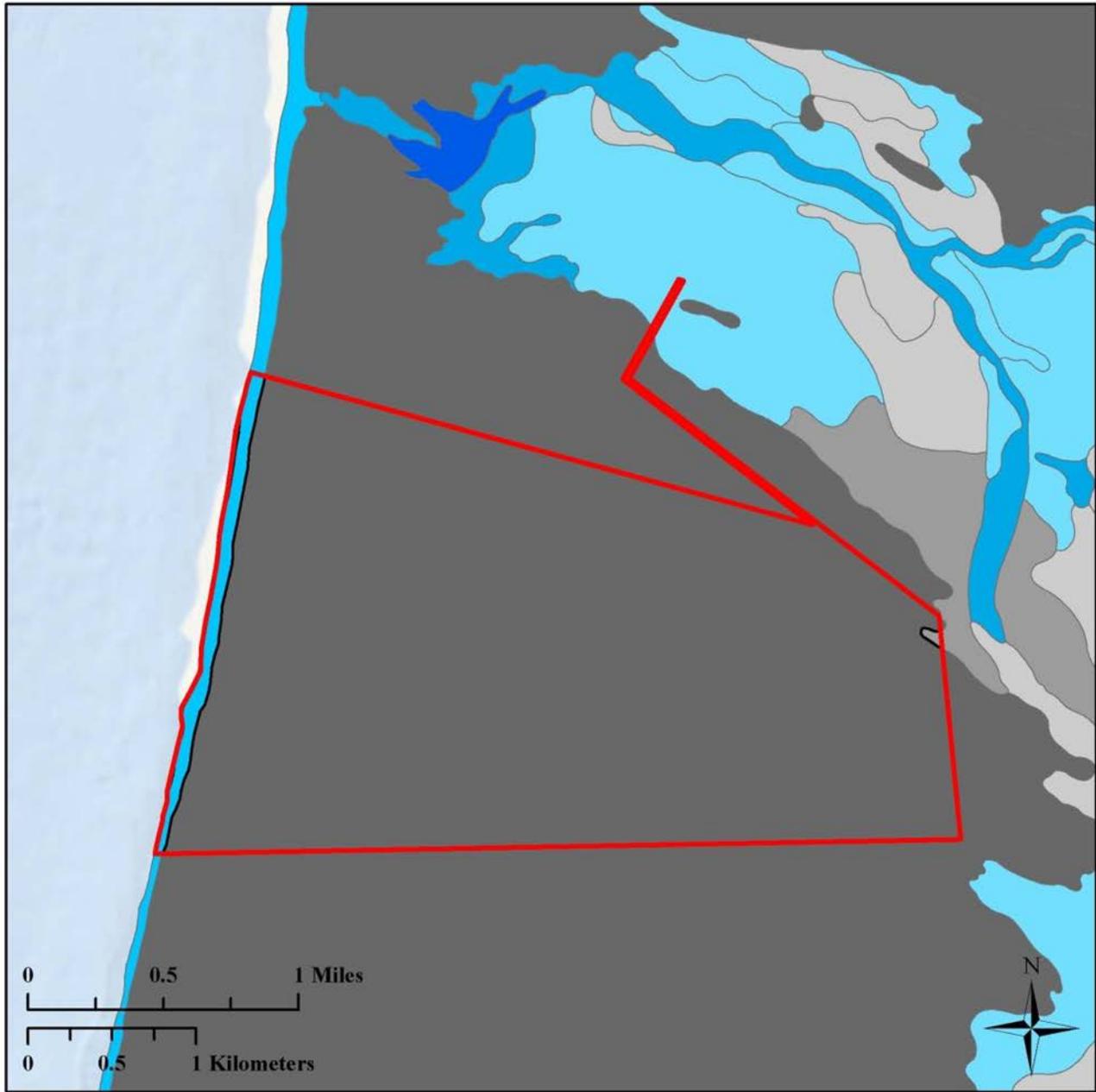
Table 2. Characteristics of Soil Map Units Occurring On and Near Guadalupe-Nipomo Dunes National Wildlife Refuge

Soil Map Unit	Dune land	Beaches	Camarillo loam, drained	Tujunga loamy sand, 0 to 2 percent slopes
Percentage of soil map unit found within Refuge	97.4	2.4	0.08	0.08
Map Units (Figure 6)	134	107	112	219
Area in acres	2434	60	3	2
Slope (percent)		0-2	0-2	0-2
Salinity	Soil descriptions are only available for major soil units. The <i>Dunes</i> unit is classified as miscellaneous.	Very slightly saline to moderately saline	Non-saline to slightly saline	Non-saline
Landform		Beaches	Alluvial fans, flood plains	Flood plains, alluvial fans
Parent Bedrock		NA	Alluvium derived from sedimentary rock	Alluvium derived from sedimentary rock
Depth to water table (inches)		0-72	60-72	> 80
Drainage		Poorly drained	Somewhat poorly drained	Somewhat excessively drained

3.3.4 Water Resources

Because the Refuge is primarily made up of sand dunes, it drains excessively (Figure 7). Groundwater and surface water gauging data are not available for the Refuge; however, such data are available for the adjacent GRP (formerly known as Guadalupe Oil Fields). Groundwater in the GRP (and likely the Refuge) occurs in what is known as the Dune Sand Aquifer. Groundwater levels of the aquifer range from near sea level at locations adjacent to the Pacific Ocean to more than 60 feet above mean sea level at inland locations (about 10,000 to 12,000 feet inland). Data from the GRP indicate that groundwater and surface water elevation levels may move up or down several feet within a given water year or between water years and that local rainfall is the prime factor that influences these changes (Mock 2000).

Figure 7. Drainage Classes of the Refuge



EXPLANATION	
	Acquired National Wildlife Refuge Boundaries
Dominant Drainage Class by Soil Map Unit	
	Water
	Very poorly drained
	Poorly drained
	Somewhat poorly drained
	Moderately well drained
	Well drained
	Somewhat excessively drained
	Excessively drained



Map Projection: North American Datum 1983 Universal Transverse Mercator Zone 10; Map Production Date: July 5, 2013; Source Data: Refuge boundaries from U.S. Fish & Wildlife Service Cadastral Data, May 2012; Soils from U.S. Department of Agriculture Natural Resources Conservation Service Soil Science Geographic Database (SSURGO), 2012

While several ponded wetlands exist, there are no surface streams or rivers on the Refuge. However, there are several surface waterways near the Refuge. Various waterways can be found within the Dunes Complex with the largest being the Santa Maria River, which cuts through the Dunes Complex south of the GRP, forming part of the border between Santa Barbara and San Luis Obispo Counties. The Santa Maria River fluctuates widely throughout the season, with low flows during the summer months and great flows during and immediately after periods of heavy rainfall. Much of the water provided to the Santa Maria River Valley is from local rainfall and from the Santa Maria River, mostly by way of subsurface flow. The Santa Maria River supplies sufficient freshwater to sustain riparian plant communities.

The Santa Maria River and Arroyo Grande Creek (which is located about 12 miles north of the Refuge) are important sources of sand for the continuing process of dune formation in the Dunes Complex. However, as mentioned previously, dams built on both of these streams have substantially decreased the amount of sand transported downstream to the ocean for nourishment of the dune system (TNC 1999).

During 2006 and 2007, at least 14 wetlands on the Refuge possessed either permanent or seasonal surface water. However, due to a prolonged drought that resulted in dropping groundwater levels, by 2014, the numbers of known freshwater marshes and ponds on the Refuge possessing either permanent or seasonal surface water inundation decreased from 14 to 7 inundation (G. Greenwald, USFWS, personal communication, 2014).

During 2014, seven freshwater marshes and ponds on the Refuge were known to possess either permanent or seasonal surface water inundation (Figure 8). Cumulatively, all seven marshes and ponds combined possess less than 1 acre of surface water. Five were constructed as stock ponds by a local rancher during 1960 and 1961 (C. Minetti, Maretti-Minetti Ranch, personal communication, 2012). These former stock ponds range in size from several hundred square feet to about 2,500 square feet.

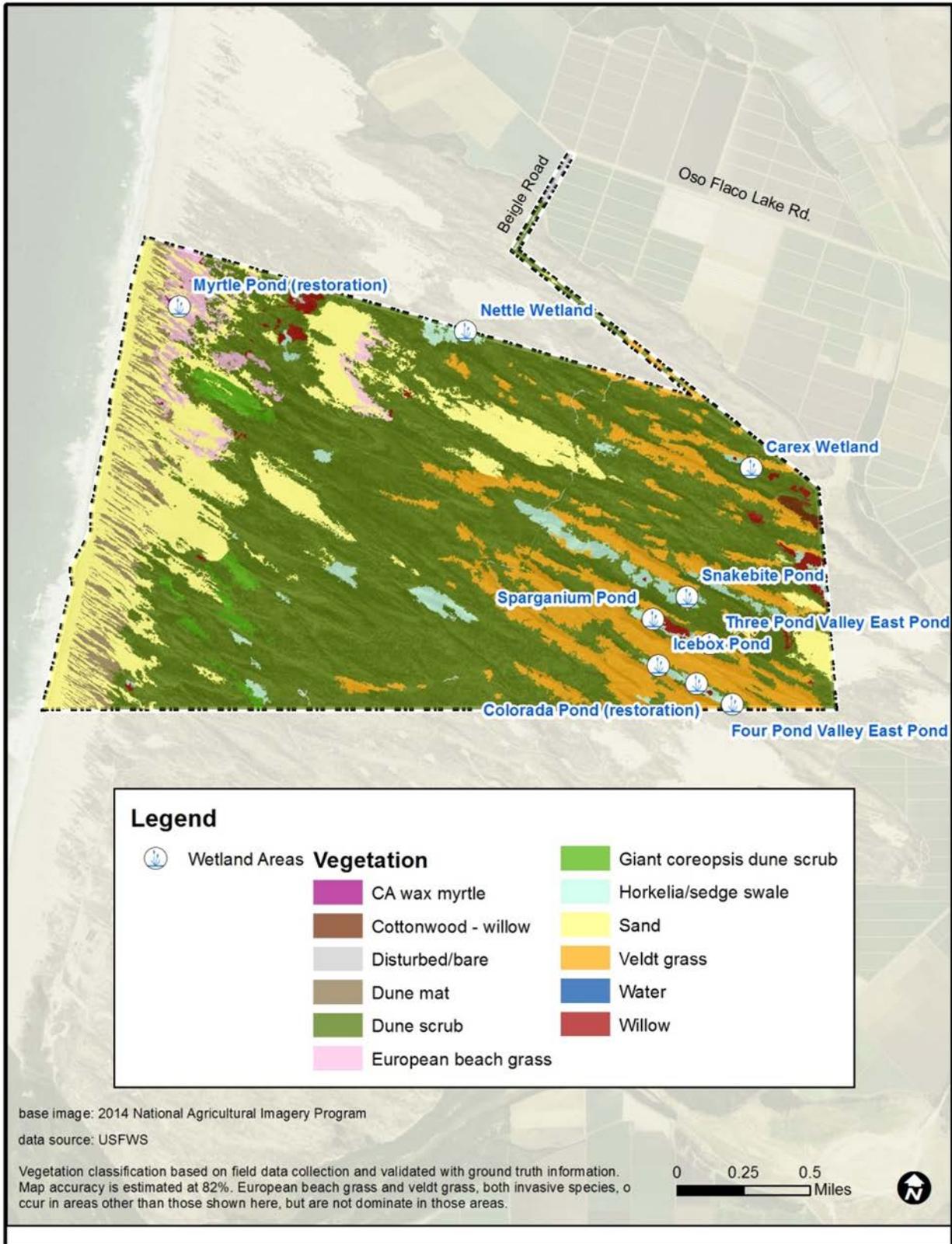
The Service constructed two ponds in 2013—one in the northwest portion of the Refuge and one in the southeast portion. Both ponds occupy about 6,000 square feet in area (USFWS 2012a). These ponds are discussed in detail in the plant communities section.

Oso Flaco Lake and Little Oso Flaco Lake are located about 1 mile north of the northern Refuge boundary on land owned by the State of California in the ODSVRA. These two small freshwater lakes and their adjacent wetlands are supplied with surface water from Oso Flaco Creek, which receives the bulk of its water supply from agricultural runoff. As a result, Oso Flaco Creek, Oso Flaco Lake, and Little Oso Flaco Lake have become contaminated with fertilizers, pesticides, and other agricultural chemicals, and each is classified as an impaired waterbody (RWQCB 2008; EPA 2010; RWQCB 2012).

Black Lake and the Dune Lakes area lie north of the Santa Maria River. Other freshwater lakes within the Dunes Complex include Coreopsis, Jack, White, Big Twin, and Celery Lakes. Approximately 284 acres of open water in the Dunes Complex have been identified through geospatial analysis by TNC.

Because the wind is capable of eroding sand so deep that groundwater is uncovered, it has produced a scattering of small wetlands and water holes throughout the dunes. The connection of the dune lakes and wetlands with shallow groundwater and agricultural runoff has created important management concerns. For example, during drought years, lakes within the dunes areas have gone dry when groundwater supplies were depleted through pumping. Riparian communities and endangered plant populations have been eliminated due to dredging of agricultural drains (USFWS 2000b). In addition,

Figure 8. Wetland Areas



the hydrology of Black Lake Canyon has changed due to urbanization of the Nipomo Mesa (TNC 1999; USFWS 2000b).

Water Quality

Water quality data has been periodically gathered during standardized protocol abnormal amphibian surveys (USFWS 2007a) conducted in four Refuge ponds from 2007 to 2010 (USFWS 2009c unpublished field notes). Since water quality monitoring equipment was not regularly available, water quality measurements were only taken intermittently.

All four of the studied ponds were heavily overgrown with both emergent and floating wetland vegetation (USFWS 2009b). Water station depths ranged from 18 to 48 inches. Since groundwater levels dropped over time, the pond depths tended to be deeper in earlier years and shallower in later years. Measured water quality parameters included temperature, dissolved oxygen (DO), percent DO saturation, pH, conductivity, specific conductance, and salinity.

Water Temperature. Surface water temperatures ranged from 6.8 to 19.7 degrees Celsius ($^{\circ}\text{C}$), with the coldest temperature recorded on February 10, 2009, and the warmest recorded on September 9, 2009. Bottom water temperatures ranged from 4.0 to 16.1 $^{\circ}\text{C}$, with the coldest temperature recorded on February 10, 2009, and the warmest recorded on August 19, 2008.

Dissolved Oxygen. DO readings taken at all locations on all dates were low. Surface DO ranged from 1.2 to 5.0 milligrams per liter (mg/l), with the lowest reading on September 3, 2009, and the highest reading on August 5, 2008. Bottom DO ranged from 0.5 to 1.3 mg/l, with the lowest reading on September 23, 2010, and the highest reading on November 5, 2009. These low DO levels were likely a reflection of the high amounts of decomposing vegetation contained in the ponds.

Percent Dissolved Oxygen Saturation.² Percent DO saturation readings taken at all locations on all dates were low. Surface percent DO saturation ranged from 10.5 to 50.3 percent, with the lowest reading on September 16, 2010, and the highest reading on September 9, 2009. Bottom percent DO saturation ranged from 3.2 to 10.1 percent, with the lowest reading on September 23, 2010, and the highest reading on September 16, 2010. As with the DO levels, these consistently low percent DO saturation levels were likely a reflection of the high amounts of decomposing vegetation contained in the ponds.

Acidity (pH). Surface pH readings ranged from 6.34 to 6.61 pH units, with the lowest reading recorded on September 30, 2009, and the highest reading on September 23, 2010. Bottom pH readings ranged from 5.65 to 6.63, with the lowest reading on November 6, 2009, and the highest reading on September 16, 2010. The tendency to record acidic pH readings was likely a combination of dissolved high carbon dioxide that creates carbonic acid and organic acids that formed during the decomposition of submerged decaying vegetation.

Conductivity.³ Surface conductivity readings ranged from 351.0 to 453.2 microsiemens per centimeter ($\mu\text{s}/\text{cm}$), with the lowest reading recorded on September 23, 2010, and the highest reading on September 30, 2009. Bottom conductivity readings ranged from 344.4 to 386.3, with the lowest reading on September 23, 2010, and the highest reading on November 6, 2009.

² Some of the DO meters used in this study contained an internal algorithm that calculated the percent DO saturation, which is based on the measured DO as compared to measured water temperature and conductivity.

³ Conductivity is a measure of the ability of a substance, such as water, to pass an electrical current. Conductivity in water is primarily affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate, and phosphate anions (negatively charged ions) or sodium, magnesium, calcium, iron, and aluminum cations (positively charged ions). In waterbodies in the Dunes Complex and many other coastal areas, sodium and chloride are two of the main ions that contribute to conductivity. Therefore, conductivity measurements are useful to determine the freshwater, brackish water, or saltwater status of a body of water.

Specific Conductance.⁴ Surface specific conductance readings ranged from 370.0 to 657.0 $\mu\text{s}/\text{cm}$, with the lowest reading recorded on June 12, 2007, and the highest reading on August 21, 2007. Bottom conductivity readings ranged from 443.8 to 513.0 $\mu\text{s}/\text{cm}$, with the lowest reading on September 16, 2010, and the highest reading on November 6, 2009. Based on the specific conductance ranges described, the Refuge ponds all contain freshwater.

Salinity.⁵ Some of the water quality meters contained an internal algorithm that calculated salinity from specific conductance. Surface salinity readings ranged from 0.1 to 0.3 parts per thousand (ppt), with the lowest reading recorded on September 30, 2009, and the highest reading on November 6, 2009. Bottom salinity readings on all five recorded dates (ranging from November 5, 2009, to September 23, 2010) were constant at 0.2 ppt. Salinity levels (as supported by the conductivity and specific conductance algorithms) indicated that the studied Refuge ponds contain freshwater, rather than brackish water or saltwater.

Adjacent Lands. Water quality is a measure of the suitability of water for a particular use based on physical, chemical, and biological characteristics. Natural water quality varies from place to place with the seasons, with climate, and with the types of soils and rocks through which water moves. Human activities (e.g., urban and industrial development, farming, combustion of fossil fuels, and stream channel alteration) also affect water quality.

The Clean Water Act of 1977 requires states to identify and prioritize waters that do not currently support designated uses. Waterbodies that do not meet one or more applicable water quality standards and those that are threatened from a designated use by one or more pollutants are listed on each state’s 303(d) list. The 303(d) list includes waters impaired by both point and non-point source pollution. Point source pollution occurs when contaminants enter the waterbody from a distinct localized source, such as a chemical plant or equipment exhaust. Non-point source pollution occurs when contaminants enter the waterbody from indirect sources, such as residential development or agricultural practices.

The Refuge does not contain any impaired waterbodies currently listed on the California Water Resources Control Board’s 303(d) list, but several impaired waterbodies are near the Refuge (Table 3).

Table 3. California 303(d) Listed Water Bodies near the Refuge

Impaired Waterbodies	Pollutants	Potential Sources
Oso Flaco Lake	Dieldrin, nitrate	Agriculture, unknown sources
Oso Flaco Creek	Ammonia (unionized), chloride, fecal coliform, nitrate, sediment toxicity, sodium, other unknown toxicity	Agriculture, natural sources, groundwater loading, unknown non-point sources

⁴ Conductivity values that have been compensated to 25°C. By using specific conductance, the conductivity of waters of difference temperatures can be more accurately compared. Conductance is a measure of the ability of water to transmit an electrical current and is proportional to the amount of dissolved solids in the water; thus, the greater the conductance, the greater the salinity. Specific conductance in freshwater ranges from zero to 1,300 $\mu\text{s}/\text{cm}$, specific conductance in brackish water ranges from 1,301 to 28,800 $\mu\text{s}/\text{cm}$, and specific conductance in saltwater is greater than 28,800 $\mu\text{s}/\text{cm}$ (Remane and Schleiper 1971; Hem 1985).

⁵ Salinity of water is sometimes expressed in grams of salt per liter, but is more often expressed as ppt. By standard conventions for salinity (Remane and Schleiper 1971), freshwater contains less than 5 ppt, brackish water contains from 5 to 30 ppt, saltwater contains from 30-50 ppt, and hypersaline water contains greater than 50 ppt.

Santa Maria River Estuary	Escherichia coli (E. coli), fecal coliform, total coliform	Agriculture, collection system failure, grazing-related sources, natural sources, onsite wastewater systems (septic tanks), urban runoff and storm water sewers, sand and gravel mining
Santa Maria River	Chloride, chlorpyrifos, DDT, dieldrin, endrin, E. coli, fecal coliform, nitrate, sediment toxicity, sodium, toxaphene, turbidity, unknown toxicity	Agriculture, grazing-related sources, natural sources, other urban runoff, unknown sources, onsite wastewater systems (septic tanks), urban runoff and storm sewers

3.3.5 Contaminants

Prior to acquisition of the Mobil Coastal Preserve by the Service, two contaminants surveys were conducted by the Service, a Level I Preacquisition Contaminants Survey (USFWS 1999) and a Level II Preacquisition Contaminants Survey (USFWS 2000d).

The Level I Preacquisition Contaminants Survey identified three contaminants issues: (1) four abandoned oil wells (one was later determined to be located off-Refuge); (2) an abandoned underground petrochemical pipeline corridor that runs from south to north along the middle portion of the Refuge (contains three separate pipelines); and (3) 90 plumes of diluent on the adjacent GRP property that were in the process of being remediated. As part of the Level I survey, the four abandoned oil wells and the abandoned petrochemical pipeline corridor were field inspected on foot in May 1999. Based on the findings of this Level I survey, a more comprehensive Level II survey was recommended (USFWS 1999).

The Level II survey consisted of collecting 37 soil and groundwater samples during October 1999 at three types of locations: along the abandoned petrochemical pipeline corridor, along the boundary of the Mobil Coastal Preserve and the GRP, and near an abandoned oil well and sump. These samples were collected using a track-mounted geoprobe drill rig or a hand auger and were analyzed by Zymax Forensics and Environmental (Zymax) in San Luis Obispo, California, for total petroleum hydrocarbons (TPH). Samples were extracted by the Environmental Protection Agency's Method 3510 and analyzed by gas chromatography/mass spectrometry combination. The practical quantitation limit, or detection limit, for soil was 10 milligrams per kilogram (mg/kg) and 0.1 mg/l for water. Non-petroleum related compounds present in samples were not included in the TPH results. Non-petroleum compounds were eliminated by screening out peaks in the chromatograph that did not relate to petroleum compounds. Zymax was directed to analyze samples only for TPH because there was no evidence that any other contaminant was likely to be present and because of the added expense of analyzing for other contaminants.

The survey did not detect any contamination on the current Refuge property. However, very low levels of TPH contamination were found in a dune swale on land owned by the State of California about 150 yards north of the Refuge boundary (USFWS 2000c). Levels of TPH contamination in this state-owned dune swale ranged from none detected to a maximum of 0.36 mg/l in groundwater and to 31.0 mg/kg in soil. These TPH levels were described as being far below any threshold for cleanup of crude oil or other petroleum hydrocarbons in California (USFWS 2000c).

3.3.6 Air Quality

Of the ten ambient air quality stations in San Luis Obispo County, the three nearest the Refuge are located on Nipomo Mesa: the California Department of Forestry in Arroyo Grande; Mesa2, operated by the San Luis Obispo County Air Pollution Control District for the Conoco Phillips refinery; and the Nipomo Regional Park. Collectively, these stations monitor ozone, PM₁₀ (particulate matter), PM_{2.5}, nitric oxide, nitrogen dioxide,

oxides of nitrogen, and sulfur dioxide. The southern part of San Luis Obispo County is impacted by dust blown from the Dunes Complex along the coast of the Five Cities area. No exceedances of the federal PM₁₀ standard occurred at any of the three sites in 2011, but numerous exceedances of the state standard were recorded for 2011 at the Mesa2, Cal Fire and Nipomo Regional Park monitoring sites (APCD 2012). No exceedances of the state or federal ozone, PM_{2.5}, nitric oxide, nitrogen dioxide, oxides of nitrogen, and sulfur dioxide standards were observed in 2011. Violations tend to occur when strong winds blow from the northwest and sweep across the ODSVRA.

3.4 Biological Environment

3.4.1 Plant Communities

To date, 248 taxa (species, subspecies, and varieties) of plants have been identified on the Refuge (Appendix E). The vegetation of the Refuge exists as an ever-changing mosaic of plant communities and unvegetated sand dunes, as classified by Holland and Keil (1989) and Holland et al. (1995).

- 1) **Coastal strand and active primary dunes.** Coastal strand is a plant community that forms along the shore in loose, shifting sands located immediately above the high tide line of the upper beach area and extends along the entire Refuge shoreline as a continuous narrow band. This community typically extends just a few yards from the mean high tide line to the next plant community, active primary dunes.

Characterized by small hummocks (small knolls) and dunes, active primary dunes is a plant community immediately above the coastal strand. The hummocks and dunes of the active primary dunes may range from a few inches to a few feet tall and extend inland from the coastal strand from a few yards to about 50 yards. These active coastal dunes are formed as a result of ocean breezes blowing dry sand grains inland from the beach. Active dunes may occupy a zone immediately adjacent to the beach, or they may gradually be blown inland, sometimes engulfing and burying entire plant communities in their path. There may be a marked zonation in coastal strand, active coastal dunes, and foredune communities, or these communities may gradually phase from one to the other (Holland et al. 1995).

Plants growing on active primary dunes tend to collect sand and form vegetated hummocks. If enough plants become established, hummocks form that significantly reduce the rate of wind movement along the sand surface, causing dune migration to slow or stop. Once dune movement is reduced or stopped, species of plants intolerant of rapid burial and the abrasive action of the sand can become established, forming a stabilized dune. A dune that has ceased movement due to vegetative cover is considered a stabilized dune. Pioneer (foredune) communities develop on newly stabilized dunes near the coast (Holland et al. 1995).

Plants that exist in coastal strand and active primary dunes must be tolerant of such stressful environmental factors as frequent high winds, high salt content of the dune sand substrate, scouring from sand, low nutrient levels, intense solar reflection from the sand, excessive substrate drainage, and periodic inundation by storm surf and seasonally high tides. Trees and tall shrubs do not exist here; rather, the plants tend to be low-growing shrubs and herbs.

Due to the special adaptations needed to exist in this hostile environment, the number of plant species that exist in this community is not large. Dominant plants include beach sand verbena (*Abronia maritima*), beach-bur (*Ambrosia chamissonis*), beach saltbush (*Atriplex leucophylla*), sea rocket (*Cakile maritima*), and invasive European beachgrass (*Ammophila arenaria*).

- 2) **Central Coast foredunes (pioneer dunes).** Central coast foredunes typically extend inland from the active primary dunes about 200-600 yards. These dunes tend to exist as longitudinal dunes ranging from several feet to about 50 feet tall, arranged in a northwest to southeast direction—downwind of the prevailing northwest breezes. The individual dune ridges tend to be parallel to each other, with vegetation growing on the tops and sides of the sand ridges. The sand valleys existing between neighboring sand ridges are commonly referred to as blowouts; plants typically do not grow here. A few portions of the

foredunes contain transverse dunes, which are arranged perpendicular to the prevailing winds. The oldest foredunes on the Refuge are estimated to range from 1,000 to 2,000 years old, with the older dunes tending to be located more inland (Parsons 2006).

Common plant taxa in this plant community include purple sand verbena (*Abronia maritima*), yellow sand verbena (*Abronia latifolia*), beach saltbush (*Atriplex leucophylla*), beach morning glory (*Calystegia soldanella*), beach evening-primrose, (*Camissoniopsis cheiranthifolia*), California sand aster (*Corethrogyne filaginifolia*), dune ragwort (*Senecio blochmaniae*), beach-bur, and sea rocket. Non-native, invasive species such as European beachgrass (*Ammophila arenaria*), sea fig, and purple ragwort (*Senecio elegans*) are also common in the central coast foredunes. These non-native invasive species tend to grow in thick mats or patches that usually outcompete native plant species. This heavy vegetative growth creates unnaturally stable dunes that cause a loss of natural sand dune dynamics.

- 3) **Central coast dune scrub (stabilized back dunes) with active interior dunes.** Central coast dune scrub with active interior dunes is the most common plant community on the Refuge, and it typically exists immediately inland of the foredunes. These dune scrub communities are often located in the wind-shadow of the foredunes but are more commonly located at least a quarter mile or so inland from the immediate coast. Several areas of unvegetated, active interior sand dunes exist as a scattered mosaic throughout the dune scrub habitat. Both the vegetated dune scrub and unvegetated active interior dune scrub communities extend more than 3 miles inland, beyond the eastern limits of the Refuge.

The central coast dune scrub with active interior dunes community is geologically older than the active primary dunes and foredunes communities. Since they tend to possess a well-developed vegetative cover that helps create soils that contain a higher organic content, they are typically considerably more stable than the active primary dunes and foredunes communities. Ranging from 4,000 to 6,000 years old, the back dunes are geologically older than the foredunes (which are typically no older than 1,000 to 2,000 years old). The oldest dunes are located along the eastern edge of the Refuge (Parsons 2006).

The well-developed vegetative cover of the central coast dune scrub plant community provides several ecological factors that contribute to developing soils considerably more stable than those of the geologically younger foredune communities. The soils of dune scrub communities typically have more organic matter, retain more water, are more fertile, and have a lower salt content than soils of foredune communities. Shade and litter from the vegetation tend to reduce substantially the reflectivity and temperature fluctuations of the soil. The scattered presence of fungal hyphae, spike mosses, and lichens helps to bind sand particles together, further stabilizing the substrate (Holland et al. 1995). The height and density of shrubs and subshrubs helps block the soil eroding effects of the wind. Further, these shrubs and subshrubs tend to reduce the dehydrating and sand blasting effects of the strong winds on other plants. Shading produced by these shrubs and subshrubs creates microhabitats that many plant species favor.

Dune scrub communities typically have greater species diversity than foredune communities and are inhabited by plants that possess taller and denser growth forms. Dune scrub varies in species composition and structure from location to location, and—like the foredunes—differences in cover and species composition are common between the windward and leeward side of the back dunes. The general growth form of dune scrub vegetation is a relatively continuous cover of low to medium height shrubs (usually less than a meter tall), subshrubs, and herbs (Holland et al. 1995). Also, the northern slopes of taller back dunes tend to favor plant species that prefer a cooler, moister microhabitat.

Common plant taxa in this coastal dune scrub community include silver bush lupine (*Lupinus chamissonis*), mock heather (*Ericameria ericoides*), prickly phlox (*Leptodactylon californicum*), sea cliff buckwheat (*Eriogonum parvifolium*), coyote bush (*Baccharis pilularis*), Kellogg's horkelia (*Horkelia cuneata* ssp. *sericea*), California poppy (*Eschscholzia californica*), clustered field sedge, fiddleneck (*Amsinckia spectabilis*), ripgut brome (*Bromus diandrus*), and wild oat (*Avena sativa*). Giant coreopsis

(*Leptostyne gigantea*) co-dominate several scattered portions of this community within a mile or so of the coast.

Most portions of active interior sand dunes typically are not vegetated. However, isolated plants and patches of vegetation are periodically encountered in this habitat. Some of the more commonly encountered plant taxa here include silver bush lupine, dune ragwort, European beachgrass, crisp dune mint (*Monardella undulata* subsp. *crispa*), beach-bur, and beach evening-primrose.

The presence of such invasive plants as perennial veldt grass (*Ehrharta calycina*), European beachgrass, sea fig (*Carpobrotus chilensis*), and narrowleaf iceplant (*Conicosia pugioniformis*) presents a threat to the continued existence of both the vegetated coastal dune scrub and the active, unvegetated interior dunes. These invasive plants (most notably perennial veldt grass and European beachgrass) tend to out-compete the native plant taxa and may then grow into dense monocultures that cause a stabilization of active dunes. This stabilization of sand dunes causes a loss of the natural sand dynamics required to maintain a natural dune landscape. Invasive plants are a primary environmental threat to the Refuge and the entire Dunes Complex ecosystem.

- 4) **Coastal dune swale.** Back dune areas of the Refuge consist of a series of dune ridges and valleys. The floors of the valleys are not uniform and are composed of a series of depressions of varying depths, where natural dune dynamics have created scoured areas. Depending on the distance from the groundwater table, these depressions are sometimes called dune swales. The bottoms of these dune swales range from a foot or two below the water table to a few feet above the water table.

Several dozen dune swale wetlands exist on the Refuge. Although dune swales are located in many back dune locations, several are also located along the eastern (leeward) edge of the foredunes.

Coastal dune swales are transitional (ecotonal) in nature between wetland and upland plant communities, and some represent later stages of wetland community succession towards becoming an upland (non-wetland) community. During the rainy season, the soils of some dune swales close to groundwater level exhibit saturated surface soil; during high rainfall periods, dune swales may be periodically inundated with surface water for at least a few weeks.

A few dune swales on the Refuge possess short-term soil saturation and/or inundation and meet criteria to be classified as wetlands by Cowardin et al. (1979). These dune swales would be classified in the palustrine wetlands system and the emergent classes. Under the emergent class, most of the dune swale wetlands would fall under the sand subclass.

However, most of the dune swales on the Refuge are located at higher vertical distances from groundwater and would be classified as uplands, not as wetlands. Due to the accumulation of sand from dunes located upwind, many coastal dune swales on the Refuge tend to become filled and more xeric (drier) and they will transition into dune scrub communities. In recent years, a gradual lowering of the water table from drought has increased this trend towards evolution of dune swales into dune scrub communities. Near the bases of back dune slopes, coastal dune swales typically transition into dune scrub communities. A few of the more hydric (wetter) coastal dune swale communities physically overlap into the edges of freshwater marsh and riparian woodland communities.

The location of the groundwater table and resultant depth of water in these dune swales is the critical environmental factor of these valleys; it determines the type of plant community that is present. Just a few inches in elevation can make a significant difference in the plant community that occurs on a site. Coastal dune swale communities typically exist at the dry end of the moisture gradient for wetland communities and often are composed of a mixture of wetland and upland plants. Dune swale communities usually are dominated by phreatophytes (plants with high moisture requirements that have the ability to tap the fringe

of the groundwater table). Shrubs and trees are typically not common in dune swale plant communities (Holland et al. 1995).

Common plant species in coastal dune swale communities on the Refuge include clustered field sedge (*Carex praegracilis*), San Francisco rush (*Juncus lescueurii*), Brewer's rush (*Juncus breweri*), salt grass (*Distichlis spicata*), western goldenrod (*Euthamia occidentalis*), California goldenrod (*Solidago velutina* subsp. *californica*), common scouring rush (*Equisetum hyemale* subsp. *affine*), giant wild rye (*Leymus condensatus*), poison hemlock (*Conium maculatum*), fennel (*Foeniculum vulgare*), curly dock (*Rumex crispus*), marsh baccharis (*Baccharis glutinosa*), coyote brush (*Baccharis pilularis*), coastal goldenbush (*Isocoma menziesii* var. *vernonioides*), tarragon (*Artemisia dracuncululus*), Kellogg's horkelia, red brome (*Bromus madritensis* ssp. *rubus*), and ripgut brome.

As mentioned previously, active sand dunes tend to become stabilized by the dense growth of such invasive plants as perennial veldt grass, European beachgrass, sea fig, and narrowleaf iceplant. When active sand dunes become stabilized by dense vegetation, they tend to lose the natural sand dynamics that cause scouring and the resultant formation of dune swales. Due to the proliferation of invasive plants and the increased stabilization of active sand dunes, the formation of new dune swales has declined in the Refuge in recent years. The drought experienced during recent years has compounded this problem by causing a drop in groundwater levels, which has made the soil substrates of dune swales (and other plant communities) more xeric.

- 5) **Coastal dune freshwater marsh and pond.** Marshes and ponds occur in scattered locations throughout the Refuge, especially in the back dunes, where physical depressions in dune valleys exist where the water table is above or near the ground surface. They are typically small in size and few in number, and they tend to dry up during low rainfall years. Various types of freshwater marshes and ponds occur, ranging from wet meadows to 4-foot-deep ponds.

Some of the ponds and freshwater marshes on the Refuge are temporary pools that fill with water during the wet season (winter and spring) but dry up during summer and early fall. Even the permanently flooded ponds experience seasonal and annual fluctuations in water level that may affect the vegetation. The depth of the dune swale areas varies in response to rainfall trends, such as the drought of the recent years. Pond basins that hold year-round surface water in years of normal rainfall may be seasonally or completely dry in drought years.

Many of the valleys on the Refuge possess variable sized depressions separated by elevated areas only a few feet (and in several cases, only a few inches) higher. Because wetland areas occur in this island-like mosaic pattern with a complex of overlapping transitional habitats, types of plant communities and their boundaries are not always well defined. Therefore, it is not always easy to distinguish between a pond and a marsh.

The main difference between marshes and ponds on the Refuge is the water depth. Marshes have shallower depths, whereas ponds are deeper. However, no sharp demarcation separates the classification of marshes and ponds on the Refuge. Classification of these wetlands has not been consistently performed by scientists. During the past decade or so, due to dropping groundwater levels, several ponds on the Refuge have evolved into freshwater marshes.

These marshes and ponds are quite variable in both geological and plant community structure, and they are dependent on several interacting environmental factors. Fluctuations in groundwater level can result in seasonal and/or long-term changes in plant community structure.

Water depth is particularly important in determining the composition of marsh and pond communities. In deep open water, only submersed or floating aquatic plants become established. In shallow water,

however, the dominant plants are generally emergents—rooted below the water level but having their leaves, stems, and flowers elevated above the water.

Most inland ponds and marshes (including those on the Refuge) become deposited with accumulated sediments and decomposed vegetation. This gradual filling-in of wetlands results in seral succession of the plant communities that transitionally occupy the site. Most of the ponds on the Refuge display a series of concentric zones of vegetation in different stages of succession. As the ponds fill in, freshwater marsh communities develop near the shoreline in shallow water but then transition into riparian woodland at higher ground elevations on the banks. The changes in community structure that accompany the filling-in of these marshes and ponds are an important feature to consider in the management of wetlands on the Refuge (Holland et al. 1995).

Freshwater marshes on the Refuge tend to exist along the shorelines of existing ponds, adjacent to existing ponds, and at locations where former ponds have substantially dropped in water depth. Depending on their location and recent rainfall patterns, these freshwater marshes may undergo permanent flooding, seasonal flooding, permanently saturated soils, and/or seasonally saturated soils.

Common dominant plants of freshwater marshes on the Refuge include broad-leaved cattail (*Typha latifolia*), annual tule (*Isolepis cernua*), small-headed bulrush (*Scirpus microcarpus*), arroyo willow, marsh baccharis, broad fruit bur-reed (*Sparganium eurycarpum* var. *eurycarpum*), toad rush (*Juncus bufonius* var. *bufonius*), stinging nettle, willow-herb (*Epilobium ciliatum* subsp. *ciliatum*), soft rush (*Juncus effusus*), poison hemlock, and marsh pennywort (*Hydrocotyle ranunculoides*, *H. verticillata*).

As mentioned previously, due to a prolonged drought that resulted in dropping groundwater levels, by 2012, the numbers of known freshwater marshes and ponds on the Refuge possessing either permanent or seasonal surface water inundation decreased from 14 to 7. To help mitigate this loss, the Service created two new ponds on the Refuge in 2013, Myrtle Pond and Colorada Pond (refer to Figure 8), resulting in nine permanent or seasonal wetland ponds. Each new pond was constructed to occupy an estimated 6,000 square feet of surface area, with average water depth of about 4 feet and maximum depth of 7 feet.

Myrtle Pond is located about 200 yards inland from the ocean, and Colorada Pond is located about 2.5 miles inland from the ocean. Within 12 months of its creation, the dominant plants along Myrtle Pond included low bulrush (*Isolepis cernua*), San Francisco rush (*Juncus lescurii*), marsh pennywort (*Hydrocotyle ranunculoides*), tule (*Schoenoplectus* sp.), and arroyo willow (*Salix lasiolepis*). Despite constant hand pulling by Refuge staff, sea fig and European beachgrass continued to invade the shoreline area heavily. Common plants on the water surface of Myrtle Pond included mud midget (*Wolffiella lingulata*), duckmeat (*Landoltia punctata*), duckweed (*Lemna* sp.), and marsh pennywort. Fennel-leaf pondweed (*Stuckenia pectinata*) had become well established in the water column, growing from the bottom of the pond (USFWS, unpublished data).

Along the Colorada Pond shoreline, dominant plants included arroyo willow, red willow (*Salix laevigata*), low bulrush, toad rush (*Juncus bufonius* var. *bufonius*), stinging nettle (*Urtica dioica* subsp. *holosericea*), willow-herb, soft rush, and marsh pennywort. Common plants on the water surface of Colorada Pond include mud midget (*Wolffiella lingulata*), duckmeat (*Landoltia punctata*), duckweed (*Lemna* sp.), and marsh pennywort. Fennel-leaf pondweed (*Stuckenia pectinata*) had become well established in the water column, growing from the bottom of the pond (USFWS, unpublished data).

Five of the permanent or seasonally wetland ponds are former stock ponds created by a local rancher from 1960 to 1961 (C. Minetti, Maretti-Minetti Ranch, personal communication, 2012). Prior to the Refuge establishment, open range cattle ranching occurred in the vicinity as early as 1911. Cattle were excluded from the Refuge in 2007 through the installation of more than 5 miles of perimeter fencing along the Refuge's eastern and southern boundaries with the assistance of a local rancher.

With the removal of cattle in 2007, vegetation has become overgrown in these ponds. Common emergent plant taxa include arroyo willow, low bulrush, broad fruit bur-reed, and marsh pennywort. Common plants on the water surface of these five ponds include mud midget, duckweed, duckmeat, marsh pennywort, and mosquito fern (*Azolla filiculoides*). However, during 2014, most of these former stock ponds dried up due to a prolonged drought, which lowered groundwater levels on the Refuge and throughout the Dunes Complex (G. Greenwald, USFWS, personal communication, 2014).

- 6) **Coastal dune riparian woodland.** Small patches (usually less than 3 acres) of coastal dune riparian woodland are found intermittently scattered in the back dunes of the Refuge. These riparian woodland communities typically exist along the base of sand ridges and along the perimeter of ponds and marshes. They also are common in locations adjacent to marshes and ponds. Some of these riparian woodlands possess hydric soil characteristics that qualify them as wetlands (Cowardin et al. 1979).

The overstory of these riparian woodlands tends to be dominated by arroyo willow, with black cottonwood (*Populus trichocarpa*), red willow (*Salix laevigata*), blue elderberry (*Sambucus nigra* subsp. *caerulea*), and California wax myrtle sporadically common. Dominant understory species include arroyo willow, coyote bush, blue elderberry, western poison oak (*Toxicodendron diversilobum*), scouring rush, stinging nettle (*Urtica dioica* subsp. *holosericea*), western goldenrod (*Euthamia occidentalis*), coast tarweed (*Madia sativa*), California goldenrod (*Solidago velutina* subsp. *californica*), and poison hemlock. Red willow, black cottonwood, twinberry (*Lonicera involucrata* var. *ledebourii*), sneezeweed (*Helenium puberulum*), white sweet clover (*Melilotus albus*), California blackberry (*Ribes ursinus*), and straggly gooseberry (*Ribes divaricatum* var. *pubiflorum*) are common understory plants at scattered locations.

Although native, arroyo willow tends to grow aggressively on the Refuge when near surface water. Due to this aggressive growth ability, they often spread from riparian woodlands into adjacent ponds and marshes during periods of low groundwater. Since they can grow to a height of 40 feet or more, arroyo willow often form a canopy over ponds and marshes, evolving into the dominant species in these communities. When this occurs, marshes and ponds may lose their designation and instead be classified as riparian woodlands. This continual evolution of plant communities is another example of the ongoing dynamics of a coastal dunes ecosystem.

- 7) **Formerly cultivated plant community.** A formerly cultivated) plant community exists on the Refuge at a location commonly called Beigle Flats, which is adjacent to the Refuge administrative entrance road known as Beigle Road (see Figure 8). Beigle Flats occupies approximately 2 acres of land area and is the only portion of the existing Refuge not located within coastal dune or beach habitat. Beigle Flats was farmed for at least 60 years, primarily for strawberries and broccoli. Farming ceased on this land in 2007. Due to its long history of disturbance from farming, this land area is now dominated by a variety of non-native weed species.

Water from sprinkler irrigation on adjacent farmland tends to be deposited by the prevailing winds onto Beigle Flats, primarily along its northern and western portions. Weeds in Beigle Flats grow densest and tallest where this irrigation water accumulates.

The dominant plant shrub species that currently exist here are bull mallow (*Malva nicaeensis*), cheeseweed (*Malva parviflora*), common knotweed (*Polygonum aviculare* subsp. *depressum*), London rocket (*Sisymbrium irio*), pitseed goosefoot (*Chenopodium berlandieri*), rescue grass (*Bromus catharticus* var. *catharticus*), and foxtail barley (*Hordeum murinum*). Brass buttons (*Cotula coronopifolia*), common sow thistle (*Sonchus oleraceus*), and sticky sand-spurrey (*Spergularia macrotheca* var. *macrotheca*) are sporadically common.

3.4.2 Animals

Invertebrates

Due to the limited number of invertebrate surveys conducted, only 72 invertebrate taxa have been documented on the Refuge. Refer to Appendix F for a full list.

Commonly observed invertebrate groups include a wide variety of leeches, snails, crustaceans, spiders, scorpions, grasshoppers, beetles, flies, moths, and butterflies (Table 4). A wide variety of invertebrates are found in all habitats on the Refuge, including active sand dunes that are devoid of vegetation. Some of the more commonly observed species include California orange-winged grasshopper (*Arphia ramona*), seven-spotted ladybeetle (*Coccinella septempunctata*; introduced from Europe), Acmon blue butterfly (*Plebejus acmon*), Morro blue butterfly (*Plebejus icarioides moroensis*), Mormon metalmark butterfly (*Apodemia mormo*), and monarch butterfly (*Danaus plexippus*).

Table 4. Guadalupe-Nipomo Dunes National Wildlife Refuge Commonly Observed Invertebrate Species

Seven-spotted ladybeetle (<i>Coccinella septempunctata</i> ; introduced from Europe)	California orange-winged grasshopper (<i>Arphia ramona</i>)
Morro blue butterfly (<i>Plebejus icarioides moroensis</i>)	Acmon blue butterfly (<i>Plebejus acmon</i>)
Monarch butterfly (<i>Danaus plexippus</i>)	Mormon metalmark butterfly (<i>Apodemia mormo</i>)
Western tiger swallowtail (<i>Papilio rutulus</i>)	

During 2008 and 2009 field surveys for lepidopterans (butterflies and moths) conducted on the Refuge, standard black light bucket traps were deployed over four trapping nights, which yielded 188 butterflies and moths, represented by 50 taxa (Grinter 2009).

Targeted surveys for the federally endangered El Segundo blue butterfly (*Euphilotes battoides allyni*) were conducted during 2008, 2009, 2010, and 2011 by staff from the California Academy of Sciences, the Service, Vandenberg Air Force Base (VAFB), and/or consultants for VAFB. Although the El Segundo blue butterfly is known to occur about 15 miles south of the Refuge on VAFB, it has never been detected on the Refuge (Abela 2011; G. Greenwald, USFWS, personal communication, 2014).

General surveys for terrestrial arthropods were conducted on the Refuge in July 2011 by staff from VAFB and the Refuge, as part of a one-day survey for the El Segundo blue butterfly. As in previous years, no El Segundo blue butterflies were detected; however 12 other arthropod taxa were collected and identified during this 2011 survey (Abela 2011).

Fishes

No fish species are known to inhabit the Refuge.

The surf fishing that occurs from the Refuge occurs in ocean waters owned by the State of California. During high tides, while anglers may be standing on Refuge property, fishing actually occurs in State of California waters. The majority of the fish caught in the surf adjacent to the Refuge consist of just two species, barred surf perch (*Amphistichus argenteus*) and jacksmelt (*Atherinopsis californiensis*).

Amphibians

Only three amphibian taxa have been reported to occur on the Refuge: Sierran tree frog (*Pseudacris sierra*), California toad (*Anaxyrus boras halophilus*), and California red-legged frog (Appendix F).

Sierran tree frogs are the most common amphibian on the Refuge and have been observed to breed at all freshwater marshes and ponds with surface water inundation for at least a few months. While the Sierran tree frog is most commonly found in and near marshes and ponds, it can be found nearly anywhere on the Refuge during prolonged periods of rain or high humidity. Although considered tree frogs, they are actually more commonly found on the ground or in water. During periods of fog at night, Service and California State Parks

biologists have found Sierran tree frogs on open sand sheets located at least 400 yards from the nearest vegetation and nearest water.

California toads have been found at Beigle Flats and near Myrtle Pond. From 2006 to 2012, the California toad was known to breed intermittently in Myrtle Marsh when surface water inundation was present. However, in most years, the surface water did not last long enough for the tadpoles to mature, and most perished from predation or desiccation.

A few weeks after Myrtle Pond was created in February 2013, California toads were observed breeding there, and thousands of tadpoles were observed a few weeks later in the water column. In early June 2013, thousands of metamorphosed California toadlets were observed along the shores of Myrtle Pond. This was the first successful breeding of California toads noted on the Refuge in more than eight years (G. Greenwald, USFWS, personal communication, 2013).

California red-legged frogs are known to occur and breed at six freshwater marshes and ponds on the Refuge. Since the California red-legged frog is a federally threatened species, it is discussed in the Special Status Taxa section of this chapter.

Refuge amphibian data has been primarily obtained from conducting standardized Abnormal Amphibian surveys on the Refuge from 2007 to 2010 (USFWS, unpublished data) and from incidental observations by Service biologists.

Reptiles

Refuge reptile data has primarily been obtained from incidental observations by Service biologists. Thus far, 12 reptile taxa have been recorded on the Refuge, including one turtle, four lizards, and seven snakes (Appendix F). Pacific pond turtles (*Actinemys marmorata*) have been periodically observed in Refuge ponds. Due to the limited number of habitats, a large population of Pacific pond turtles is not likely to occur on the Refuge. The most common lizard observed on the Refuge is the Coast Range fence lizard (*Sceloporus occidentalis bocourtii*). Although it favors the edges of clearings and trails in coastal dune scrub habitat, this subspecies of the western fence lizard can be found nearly anywhere on the Refuge, including along the shoreline of ponds, in riparian woodlands, and occasionally on driftwood in the primary active dunes.

Two other lizard species commonly found on the Refuge include the Northern California legless lizard (*Anniella pulchra*) and California alligator lizard (*Elgaria multicarinata multicarinata*). The Northern California legless lizard lives a subterranean life, and it tends to favor the sandy soils of coastal dune scrub that possess leaf litter from native plants. Due to this subterranean lifestyle, the abundance of this species is probably underestimated on the Refuge and other locations where it occurs. The California alligator lizard tends to favor riparian woodlands and other habitats with dense brush and/or woody debris. Skilton's skink (*Plestiodon skiltonianus skiltonianus*) is also periodically found on the Refuge, usually under woody debris, but typically is less common than the other lizard species.

The most common snakes found on the Refuge include the coast garter snake (*Thamnophis elegans terrestris*), California striped racer (*Coluber lateralis lateralis*), San Diego gopher snake (*Pituophis catenifer annectens*), and Southern Pacific rattlesnake (*Crotalus oreganus helleri*). The coast garter snake tends to favor wetlands but is commonly found in coastal dune scrub. The other three species tend to favor coastal dune scrub.

Other snakes less commonly found on the Refuge include the Monterey ring-necked snake (*Diadophis punctatus vandenburghi*), California red-side garter snake (*Thamnophis sirtalis infernalis*), and two-striped garter snake (*Thamnophis hammondi*). The Monterey ring-necked snake favors hiding under woody debris near the edges of marshes and riparian woodlands, while the last two species prefer ponds and flooded freshwater marshes. On warm, sunny days, juvenile California red-sided garter snakes are periodically observed hunting for Sierran tree frogs in the canopy of broad-leaved cattail and broad fruit bur-reed. The adult California red-sided garter snakes are too heavy to climb on these flimsy, vertically aligned leaves. Just one

record for the two-striped garter snake exists for the Refuge—an individual about 30 inches long was observed in a pond in April 2011.

The Refuge is located at a geographic junction between the ranges of the Southern Pacific rattlesnake and the Northern Pacific rattlesnake (*Crotalus oreganus oreganus*). Although the only reported rattlesnake taxon on the Refuge is the Southern Pacific rattlesnake, Northern Pacific rattlesnake and hybrids between these two subspecies likely occur on the Refuge (S. Sweet, University of California Santa Barbara, Department of Ecology, Evolution, and Marine Biology, personal communication, 2009).

Birds

A total of 148 bird species, including 29 special status species, have been reported on the Refuge (Appendix F).

The primary active dune and coastal strand habitats attract a wide variety of bird species. Some of the more common species include western gull (*Larus occidentalis*), Heerman's gull (*Larus heermanni*), sanderling (*Calidris alba*), whimbrel (*Numenius phaeopus*), long-billed curlew (*Numenius americanus*), western snowy plover, black-bellied plover (*Pluvialis squatarola*), semipalmated plover (*Pluvialis squatarola*), western sandpiper (*Calidris mauri*), California brown pelican (*Pelecanus occidentalis californicus*) and American pipit (*Anthus rubescens*). Some of these species may be seasonally represented by large numbers of individuals.

In coastal dune scrub habitat, the most commonly observed birds include California quail (*Callipepla californica*), spotted towhee (*Pipilo maculatus*), wrentit (*Chamaea fasciata*), bushtit (*Psaltriparus minimus*), and California towhee (*Melospiza crissalis*). Common poorwill (*Phalaenoptilus nuttallii*) have been periodically observed both roosting and nesting on the ground in coastal dune scrub.

The coastal foredunes tend to be inhabited by fewer bird species than other plant communities of the Refuge. Some of the more commonly encountered bird species of the coastal foredunes include Brewer's blackbird (*Euphagus cyanocephalus*), American pipit, horned lark (*Eremophila alpestris*), mourning dove, and turkey vulture. Birds commonly found in dune swales include barn swallow, cliff swallow, Say's phoebe, mourning dove, western meadowlark (*Sturnella neglecta*), and California towhee.

The most common birds found in Refuge ponds and marshes include red-winged blackbird (*Agelaius phoeniceus*), song sparrow (*Melospiza melodia*), marsh wren (*Cistothorus palustris*), black phoebe (*Sayornis nigricans*), green heron (*Butorides virescens*), common yellowthroat, barn swallow, and cliff swallow. Due to the lack of open surface water in Refuge ponds and marshes, waterfowl tend to be less common. The only recorded waterfowl species in Refuge marshes and ponds are mallard (*Anas platyrhynchos*), bufflehead (*Bucephala albeola*), and American coot (*Fulica americana*). These three waterfowl species are not abundant on the Refuge; typically, only two or three individuals of any of these species are observed during one day on any pond.

In riparian woodlands, common birds include Wilson's warbler (*Wilsonia pusilla*), Bullock's oriole (*Icterus bullockii*), hooded oriole (*Icterus cucullatus*), bushtit, western tanager (*Piranga ludoviciana*), yellow-rumped warbler (*Dendroica coronata*), and common yellowthroat (*Geothlypis trichas*). Willow riparian woodland and willow patches on the Refuge are often occupied by a roosting great horned owl and/or a red-tailed hawk. Red-shouldered hawk (*Buteo lineatus*), Cooper's hawks (*Accipiter cooperii*), and sharp-shinned hawks (*Accipiter striatus*) are commonly observed in small numbers in or near riparian woodlands.

In the formerly cultivated plant community on the Refuge, the most common birds include Brewer's blackbird, savannah sparrow (*Passerculus sandwichensis*), European starling (*Sturnus vulgaris*), western meadowlark, horned lark, and killdeer (*Charadrius vociferus*). Red-tailed hawk and northern harrier are encountered frequently there.

Refuge bird data have been primarily obtained from bird surveys conducted from 2006 to 2009, western snowy plover surveys conducted from 2001 to the present, and incidental observations by Service biologists from 2006 to the present.

Mammals

At least 30 mammal taxa occur on the Refuge. The most commonly detected mammal species include deer mouse (*Peromyscus maniculatus*), Lompoc kangaroo rat (*Dipodomys heermanni arenae*), California vole (*Microtus californica*), desert cottontail (*Sylvilagus audubonii*), black-tailed jackrabbit (*Lepus californicus*), northern raccoon (*Procyon lotor*), dusky-footed woodrat (*Neotoma fuscipes*), coyote (*Canis latrans*), opossum (*Didelphis virginiana*), and pocket gopher (*Thomomys sp.*).

Bats can be observed on most nights; however, studies for bats have not been conducted on the Refuge, so the bat species have not been identified. Townsend's big-eared bat (*Corynorhinus townsendii*) and greater western mastiff bat (*Eumops perotis*) have been reported to occur in the Dunes Complex (Hall 1991), but have not been confirmed to occur on the Refuge.

The Department of Biological Sciences at California Polytechnic State University, San Luis Obispo, conducted a live-trapping of small mammals along the northern portion of the Refuge from 2007 to 2013 in coastal dune scrub habitat to study the relationship between the Lompoc kangaroo rat and perennial veldt grass. Incidental observations of other small mammals were also noted. The most abundant species trapped in this study were deer mouse, Lompoc kangaroo rat, and California vole (Villablanca 2011; Villablanca 2012).

Mountain lion (*Felis concolor*), bobcat (*Lynx rufus*), and black bear (*Ursinus*) are periodically present on the Refuge and are typically detected via tracks and/or scats.

Mule deer (*Odocoileus hemionus*) occur on the Refuge and are most commonly observed in or adjacent to riparian woodlands, marshes, and ponds. However, deer and deer sign are commonly observed along the Refuge foredunes and beach areas. Refuge population estimates for mule deer have not been conducted.

The Refuge exists in a geographic transition zone between two mule deer subspecies: California mule deer (*Odocoileus hemionus californicus*) and Columbian black-tailed deer (*Odocoileus hemionus columbianus*) (Higley 2002). Due to these geographic range overlaps and the likely hybridization between these two subspecies, confusion exists regarding the taxonomy of mule deer near the Refuge. Thus, Villablanca (F. Villablanca, personal communication, 2008) suggested identifying mule deer only to the species level.

Feral swine (*Sus scrofa*) were first documented on the Refuge in 2010 (USFWS, unpublished data), and they can be found throughout the Refuge, including the coastal strand. However, the highest feral swine activity tends to be in riparian woodland, marsh, and pond habitats. Feral swine seem to favor eating the roots from broad-leaved cattail and narrowleaf iceplant. Of particular note, feral swine leave a crater in the ground (often 2 feet in diameter by a foot or two deep) when they dig up the long taproots of narrowleaf iceplant, which creates a mosaic of craters along Refuge trails where they tend to travel and feed. Feral swine also have rooted in the beach portions of the Refuge, and the shell remnants in their scat indicate they seem to also feed on sand crabs (amphipods) that live under the beach sand near the high tide line.

3.4.3 Special Status Taxa

On the Refuge, 60 special status species have been confirmed (Appendix F). These species have been listed by a government agency (such as CDFW or the Service) or a conservation organization (such as the International Union for Conservation of Nature or California Native Plant Society [CNPS]) as endangered, threatened, rare, and/or of limited geographic distribution.

Special Status Plant Taxa. A total of 21 special status plant taxa have been found on the Refuge (Appendix E). These special status plants include the federally endangered marsh sandwort, Gambel's watercress, and La Graciosa thistle; and the state threatened surf thistle (*Cirsium rhizophyllum*) and beach spectacle pod

(*Dithyrea maritima*). Of the 21 special status taxa, 16 are neither federally nor state listed (hereafter, referred to as non-listed); however, they still have special status recognition from the CNPS or the Dunes Collaborative based on other criteria, such as being very limited in distribution. Some of the non-listed special status taxa include San Luis Obispo monardella (*Monardella undulata* subsp. *undulata*), crisp monardella (*Monardella undulata* subsp. *crispa*), coastal goosefoot (*Chenopodium littoreum*), Blochman's leafy daisy (*Erigeron blochmaniae*), and dune larkspur (*Delphinium parryi* subsp. *blochmaniae*). Some of the non-listed special status species, such as prickly phlox, California spineflower, suffrutescent wallflower, and giant coreopsis, are either common or dominant plants in some areas of the Refuge. The three federally listed species are discussed here.

La Graciosa thistle. The La Graciosa thistle was federally listed as endangered on March 20, 2000. The State of California listed this plant as threatened in 1990. This member of the sunflower family (Asteraceae) is a short-lived monocarpic perennial (a plant that blooms once, then dies) well armored with spines on the leaves and flower heads (Hendrickson 1990; Keil and Turner 1993; Teed 2003). These plants possess one or more stems that range in height from 4 to 39 inches and occasionally up to 59 inches. Currently, La Graciosa thistle is presumed extant in four populations that range from San Luis Obispo County to the Santa Barbara County: southern Callender Dune Lakes, Oso Flaco, southern Guadalupe Dunes, and Santa Maria River. La Graciosa thistle historically was found in mesic areas (areas with intermediate or medium moisture conditions that are neither very wet nor very dry) in back dune and coastal wetlands along a 32-mile stretch of the coastal region of central California between Arroyo Grande Creek in San Luis Obispo County to the north and the Santa Ynez River in Santa Barbara County to the south (Hendrickson 1990; USFWS 2009d; Consortium of California Herbaria 2010; CNDDDB 2010).

There is one La Graciosa thistle occurrence on the southeast portion of the Refuge. La Graciosa thistle is scattered in approximately 2.5 acres of habitat that primarily consists of mesic coastal dune swale. However, many plants in this occurrence are also found along the ecotones of coastal freshwater marsh/coastal dune swale and riparian woodland/coastal dune swale. This Refuge occurrence is part of the southern Guadalupe Dunes population. From 2007 to 2013, the Refuge occurrence has ranged from about 150 to 300 individuals (IRVC 2010; UCR 2008; USFWS, unpublished field data). During surveys in July 2013, 172 La Graciosa thistle plants were observed, 70 flowering and 102 juvenile plants (USFWS, unpublished field data, July 9, 2013).

However, during August 2014, a brief survey of the Refuge yielded only about 10 observations of individual La Graciosa thistle plants; all were juveniles, and no plants were found to have been adults (existing in a flowering stage). This survey was conducted after a prolonged drought and following a year that produced only 4 inches of rain. This information and other anecdotal data suggest that La Graciosa thistle reproduction and recruitment may be adversely affected by drought (M. Elvin, USFWS, personal communication, 2014).

In the final rule to list the species (USFWS 2000d), we stated the potential threats to the existence of La Graciosa thistle from:

- (1) displacement by non-native weeds;
- (2) altered fire regimes;
- (3) facility accidents by oil companies or VAFB;
- (4) small population sizes;
- (5) loss of reproductive vigor in small populations (seeds of La Graciosa thistle in small back dune populations have been shown to be of limited viability, per Hendrickson 1990);
- (6) habitat fragmentation (due to residential, commercial, agricultural, and oil and gas development, roads, and pathways);
- (7) herbicides used to control non-native species;
- (8) stochastic (random) extirpation events, and
- (9) groundwater extraction.

Threats to La Graciosa thistle identified since the time of listing include: (1) loss of connectivity between and among populations (i.e., long-distance dispersal) due to fragmentation and hydrological alterations (e.g., flood control, agricultural conversion of riparian areas); (2) water quality; (3) genetics as affected by small population sizes; (4) trampling of plants from cattle; and (5) climate change (Elvin 2007a; USFWS 2008d; USFWS 2009d; USFWS 2011c; CNDDDB 2010). Herbivory by cattle continues on this species and is reported to occur on plants along the Santa Maria River and in the southern Guadalupe Dune Sheet populations (CNDDDB 2010). Cattle were previously documented crushing and breaking La Graciosa thistle plants on the Refuge (Elvin 2007a). A fence was installed along the eastern and southern Refuge boundaries in 2007 to keep cattle out, and La Graciosa thistle on the Refuge have not been disturbed by cattle since then.

Marsh sandwort. Marsh sandwort was federally listed as endangered on August 3, 1993 (USFWS 1993a). This member of the pink family (Caryophyllaceae) is an herbaceous perennial. Trailing stems can grow up to 39 inches long and are often supported by surrounding vegetation. Marsh sandwort has small white flowers that are borne singly on long stalks arising from the leaf axils (point of leaf attachment to the stem). This plant also reproduces asexually. When the trailing stems are exposed to suitable conditions, adventitious roots are produced. This species generally blooms from May to August. Marsh sandwort is a coastal species historically known to occur in marshes and other perennially mesic areas (i.e., streams, creeks) from central Washington (Pierce County) to southern California (Los Angeles County) (USFWS 2008a). In the Dunes Lakes area of San Luis Obispo County, it has been reported to grow within dense mats of reeds (*Juncus* spp.), cattails (*Typha* spp.), bur-reed (*Sparganium* spp.), and bulrush (*Scirpus* spp.) (California Academy of Sciences Herbaria 2007; University of California Herbarium 2007). Currently, it is believed that its primary habitat consists of boggy areas in freshwater marshes and swamps below 560 feet in elevation (Consortium of California Herbaria 2007; California Academy of Sciences Herbaria 2007; Skinner and Pavlik 1994; CNPS 2001; Hartman 1993; Hartman et al. 2005; University of California Herbarium 2007).

In California, historical populations are known from five areas: San Francisco Bay (Crissy Field, San Francisco County), Santa Cruz (Scotts Valley, Santa Cruz County), Guadalupe-Nipomo Dunes (Black Lake, Black Lake Canyon, Jack Lake, Oso Flaco Lake, Twin Lake, Pismo Beach, San Luis Obispo County), Los Angeles basin (Los Angeles County), and along the Santa Ana River (vicinity of San Bernardino, San Bernardino County). At the time of listing in 1993, the only known extant population was in Black Lake Canyon. Currently, there is only one known extant wild population, at Oso Flaco Lake, and one extant introduced population, at Sweet Springs Marsh on the southern edge of Morro Bay (USFWS 2008a). Re-introduction efforts of Marsh sandwort have occurred at Baldwin Creek in Santa Cruz County, California, and the Rodeo Creek watershed in the Golden Gate National Recreation Area. While plants are still extant at these sites, it is still too early to determine if these will be successful long term.

The primary threats to the continued existence of marsh sandwort include: (1) habitat modification by converting marsh habitat to mesic upland habitats that support grass and shrub dominated plant communities; (2) increased sedimentation caused by urbanization (3) alteration of the hydrological regime; (4) herbivory by mammals; (5) water quality issues (e.g., excessive nitrogen); (6) climate change; and (7) sea-level rise (USFWS 1993a; USFWS 2008a; M. Elvin, USFWS, personal communication, 2014).

Approximately 200 marsh sandwort propagules were outplanted at six ponds and marshes on the Refuge in October 2008 (USFWS 2008b; USFWS 2008c). While most survived the move, grazing mammals consumed nearly all of the plants within two years (G. Greenwald, USFWS, personal communication, 2009). In August 2013, as part of the Wildlife Ponds Project (USFWS 2012a) approximately 90 marsh sandwort propagules were outplanted at the new Colorado Pond and 90 at the new Myrtle Pond. Exclusion fencing minimized the plants from threat of herbivory by mammals, and at least 50 percent survived through at least October 2013. Their current status on the Refuge is unknown.

Gambel's watercress. Gambel's watercress was federally listed as endangered on August 3, 1993 (USFWS 1993a). This member of the mustard family (Brassicaceae) is a coastal species historically known to occur in marshes and other perennially mesic areas (i.e., streams, creeks) from Arroyo Grande in central California (San Luis Obispo County) to the Santa Ana River in Southern California (Orange and San Bernardino Counties). In San Luis Obispo and Santa Barbara Counties, Gambel's watercress has been reported to grow in perennially swampy and other mesic areas with bulrush (*Scirpus* spp.), broad fruit bur-reed, cutleaf water-parsnip (*Berula erecta*), straggly gooseberry (*Ribes divaricatum* var. *pubiflorum*), western poison oak, willow (*Salix* spp.), and other riparian vegetation (Dial 1980; Chesnut 1998; Elvin 2005; SRS 2008; University of California at Berkeley Herbaria 2009). This rhizomatous perennial herb can grow up to 6 feet tall. Gambel's watercress generally blooms from April to July, producing dense clusters of white flowers.

Threats to Gambel's watercress consist of the following: (1) loss and degradation of habitat due to development and urbanization; (2) adverse effects from biostimulation (excessive growth caused by the addition of nutrients into an ecological system); (3) sedimentation; (4) inadequacy of existing regulatory mechanisms; (5) competition by non-native species; (6) stochastic (i.e., random) extirpation or extinction events due to the small size and isolation of the remaining population; (7) genetic swamping from the closely related introduced crop species, common watercress (*Nasturtium officinale*); and (8) grazing mammals (USFWS 2011a).

Genetically pure (non-hybridized) Gambel's watercress is currently known from one remaining wild population discovered in 1996 on VAFB in Santa Barbara County and one population introduced in October 2008 on the Refuge from material taken from the VAFB population.

Special Status Animals. Blecha et al. (2007) report that at least 118 taxa of special status invertebrates, amphibians, reptiles, birds, and mammals have been found on the Dunes Complex. Most are likely found on the Refuge; however, to date, only 39 special status animal species have been confirmed present on the Refuge (Appendix F). These 39 confirmed special status animal taxa include 3 invertebrates, 2 amphibians, 3 reptiles, 30 birds, and 1 mammal.

The three special status invertebrate taxa are the Morro blue butterfly (*Plebejus icarioides moroensis*), monarch butterfly (*Danaus plexippus*), and Oso Flaco patch butterfly (*Chlosyne leanira elgans*), all of which are considered a state species of special concern. As mentioned previously, Morro blue butterfly adults are commonly seen flying around the Refuge and landing on silver bush lupine, and their caterpillars are often found there. Monarch butterflies are commonly observed on the Refuge in the fall and winter months. Clusters of several hundred to several thousand monarch butterflies have been observed in large arroyo willow trees on California State Parks land adjacent to Refuge land, but this event has not been recorded on Refuge land.

The two special status amphibians recorded from the Refuge are the California red-legged frog and the California toad. The California red-legged frog is federally threatened, and the California toad is classified as near threatened by the International Union for Conservation of Nature and Natural Resources (IUCN).

The three special status reptiles recorded from the Refuge are the Pacific pond turtle, Northern California legless lizard, and two-striped garter snake. All three are species of special concern by the State of California. Additionally, the IUCN has classified the Pacific pond turtle as vulnerable.

At least 30 bird taxa recorded on the Refuge are considered special status, and several have received special status rankings from more than one conservation organization. The California least tern is federally listed as endangered, and the western snowy plover is federally listed as threatened. Both of these are described in more detail in the "Federally Listed Animals" section.

The Service considers eight Refuge taxa birds of conservation concern, including American peregrine falcon (*Falco peregrinus anatus*), golden eagle, yellow warbler (*Dendroica petechia*), western burrowing owl (*Athene*

cunicularia hypugaea), ferruginous hawk (*Buteo regalis*), prairie falcon (*Falco mexicanus*), Caspian tern (*Hydroprogne caspia*), and Lawrence's goldfinch (*Carduelis lawrencei*).

Five avian taxa occurring on the Refuge are State of California fully protected species: California least tern, American peregrine falcon, golden eagle, white-tailed kite (*Elanus leucurus*), and California brown pelican. State of California species of special concern are the American white pelican, brant (*Branta bernicula*), northern harrier, loggerhead shrike (*Lanius ludovicianus*), yellow warbler (*Dendroica petechia*), large-billed savannah sparrow, yellow warbler, western burrowing owl, and western screech owl (*Megascops kennicottii*).

The only known special status mammal species occurring on the Refuge is the American badger, a California species of special concern. American badger burrows have been observed along the sides of vegetated dune ridges in the southeast corner of the Refuge.

Federally Listed Animals. Three federally listed animals have been confirmed present on the Refuge: the federally threatened western snowy plover and California red-legged frog, and the federally endangered California least tern.

California red-legged frog. The California red-legged frog was federally listed as threatened on May 23, 1996 (*Federal Register*: Volume 61, Number 101, pages 25813-25833). The historical range of the California red-legged frog extended coastally from the vicinity of Point Reyes National Seashore, Marin County, California, and inland from the vicinity of Redding, Shasta County, California, southward to northwestern Baja California, Mexico (Jennings and Hayes 1985; Hayes and Krempels 1986).

The California red-legged frog uses a variety of habitat types, including various aquatic systems, riparian, and upland habitats. California red-legged frogs spend most of their lives in and near sheltered backwaters of ponds, marshes, springs, streams, and reservoirs. Deep pools with dense stands of overhanging willows and an intermixed fringe of cattails (*Typha* spp.) are optimal habitat. Eggs, larvae, transformed juveniles, and adults also have been found in ephemeral creeks and drainages and in ponds that do not have riparian vegetation. California red-legged frogs frequently breed in artificial impoundments such as stock ponds, if conditions are appropriate. Although they successfully breed in streams and riparian systems, high seasonal flows and cold temperatures in streams often make these sites risky environments for eggs and tadpoles. The importance of riparian vegetation for this species is not well understood.

When riparian vegetation is present, California red-legged frogs spend considerable time resting and feeding in it; the moisture and camouflage provided by the riparian plant community likely provide good foraging habitat and may facilitate dispersal, in addition to providing pools and backwater aquatic areas for breeding. Accessibility to sheltering habitat is essential for the survival of California red-legged frogs within a watershed and can be a factor limiting population numbers and distribution. California red-legged frogs breed from November through March with earlier breeding records occurring in southern localities (Storer 1925). California red-legged frogs found in coastal drainages are rarely inactive (Jennings et al. 1992), whereas those found in interior sites may hibernate (Storer 1925). Well-vegetated terrestrial areas within the riparian corridor may provide important sheltering habitat during winter. California red-legged frogs spend the summer in small mammal burrows and moist leaf litter (Jennings and Hayes 1994). California red-legged frogs have been found up to 98 feet from water in adjacent dense riparian vegetation for up to 77 days (Rathbun et al. 1993).

Aestivation⁶ habitat for the California red-legged frog is potentially all aquatic and riparian areas within the range of the species and includes any landscape features that provide cover and moisture during the dry season within 300 feet of a riparian area. This could include boulders or rocks and organic debris such as

⁶ Aestivation or estivation is a state of animal dormancy, similar to hibernation, characterized by inactivity and a lowered metabolic rate. This lower-level physiological state occurs in some animals as a response to high temperatures and arid conditions, which often occur during the summer months.

downed trees or logs; industrial debris; and agricultural features, such as drains, watering troughs, spring boxes, abandoned sheds, or hayricks. Incised stream channels with portions narrower than 18 inches and depths greater than 18 inches may also provide estivation habitat.

The California red-legged frog has sustained a 70 percent reduction in its geographic range in California as a result of several factors, singly or in combination. Habitat loss and alteration, overexploitation, and introduction of exotic predators were significant factors in its decline in the early to mid-1900s. California red-legged frogs were likely extirpated from the Central Valley floor before 1960. Remaining aggregations (assemblages of one or more individuals, not necessarily a viable population) in the Sierran foothills became fragmented and were later eliminated by reservoir construction, continued expansion of exotic predators, grazing, and prolonged drought. Within the Central Valley hydrographic basin, only 14 drainages on the Coast Ranges slope of the San Joaquin Valley and one drainage in the Sierran foothills are actually known to support or may support California red-legged frogs, compared to over 60 historic locality records for this basin (a 77 percent reduction). The pattern of disappearance of California red-legged frogs in southern California is similar to that in the Central Valley, except that urbanization and associated roadway, large reservoir (introduction of exotic predators), and stream channelization projects were the primary factors causing population declines. In southern California, California red-legged frogs are known from only five locations south of the Tehachapi Mountains, compared to over 80 historic locality records for this region (a reduction of 94 percent) (Jennings et al. 1992).

California red-legged frogs are known to occur in 243 streams or drainages in 22 counties, primarily in the central coastal region of California (USFWS 1996). The term “drainage” is used to describe named streams, creeks, and tributaries from which California red-legged frogs have been observed. Monterey, San Luis Obispo, and Santa Barbara Counties support the greatest number of currently occupied drainages, with 32, 36, and 36, respectively. Historically, the California red-legged frog was known from 46 counties, but the taxon is now extirpated from 24 of those counties (a 52 percent reduction in county occurrences). In 7 of the 22 occupied counties (32 percent), California red-legged frogs are from a single occurrence. The most secure aggregations are found in aquatic sites that support substantial riparian and aquatic vegetation and lack exotic predators, such as bullfrogs (*Lithobates catesbeiana*), bass (*Micropterus* spp.), and sunfish (*Lepomis* spp.). Only three areas within the entire historic range of the California red-legged frog may currently support more than 350 adults, Pescadero Marsh Nature Preserve (San Mateo County), Point Reyes National Seashore (Marin County), and Rancho San Carlos (Monterey County). Threats such as expansion of exotic predators, proposed residential development, and water storage projects occur in the majority of drainages known to support California red-legged frogs.

California red-legged frogs are present and breed in at least six ponds on the Refuge. The ability of these ponds to continue to support amphibian breeding is threatened by two major factors: fluctuating groundwater levels and trophic enrichment (USFWS 2012a). Due to the combined effects of periodic droughts, fluctuating groundwater levels, and trophic enrichment, four of these ponds on the Refuge currently exist with poor water quality and are in serious danger of drying up during low rainfall years (USFWS 2012a).

Abnormal amphibian surveys were conducted from 2007 to 2010 at these ponds using standardized USFWS protocol (USFWS 2007a). After collecting and examining more than 600 late-stage California red-legged frog tadpoles and metamorphs over a four-year period, only six individuals exhibited abnormalities (less than 1 percent abnormality rate). Five abnormalities were suspected to be the result of predator-induced trauma, and one was suspected to be the result of an unidentified ranavirus (USFWS 2010b; USFWS 2011b).

For comparison, abnormalities among frogs and toads collected in a study that surveyed 152 NWRs (including Refuge) averaged about 2 percent (Reeves et al. 2013). In central California, abnormalities in frogs and toads tend to average as high as 6–8 percent of the population (Reeves et al. 2013).

Western snowy plover. The western snowy plover's preferred breeding habitats include sandy coastal beaches, barrier islands, barren shores of inland saline lakes, and river bars along the Pacific coastline of Washington, Oregon, California, and Mexico. In the interior portions of the western states, this species also inhabits alkaline lakes, ponds, and river bars (Page et al. 2009). Due to a declining population size from a variety of factors—including loss of habitat from coastal development, increased human recreational use of beaches, increased spread of invasive plant species, and increased numbers of native and introduced predators (USFWS 2007b; Page et al. 2009)—the Pacific Coast breeding population of the western snowy plover was federally listed as threatened on March 5, 1993 (USFWS 1993b) under provisions of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*). A recovery plan for the western snowy plover was finalized in 2007 (USFWS 2007b), which identified six recovery units for the listed population. The Refuge is located in Recovery Unit 5 for this species.

Western snowy plover are primarily visual foragers. They forage on invertebrates in the wet sand and among surf-cast kelp within the intertidal zone; in dry, sandy areas above the high tide; on salt pans; and along the edges of salt marshes, salt ponds, and lagoons. Western snowy plover food consists of immature and adult forms of aquatic and terrestrial invertebrates. The breeding season extends from early March through late September; it generally begins earlier in more southerly latitudes than in more northerly latitudes. Due to these timing differences, the breeding season may be two to four weeks earlier in southern California than in Oregon and Washington. Fledging (reaching flying age) of late-season broods may extend into the third week of September throughout the breeding range. They nest in open, flat, sparsely vegetated beaches and sand spits above the high tide. Western snowy plover often return to the same breeding sites year after year. They lay their eggs in shallow depressions in sandy or salty areas that generally are devoid of vegetation. Because the sites they choose are in loose sand or soil, nesting habitat is constantly changing under the influence of wind, waves, storms, and encroaching plants. Nests typically occur in flat, open areas with sandy or saline substrates. Vegetation and driftwood are usually sparse or absent.

As early as the 1970s, biologists suspected a decline in plover numbers. The primary cause is loss and degradation of habitat. The introduced European beachgrass (*Ammophila arenaria*) contributes to habitat loss by reducing the amount of open, sandy habitat and contributing to steepened beaches and increased habitat for predators. Urban development has reduced the available habitat for western snowy plovers while increasing the intensity of human use, resulting in increased disturbance to nesting plovers (USFWS 2014b).

Natural and human-caused disturbances affect the western snowy plover and its habitat. Western snowy plover respond differently to disturbance depending on the type, frequency, and timing of disturbance. For example, breeding western snowy plover appear more sensitive to disturbance than wintering plovers. Western snowy plover are more likely to flush from, or abandon, a nest during the early incubation stages, but they are less likely to abandon a nest as eggs approach hatching, presumably because substantial effort and energy has been invested incubating the eggs and defending the nest. Human presence at isolated beaches on VAFB, for example, can result in western snowy plover flushing at a greater distance than plovers at ODSVRA, where they are subject to greater disturbance and have the ability to 'habituate' (USFWS 2012b).

Disturbance of nesting or brooding plovers by humans, domestic animals, feral animals, and native predators can be a major factor affecting nesting success. Western snowy plover typically leave their nests when humans, domestic animals, feral animals, or native predators approach too closely. Domestic dogs may deliberately chase plover and inadvertently trample nests. Vehicles may directly crush adults, chicks, or nests; separate chicks from brooding adults; and interfere with foraging and mating activities (Warriner et al. 1986; USFWS 1993b; Ruhlen et al. 2003). Repeated flushing of incubating plovers exposes the eggs to the weather and depletes energy reserves needed by the adult, which may result in reductions to nesting success. Surveys at VAFB from 1994 to 1997 found the rate of nest loss on southern beaches consistently higher than on northern beaches, where recreational use was much lower (Persons and Applegate 1997).

Ruhlen et al. (2003) found that increased human activities on Point Reyes beaches resulted in a lower chick survival rate.

Pacific Coast western snowy plover require relatively undisturbed areas, but disturbance appears to be site-specific and context-dependent. Consequently, plover response to disturbance can vary between sites. For example, incubating plovers at VAFB are easily disturbed because there is little human-related activity and noise there due to the military mission of the Air Force (USFWS 2012b). Similarly, western snowy plovers on the Refuge are typically very intolerant of human disturbance, and they frequently abandon active nests and also herd their broods into the foredunes when humans approach on foot within 150-200 yards (G. Greenwald, USFWS, personal communication, 2013).

Recently implemented efforts along the Pacific coast to separate nesting plovers from recreational beach users include the use of docents, symbolic fencing, and public outreach. These activities have increased reproductive success in those areas (Ruhlen et al. 2003).

Sea-level rise and hydrological changes associated with climate change are having and will continue to have significant effects on the Pacific Coast western snowy plover and its habitat over the next several decades (USFWS 2012b). Sea-level rise is a result of two phenomena: thermal expansion (from increased sea water temperatures) and global ice melt (Cayan et al. 2006).

For the Pacific Coast western snowy plover and other shorebird habitat, Galbraith et al. (2005), in a study of sites in Washington (Willapa Bay) and California (Humboldt Bay and San Francisco Bay), projected losses of intertidal habitat could range between 20 and 70 percent of the existing habitat. In addition, sea-level rise may result in coastal areas losing their ability to support the current number of shorebirds. Areas with steep topography (Northern California to Washington State) or seawalls (Southern California) with limited beach habitat are expected to have the most severe losses (Galbraith et al. 2005). Additionally, sea-level rise would cause inundation of low-lying areas by high tides; flooding of coastal areas during major storm events, especially near river mouths; acceleration of erosion of coastal bluffs; and a shift in beach profiles, of the mean high water line landward (Huppert et al. 2009).

Since 2002, the Refuge has participated in the standardized western snowy plover Range-wide Breeding Window Survey. During this survey western snowy plover are counted along the west coast of the United States during the same day or at least within the same week, during the month of May. From 2002 to 2014, the numbers of adult snowy plover observed on the Refuge during these annual breeding window surveys has ranged from a low of 7 (in 2007) to a high of 32 (in 2006), with an average of 20 (G. Greenwald, USFWS, personal observation, 2015).

On September 14, 2011, a total of 116 combined adult and fledgling snowy plover were observed on the Refuge during a standard plover breeding survey. This was the highest total western snowy plover count recorded since 2002. Large numbers of combined adult and fledgling snowy plover were also counted during 2011 from September 21 to September 27, with numbers ranging from 62 to 101 individuals (USFWS 2012c).

During the 13-year period from 2002 to 2014, the total number of snowy plover nests found each season ranged from a low of 21 (during 2012) to a high of 50 (during 2009), with a mean of 35. The Refuge snowy plover nest hatching success for this 13-year period ranged from a low of 7 nests in 2007 (30 percent hatch rate) to a high of 21 nests in 2005 (55 percent hatch rate) and 2014 (66 percent hatch rate), with a mean of 14 hatches (40 percent hatch rate). From 2002 to 2014, a total of 458 nests were detected on the Refuge, with 188 detected hatches (42 percent hatch rate), 502 cumulative total chicks produced, and an annual mean of 39 chicks produced (G. Greenwald, USFWS, personal observation, 2015).

California least tern. The California least tern's preferred breeding habitats include shorelines of bays and coastal beaches of the Pacific Ocean in Southern California, central California, San Francisco Bay,

and Baja California (Thompson et al. 1997). Due to declining population sizes, primarily caused by loss of habitat from coastal development and recreational use of beaches, the California least tern was federally listed as endangered June 2, 1970 (USFWS 1970) under the provisions of the Endangered Species Conservation Act of 1969 (16 U.S.C. 851 *et seq.*).

The California least tern is migratory in California, usually arriving at breeding territory in late April in southern California (Massey 1971) to mid-May in northern California (Anderson and Rigney 1980). This dynamic bird mainly forages on small fishes, but it also may consume shrimp or other invertebrates. The California least tern feeds primarily in shallow estuaries or lagoons where small fish are abundant. These birds typically feed by hovering and then plunging for fish near the surface without submerging completely. Considerable feeding also takes place near shore in the open ocean (Cogswell 1977), especially where lagoons are nearby, or at mouths of bays.

Most California least terns begin breeding in their third year. Courtship may take place away from the colony, typically on a beach or exposed tidal flat (Hardy 1957). Males perform elaborate aerial displays. After performing these displays, they often offer fishes to the female. A typical colony may consist of about 25 pairs. This bird nests in loose colonies in areas relatively free of human or predatory disturbance. They are known to abandon nesting areas readily if disturbed (Davis 1968). The California least tern prefers nesting on undisturbed sites with open, sandy or gravelly substrate near shallow-water feeding areas in estuaries. The nest consists of a simple scrape produced in the sand that may or may not contain shell fragments. On hard soil, they have been known to use artificially create depressions, such as a dried boot impression (Swickard 1971; Swickard 1972; Rigney and Emery 1980). In Florida, this species commonly nests on gravel rooftops (Fisk 1975; Forsys and Borboen-Abrams 2006; Brush et al. 2011).

Breeding colonies are located in southern California along marine and estuarine shores, and in San Francisco Bay in abandoned salt ponds and along estuarine shores (Wilbur 1974). After breeding, family groups regularly occur at lacustrine waters near the coast of southern California (Garrett and Dunn 1981). Wintering areas are unknown but suspected to include the Pacific Coast of South America (Massey 1977).

In California, the nesting habitat is often separated from the ocean by recreational beach use. Disturbances include people and domestic animals walking too close to nests, noise pollution from construction or other human activities, aircraft flying low or landing in nesting areas, and military training exercises.

Breeding birds are typically present at colonies from April through August. Nesting usually starts in mid-May, with most nests completed by mid-June (Bent 1921; Davis 1968; and Massey 1974). Late-season nests may be re-nesting events or second-year individuals arriving late (Wilbur 1974; Collins and Bailey 1980; Massey and Atwood 1981).

Disturbance and/or predation have been reported in least tern colonies from burrowing owls and American kestrels (Collins and Bailey 1980). In one large colony, disruption and abandonment was suspected of being caused by house cats. Other predators include larger birds and mammals such as raccoons, foxes, and domestic dogs.

In many areas in California, protective enclosures are necessary for colony success (Craig 1971; Massey 1972; Bender 1973; Bender 1974; Atwood et al. 1977; Elliot et al. 2007; Ryan and Vigallon 2009). Artificial nest structures aid in providing sand substrate and protection from wind (Loftin and Thompson 1979). Human disturbance at former coastal nesting areas has reduced the breeding population in California (Garrett and Dunn 1981) and was noted as early as the mid-1920s (Schneider 1926).

During the last 14 years, the California least tern has been intermittently observed flying over Refuge beaches and foredunes and feeding in the surf adjacent to the Refuge. Breeding activities of the California least tern have not been recorded on the Refuge, but breeding is well-documented about 2.0 miles north of

the Refuge on the ODSVRA and about 1.5 miles south of the Refuge, adjacent to the Santa Maria River estuary.

3.4.4 *Special Management Areas*

Special Management Areas, if applicable, can include additional designations for a Refuge, such as wild and scenic rivers, wilderness, important bird area, national natural landmark, and critical habitat. The Refuge contains critical habitat for both the La Graciosa thistle and Western snowy plover.

Designated Critical Habitat

When a species is proposed for listing as endangered or threatened under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*), the Service must consider whether there are areas of habitat believed to be essential to the species' conservation. Those areas may be proposed for designation as "critical habitat." Critical habitat is a specific geographic area that contains features essential for the conservation of a threatened or endangered species and that may require special management and protection. The Refuge serves to protect designated critical habitat units for two federally listed species: the La Graciosa thistle and western snowy plover.

La Graciosa thistle critical habitat. With the exception of the beach and the western edge of the foredunes, most of the Refuge has been included as part of Designated Critical Habitat Unit 1, Subunit A for the La Graciosa thistle (*Federal Register*: Vol. 74, No. 211, pages 56978-57046). This designation includes 94 percent (2,402 acres) of the Refuge (Figure 9).

The Service considers the physical and biological features essential to the conservation of the species that may require special management considerations or protection when designating critical habitat for a species. These features, which are called the primary constituent elements, are laid out in the appropriate quantity and spatial arrangement essential to the conservation of the species. The elements generally include but are not limited to space for individual and population growth and for normal behavior; food, water, air, light, minerals, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, or rearing (or development) of offspring; and habitats protected from disturbance or representative of the historical, geographical, and ecological distributions of a species.

Many primary constituent elements are present on the Refuge. However, despite the large acreage of Refuge lands within designated critical habitat and the presence of primary constituent elements on many portions of the Refuge, biologists from several natural resource agencies and conservation organizations searched for 13 years and determined the La Graciosa thistle only occurs in one valley in the southeast corner of the Refuge.

Western snowy plover critical habitat. On June 19, 2012, the Service published a final rule for designation of 24,527 acres of critical habitat along the coasts of California, Oregon, and Washington (USFWS 2012b). All of the Refuge coastal strand and large portions of the western foredunes are included in the Critical Habitat Unit CA-31 (Pismo Beach/Nipomo Dunes Unit) for the western snowy plover. This designation includes approximately 9.5 percent (242 acres) of the Refuge foredunes (Figure 9).

Figure 9. Critical Habitat Map for Guadalupe-Nipomo Dunes National Wildlife Refuge.



Since 2001, western snowy plover have occurred in most of the unvegetated portions of this critical habitat within 100 yards of the beach. In unvegetated areas, they have been observed as far inland as 600 yards (Applegate and Schultz 2009).

3.5 Socioeconomic Environment

3.5.1 Socioeconomic Setting

Urban centers closest to the Refuge include the city of Guadalupe, located in Santa Barbara County about 2 miles southeast of the Refuge, and the unincorporated community of Nipomo, which is located in San Luis Obispo County about 7 miles east-northeast of the northeast corner of the Refuge. The Santa Maria Valley is a major agricultural area, with cattle grazing becoming established in the late 1830s.

The northern portion of the Refuge panhandle area is only 100 feet wide, and its northern end is located between two agricultural fields that primarily grow broccoli and strawberries. The nearest agricultural fields to the main body of the Refuge are on its northeast corner, separated by a half-mile buffer area of coastal dune scrub. Currently, the closest cattle grazing operations to the Refuge are located on private lands about 2 miles south of the Refuge southern boundary (USFWS 2012a).

Grain and orchard crops were commonly cultivated in the 1800s; by 1897, irrigated crops such as beets became established (Smith et al. 1976). Several thousand acres to the north, east, and southeast of the Refuge have a long history of farming, and some local farms have existed for more than 100 years. Broccoli, strawberries, and lettuce are the primary crops currently grown on these farmlands. These farmlands are primarily irrigated with wells that access local groundwater (USFWS 2012a).

Santa Barbara County

Santa Barbara County covers approximately 2,745 square miles of land. The 2014 population of Santa Barbara County totaled 436,516 people (CEDD 2015). The most recent estimated employment figures for Santa Barbara County are for 2015. Major industries are in Table 5.

San Luis Obispo County

San Luis Obispo County covers approximately 3,616 square miles of land. For 2012, the population of San Luis Obispo County was estimated at 274,804 people (U.S. Census 2013). The city of San Luis Obispo, incorporated in 1856, is the county seat and has an estimated population of approximately 45,878 people in 2012 (U.S. Census 2013).

Table 5. Top Industries in Santa Barbara County, 2015.

Industry	Total Employed
Total Farm	22,700
Professional and Business Services	24,300
Accommodation and Food Service	24,800
Education Services and Health Services	25,500
Leisure and Hospitality	28,200
Trade, Transportation, and Utilities	28,700
Government	37,000

Source: California Employment Development Department. 2015. 2015 Current Employment Statistics. Accessed October 21, 2015 at <http://www.labormarketinfo.edd.ca.gov/county/sbarb.html>.

The most recent estimated employment figures for San Luis Obispo County are for 2015. The major industries in the County and the numbers of people employed by each type of industry are presented in Table 6.

Table 6. Top Industries in San Luis Obispo County, 2015.

Industry	Total Employed
Goods Producing	14,600
Educational and Health Services	15,400
Accommodation and Food Service	15,900
Leisure and Hospitality	17,600
Government	21,300
Trade, Transportation, and Utilities	21,400

Source: California Employment Development Department. 2015. 2015 Current Employment Statistics. Accessed October 21, 2015 at <http://www.labormarketinfo.edd.ca.gov/county/slo.html>.

3.5.2 Visitor Services

There is no direct vehicle access into the Refuge; access is only permitted on foot. Public access is limited from the north to foot travel through 1 mile of the Oso Flaco Lake Natural Area (part of the ODSVRA), followed by a 1-mile hike along the beach to the northern boundary of the Refuge. Public access from the south is also limited to foot travel, with a 2-mile hike from Rancho Guadalupe Dunes County Park (owned by the County of Santa Barbara) and then along the western edge of the Chevron GRP to the southern boundary of the Refuge.

Most portions of the Refuge are open to the public, with seasonal access restrictions enacted during western snowy plover breeding season, which typically runs from March 1 through September 30 each year. During western snowy plover breeding season, travel through sensitive nesting areas is prohibited.

Based on data extrapolated from plover monitoring surveys and other field activities conducted by Refuge staff, the Refuge averages about 1,500 visitor-use days (primarily self-guided) per year (G. Greenwald, USFWS, personal observation, 2014). The majority of these visitors visit the Refuge beach area. A smaller number of visitors venture to the inland areas of the Refuge, often as members of Refuge sponsored hikes. The most popular Refuge visitor activities include hiking, photography, and wildlife observation. Many visitors also use the Refuge beaches to access state waters for surf fishing.

Fires and alcohol are prohibited on the Refuge (50 CFR 27.81 and 50 CFR 27.95). The Refuge is closed to hunting, dog walking, horseback riding, camping, or vehicular use.

Due the presence of sensitive habitats and listed species, several wetland areas on the Refuge are currently closed to the public, and all of the panhandle section along the northern and northeastern portion of the Refuge is closed to public access.

Surf fishing occurs just outside of the Refuge and is not managed by the Refuge. The Refuge only owns and manages land up to the mean high tide line, and fishing occurs in the surf zone below the mean high tide line. The surf fishing that occurs from the Refuge occurs in ocean waters under the jurisdiction of the State of California. During high tides, anglers may be standing on Refuge property but actually fishing in state waters. As mentioned previously, the majority of fish caught in the surf adjacent to the Refuge consist of just two species: barred surf perch and jacksmelt.

Wildlife Observation and Photography

The Refuge offers excellent opportunities for wildlife observation and photography. Any photography for commercial use requires a special use permit.

Other Uses

Several scientific research, survey, and monitoring projects have occurred or are occurring on the Refuge, as discussed in Chapter 4.

Facilities

Currently, there are no public facilities on the Refuge.

3.5.3 Environmental Justice

EO 12898 (Federal Actions to Address Environmental Justice in Minority and Low-Income Populations; February 11, 1994) was designed to focus the attention of federal agencies on the environmental and human health conditions of minority and low-income populations, with the goal of achieving environmental protection for all communities. The order directed federal agencies to develop environmental justice strategies to help identify and address disproportionately high and adverse human health and environmental effects of their programs, policies, and activities on minority and low-income populations. The order is intended to promote nondiscrimination in federal programs substantially affecting human health and the environment and to provide minority and low-income communities with access to public information and opportunities to participate in matters related to human health and the environment.

3.5.4 Cultural Resources

Cultural resources (archaeological sites, historic structures, and Native American traditional cultural properties) are important parts of the Nation's heritage. The Service strives to preserve evidence of these human occupations, which can provide valuable information about interactions between individuals, as well as between early peoples and the natural environment. Protection of cultural resources is accomplished in conjunction with the Service's mandate to protect fish, wildlife, and plant resources.

Requirements for federal agencies to identify, evaluate, and protect cultural resources are outlined in several federal regulations, including the National Historic Preservation Act (NHPA) of 1966, as amended (Public Law 89-665; 50 STAT 915; 16 U.S.C. 470 et seq. 36 CFR 800). The NHPA sets inventory, nomination, protection, and preservation responsibilities for federally owned cultural properties and directs federal agencies to take into account the effects of their actions on items or sites listed or eligible for listing in the National Register of Historic Places (NRHP). The criteria used to evaluate eligibility for listing in the NRHP per 36 CFR 60.4 include, among others, consideration of the quality of the property's significance in American history, architecture, archaeology, and culture, as well as the property's known or likely ability to yield information important in prehistory or history. A historical property must retain the integrity of its physical identity that existed during the resource's period of significance. Integrity is evaluated with regard to the retention of location, design, setting, materials, workmanship, feeling, and association.

The Service is charged with the responsibility, under Section 106 of the NHPA, to coordinate with the State Historic Preservation Office, Native American tribal governments, local governments, and other interested parties when cultural resources could be affected by Service undertakings. In accordance with these requirements, tribes affiliated with the area are contacted about the CCP process. The following tribes are affiliated with the San Luis Obispo and Santa Barbara Counties, per consultation with the Native American Heritage Commission:

- Barbareno/Ventureno Band of Mission Indians
- Coastal Band of the Chumash Nation
- Northern Chumash Tribal Council
- Salinan-Chumash Nation
- Salinan Nation Cultural Preservation Association
- Salinan Tribe of Monterey, San Luis Obispo Counties
- San Luis Obispo County Chumash Council
- Santa Ynez Tribal Elders Council
- Xolon Salinan Tribe
- yak tityu tityu - Northern Chumash Tribe

Section 14 of the Archaeological Resources Protection Act of 1979 (ARPA) requires plans to survey lands and a schedule for surveying lands with “the most scientifically valuable archaeological resources.” It also affords protection to all archeological and historic sites more than 100 years old (not just sites meeting the criteria for the NRHP) on federal land and requires archeological investigations on federal land be performed in the public interest by qualified persons.

The Regional Historic Preservation Officer (RHPO) advises the Service regional director about procedures, compliance, and implementation of these and other cultural resource laws. The RHPO makes determinations regarding cultural resources for undertakings on Service fee title lands and for undertakings funded in whole or in part under the direct or indirect jurisdiction of the Service, including those carried out by or on behalf of the Service; those carried out with federal financial assistance; and those requiring a federal permit, license, or approval.

The refuge manager is responsible for identifying undertakings that could affect cultural resources and coordinating the subsequent review process as early as possible with the RHPO and state, tribal, and local officials. Also, the refuge manager assists the RHPO by protecting archeological sites and historic properties on Service managed and administered lands by monitoring archaeological investigations by contractors and permittees and by reporting ARPA violations.

The Refuge is located within the area traditionally used by the Obispeño Chumash. The boundary between the Obispeño and the Purismeño (their Chumash neighbors to the south) is not distinct, but the two groups occupied the outer shore of the California coast from what is now known as Morro Bay to the north and Point Conception to the south. The Handbook of North American Indians provides a comprehensive overview of these groups (Greenwood 1978). Several radiocarbon dates from archaeological sites in San Luis Obispo County date occupation back as far as 9,000-9,300 years ago.

The Obispeño occupied the narrow coastal terraces, which often included sand dunes and small valleys as well as the windswept outer shore. “It is a habitat of great variety at an interface of northern and southern plant associations and warm-water and cold-water marine life, yielding an abundance of wild plant foods, land and sea mammals, fish, birds, molluscan resources, all of which were utilized from the earliest periods” (Greenwood 1978).

The Chumash inhabited the dunes, as well as many other areas of the central coast, until about the mid-1880s. Over 100 Chumash archaeological sites have been identified from the town of Grover Beach to Mussel Point. Some areas were used as temporary camps in the dune area. As hunters and gatherers, the Chumash lived on fish, shellfish, acorns, seeds, and roots. Chumash archaeological sites within the Dunes Preserve have been recorded on official site record forms by the California Archaeological Site Inventory (TNC 1999; USFWS 2000b).

First contact between the Chumash of this region and Europeans reportedly occurred during the early years of the Manila-Acapulco Galleon trade era in the late 16th century when a Spanish galleon commanded by Pedro de Unamuno landed at Morro Bay (October 1587). More Spanish expeditions followed, though none stayed long in the area until the late 18th century when the Mission San Luis Obispo de Tolosa was established in the area in 1772. While the Chumash and other native people resisted Spanish control, the period took a heavy toll on their numbers and their culture as they succumbed to European diseases and forced relocation.

The Mission Era was followed by the Rancho Era, when California was annexed to Mexico in 1822 and former mission lands such as those at San Luis Obispo were distributed to Mexican citizens, along with the mission’s cattle herds. The Refuge appears to be located primarily within the boundaries of Rancho Guadalupe, a grant bestowed by the Mexican government (Juan Alvarado, governor) on Teodoro Arellanes and Diego Olivera on March 21, 1840, (Adam v. Norris, U.S. Supreme Court, 103 U.S. 591 in 1880). The Rancho encompassed 43,682 acres running along the coast and inland to what is now the town of Guadalupe. Rancho Guadalupe was bordered on the north by Rancho Bolsa de Chamisal, and the Refuge boundary appears to occur close to the

(apparently) indistinct boundary between the two ranchos. There have been numerous owners throughout Rancho Guadalupe's history, as well as ownership disputes regarding boundaries, foreclosures, and the division and selling of parcels.



Chapter 4. Current Management and Challenges

4.1 Habitat Management

4.1.1 Dunes Collaborative Invasive Plant Removal Program

In 1999, the Dunes Collaborative retained the Land Conservancy as the primary contractor for controlling invasive plant species and monitoring the efficacy of this treatment in the Dunes Complex. Comprehensive invasive plant control and monitoring projects began that same year. In 2000, the Refuge was added as one of the treatment areas. From 2000 through 2008, the Land Conservancy treated the southern portion of the Refuge foredunes to control European beachgrass. Other invasive plant species— mostly notably sea fig, iceplant, narrowleaf iceplant, jubata grass, and purple ragwort—were opportunistically removed as species of secondary importance (Land Conservancy 2008).

The primary goals of this program were to control invasive plants, with a focus on European beachgrass; assess treatment effects to non-target plants; monitor growth trends for invasive plants, native plants, and special status plants; and restore natural sand dune dynamics to areas that had been stabilized by invasive non-native plants. Restoring the natural foredune dynamics through the removal of European beachgrass and other invasive plants promotes the presence of native foredune plant and animal species. In particular, the restoration of foredunes encourages the recovery of sensitive animal species such as the western snowy plover by increasing the availability of breeding habitat, as recommended in the Western Snowy Plover Recovery Plan (USFWS 2007b).

The primary invasive control method employed with this project was the use of backpack sprayers to apply a glyphosate herbicide mixture to European beachgrass and to selected patches of sea fig, freeway iceplant, and purple ragwort. In areas where European beachgrass formed unnaturally tall and persistent stands, mechanical (string trimmer, McCleod, or handsaw) and/or hand removal of dead and dying biomass was deployed as needed to remove excessive vegetative matter and help restore natural foredune dynamics. Since the foredune environment is naturally dynamic with a steady supply of windblown dunes sand and a native plant seed bank, no active revegetation was implemented to restore dune dynamics or native vegetation.

Nearly all of the European beachgrass was removed from the southern Refuge foredunes by 2007. From east to west, the treatment area included the upper beach to distances ranging from about 300 to 800 yards inland. The treatment area for this project ranged from the Refuge southern boundary to more than 1 mile north, to the southern slopes of Oso Flaco Peak. Cumulatively, because of the work conducted by the Land Conservancy from 2000 to 2008, European beachgrass was controlled in about 320 acres of coastal foredunes (Land Conservancy 2008). Not all beachgrass was controlled, and it has not been controlled since 2008 due to limitations of funding and staffing. However, scattered patches of European beachgrass regrowth occurred in at least 30 acres since 2007 (M. Skinner, Coastal San Luis Resource Conservation District, personal communication, 2014), and re-application of herbicide spot treatments to these previously treated areas is needed.

As part of this invasive plant removal program, the Land Conservancy also conducted vegetation monitoring studies at several sites in the Dunes Complex from 2001 to 2008. There were two main objectives for this monitoring: to determine effects of herbicide applications on invasive plants species and to locate special status plants. This vegetation monitoring project was designed with five sampling transects in the Dunes Complex. Three transects were located on the Refuge, and two were located off-Refuge. Monitoring of vegetation along these 100-meter-long transects was conducted annually. Information collected included species presence, percentage cover by each plant taxa, and total vegetation percent cover (Land Conservancy 2008).

This project was successful in temporarily removing European beachgrass from the southern Refuge foredunes. Results indicated that European beachgrass needed to be treated with the glyphosate herbicide mix for at least three to four growing seasons so that the regrowth could be terminated. However, some locations

needed retreatment with the glyphosate mixture for up to six seasons (M. Skinner, Coastal San Luis Resource Conservation District, personal communication, 2008).

As of 2014, estimates provided by GIS vegetation mapping indicate that about 58 percent (130 acres) of coastal foredunes and back dunes of the 2,553-acre Refuge were still infested with European beachgrass (Appendix G).

4.1.2 Northern Foredunes European Beach Grass Control Project

In 2013, the Land Conservancy started groundwork for a European beachgrass control project in the northern foredunes of the Refuge scheduled to continue until at least 2016.

This project focuses on treating 5 acres of foredunes located in the extreme northwest corner of the Refuge. The primary goals of this project are to test the efficacy of the monocot specific herbicide Fusilade DX® (fluazifop p-butyl) to control European beachgrass, assess the treatment effects caused to non-target plants by the Fusilade DX® herbicide mix, and restore natural sand dune dynamics to areas that have been stabilized by European beachgrass.

As of November 2014, Fusilade DX was unsuccessful at controlling European beachgrass on the Refuge as applied at the maximum allowable concentrations. Therefore, during 2015, a switch was made to a glyphosate and imazapyr mixture (Jon Hall, Land Conservancy of San Luis Obispo County, personal communication, 2014). This mixture has proven very successful for controlling European beachgrass on the neighboring ODSVRA (Ronnie Glick, California State Parks, personal communication, 2014).

Other invasive plant species—most notably sea fig and freeway iceplant—will be opportunistically removed as species of secondary importance. In areas where European beachgrass stands have formed tall and persistent stands, mechanical removal (string trimmer, McCleod, or handsaw) of dead and dying biomass are deployed as needed to help restore natural foredune dynamics. The foredune environment is naturally dynamic with a steady supply of windblown dunes sand and a native plant seed bank, so it does not need active revegetation after the European beachgrass is removed.

4.1.3 Jubata Grass Control

Several efforts to remove jubata grass (*Cortaderia jubata*) have been conducted on the Refuge intermittently from 2004 to the present, done as part of several separate projects performed by the Land Conservancy, consultants, and Refuge staff.

Prior to the removal of jubata grass, the reproductive parts of a plant are removed and placed in a plastic bag for disposal to reduce the spread of the windblown seeds. The small, newly recruited jubata grass plants are hand pulled. Larger clumps are removed using a combination of mechanical methods, such as excavation with a shovel, cutting with a tree saw, or use of a string trimmer.

From 2004 to 2012, the Land Conservancy opportunistically removed approximately 600 seedlings and 300 adult plants from the Refuge (M. Skinner, Coastal San Luis Resource Conservation District, personal communication, 2014). By August 2012, the control efforts had removed most of the jubata grass known on the Refuge. From August 2014 to the present, about 30 additional jubata grass seedlings were opportunistically removed by the Refuge staff.

4.1.4 Invasive Plant Mapping and Removal

In the past, volunteers and partners helped with invasive plant mapping, mechanical removal, and herbicide application. The Volunteer Invasive Plant Mapping and Removal Pilot Project Task 1 and 2 were conducted on the Refuge by volunteers and the Land Conservancy from November 2006 through February 2007. In Task 1, volunteer crews inventoried invasive plant species, hand pulled invasive plant species, and mapped locations of invasive plants and special status plants (Land Conservancy 2007). Three volunteers and one paid crew leader were involved in this four-month project. As early as 2009, anecdotal observations suggested that an

increase in western snowy plover nesting occurred in the immediate area where removal occurred. As of 2014, most of these treated areas have remained free of sea fig and freeway iceplant regrowth.

Task 2 consisted of chemical and mechanical removal of invasive species. Trained Land Conservancy crew treated European beachgrass with a glyphosate-based herbicide. During the winter of 2006-2007, the crew spot-treated 19 acres of an 87-acre back dunes area using backpack sprayers (Land Conservancy 2007). The treatment area was located along the eastern boundary of Hidden Willow Valley.

Post-treatment, a noticeable “burn” was noticed on the treated European beachgrass, which suggested die off (G. Greenwald, USFWS, personal communication, 2014). However, glyphosate herbicide was applied at this location for only one growing season, and it is typically necessary to apply this herbicide for a minimum of three to four growing seasons to be effective. Due to funding limitations, this project was discontinued after one growing season.

4.1.5 Pond Restoration Project

Large amounts of floating and emergent vegetation (and willows) have choked out several ponds on the Refuge. The primary plant species floating on the pond surfaces were marsh pennywort and duckweed. The primary emergent plant species were broad-leaved cattail and broad fruit bur-reed. In an effort to restore California red-legged frog habitat, a project was conducted to manually remove a large portion of the surface and emergent vegetation from several ponds on the Refuge, starting with Snakebite Pond and Icebox Pond (USFWS 2009a; USFWS 2009b). The project was scheduled to occur after all California red-legged frog tadpoles had likely metamorphosed but before new California red-legged frog egg masses were deposited. On the Refuge, depending on weather conditions, this period typically occurs from late October to mid-December.

Larger pieces of vegetation were hand pulled, while smaller pieces of floating vegetation were removed with dip nets. The undesirable vegetation was moved about 200 yards from the wetland and deposited on uplands for composting. To ensure that some protective cover remained for California red-legged frogs and other wildlife species, at least 10 percent of the floating vegetation was left on the pond surface, and at least 80 percent of the emergent vegetation was left along the shoreline.

Feral swine appeared on the Refuge in 2009 and began to eat the roots of cattails and bur-reed, reducing the need to conduct vegetation removal on the two other ponds. California red-legged frogs and Sierran tree frog tadpoles were observed at these two ponds during the following breeding season (USFWS, unpublished field notes, abnormal amphibian study, 2007-2010; USFWS 2011b). However, by 2013, the vegetation at Snakebite Pond and Icebox Pond had grown back to a density that requires retreatment.

4.1.6 Wildlife Ponds Project

During February 2013, two new ponds were constructed on the Refuge. Myrtle Pond, named after the presence of wax myrtle (*Morella californica*) in the vicinity, is about 300 yards inland from the ocean. Colorada Pond, named for the presence of its reddish-colored water (colorado/colorada means red-colored in Spanish), is about 2.5 miles inland from the ocean. The ponds were constructed primarily to create high-quality, long-term habitat for the federally threatened California red-legged frog. The secondary purpose was to provide high-quality habitat for three federally endangered plant species: marsh sandwort, Gambel’s watercress, and La Graciosa thistle (USFWS 2012a).

At both ponds, mule deer and coyote tracks appeared at the water’s edge on the first morning after their creation. Within a few days, dozens of Sierran tree frogs occupied both ponds (USFWS 2013b; USFWS 2014b). About three weeks after Myrtle Pond was created, three pairs of California toad were observed breeding; within six weeks, several thousand California toad tadpoles were present. Ten weeks after Myrtle Pond was created, California toadlet congregations were observed near the pond’s shoreline in large numbers (USFWS 2013b; USFWS 2014b). Ten weeks after Colorada Pond was created, thousands of Sierran tree frog tadpoles and froglets were observed (USFWS 2013b; USFWS 2014b). During September 2014, more than 250 juvenile California red-legged frogs and were observed by Service biologists at multiple locations of the

Colorada Pond shoreline (M. Elvin, USFWS, personal communication, 2014). During December 2014, one juvenile California red-legged frog and two California red-legged frog egg masses were observed at Colorada Pond (USFWS, unpublished field notes, Colorada Pond, December 18, 2014).

Native vegetation was allowed to naturally recruit at these two new pond sites. By May 2014, about 10 percent of the open water portion of Myrtle Pond had naturally recruited fennel-leaf pondweed (*Stuckenia pectinata*), and about 20 percent of its shoreline was vegetated by arroyo willow, common three-square bulrush (*Schoenoplectus pungens* var. *longispicatus*), marsh pennywort (*Hydrocotyle ranunculoides*), San Francisco rush, and low bulrush (*Isolepis cernua*) (USFWS, unpublished field notes, Myrtle Pond, May 2, 2014). By May 2014, about 20 percent the open water portion of Colorada Pond had naturally recruited fennel-leaf pondweed and/or mosquito fern, and about 70 percent of its shoreline was vegetated by arroyo willow, San Francisco rush, orchard grass (*Dactylis glomerata*), rabbitfoot grass (*Polypogon monspeliensis*), soft rush, willow-herb, and southern bulrush (USFWS, unpublished field notes, Colorada Pond, May 2, 2014). During December 2014, a Service biologist saw a juvenile adult California red-legged frog along the Myrtle Pond shoreline (USFWS, unpublished field notes, Myrtle Pond, December 18, 2014).

4.1.7 Aerial Herbicide Application Research Study

The primary environmental threat to the Refuge and neighboring lands is non-native invasive plants. The ecological functioning and survival of several rare and declining native Refuge wildlife habitats are threatened numerous invasive pest plant species, including perennial veldt grass, European beachgrass, sea fig, narrowleaf iceplant, bull thistle (*Cirsium vulgare*), jubata grass, and purple ragwort. Perennial veldt grass has been the most difficult species to control on the Refuge and neighboring lands.

In 2014, vegetation mapping of the Refuge indicated that approximately 940 acres (about 37 percent) of the 2,553-acre area of the Refuge is infested with perennial veldt grass (Appendix G). If left uncontrolled, this highly invasive species will likely continue to spread into natural sand dune and central coast dune scrub habitats on the Refuge, where it likely will outcompete native plant species.

The Refuge has worked with Chevron Environmental Management Company and other Dunes Collaborative partners since 2011 to design and plan a research study to evaluate the efficacy of aerial herbicide application to control invasive perennial veldt grass. In this research study, a helicopter equipped with a spray boom applied a monocot-specific herbicide on up to 20 acres of Refuge land. Also, herbicide drift beyond the spray zone was assessed to establish appropriate buffers for future treatments that may be in proximity to sensitive ecological areas. The proposed herbicide, Arrow 2EC[®], is a clethodim-based graminicide (herbicide that only controls grasses). If permits cannot be obtained to use Arrow 2EC[®], an alternative herbicide (Poast[®], a sethoxydim-based product that is also a graminicide) would be used. California Polytechnic State University, San Luis Obispo; ODSVRA; and other Service offices will provide additional technical support. Groundwork was initiated in 2015 and results are being analyzed.

4.1.8 Marsh Sandwort and Gambel's Watercress Recovery Project

As mentioned in the Special Status Plant Taxa section, a recovery project for marsh sandwort and Gambel's watercress began in 2006 and continued through 2013. It is an ongoing joint effort with California Polytechnic State University, San Luis Obispo; University of California, Santa Cruz; Ventura Fish and Wildlife Office; CNPS; and the Refuge Complex.

Approximately 200 marsh sandwort propagules were outplanted at six ponds and marshes on the Refuge in October 2008 (USFWS 2008b; USFWS 2008c). While most survived the move, grazing mammals consumed nearly all of the plants within two years (G. Greenwald, USFWS, personal communication, 2009). In August 2013, as part of the Wildlife Ponds Project (USFWS 2012a) approximately 90 marsh sandwort propagules were outplanted at the new Colorada Pond and 90 at the new Myrtle Pond. Exclusion fencing minimized the plants from threat of herbivory by mammals, and at least 50 percent survived through at least October 2013. Their current status is unknown.

Approximately 150 Gambel's watercress propagules were outplanted at six ponds and marshes on the Refuge in October 2008 (USFWS 2008b; USFWS 2008c). While the survival rate was high, grazing mammals ate nearly all of the plants within two years (USFWS, unpublished field notes). In August 2013, as part of the Wildlife Ponds Project (USFWS 2012a), approximately 75 Gambel's watercress propagules were outplanted at the new Colorado Pond and 75 at the new Myrtle Pond. Exclusion fencing minimized the plants from threat of herbivory by mammals, and at least 50 percent survived through at least October 2013. Their current status is unknown.

4.1.9 La Graciosa Thistle Surveys and Recovery Projects

Biologists from the Refuge Complex and the Ventura Fish and Wildlife Office conducted surveys intermittently from 2007 to the present to monitor known populations of La Graciosa thistle and to attempt to locate previously undiscovered populations on the Refuge and adjacent California State Parks lands.

The focus of these surveys has been to determine population trends, identify threats, and manage La Graciosa thistle occurrences proactively on the Refuge. Currently, it is presumed extant in four populations that range from San Luis Obispo County to the Santa Barbara County: southern Callender Dune Lakes, Oso Flaco, southern Guadalupe Dunes, and Santa Maria River (Elvin 2006; Elvin 2007a; CNDDDB 2010; USFWS 2011c). One occurrence has been found on the Refuge and one occurrence on adjacent California State Parks lands. The size of the Refuge occurrence ranged from 150 to 300 plants. While only a partial survey was conducted in 2014, only about 10 individuals were observed, none of which were flowering (M. Elvin, USFWS, personal observation, 2014). Larger numbers of plants typically are found in years when a larger number of juvenile plants (which sprout from wind dispersed seeds) have germinated and are present. A larger number of recruited plants appear to occur following wetter winters than drier winters. Anecdotal information suggests that one of the effects of drought may be a suppression of La Graciosa thistle seedling recruitment.

In addition to the field surveys mentioned, three recovery actions have been implemented for the La Graciosa thistle:

- From 2007 to 2010, more than 7 miles of wire fencing was installed along the Refuge southern and eastern boundaries to protect La Graciosa thistle and Refuge wetlands from trespassing cattle. This fencing successfully excluded cattle from the Refuge.
- During 2007, an enclosure fence was placed around the perimeter of sensitive habitat that had a majority of the La Graciosa thistle on the Refuge. The fence serves as a backup to protect La Graciosa thistle from cattle that could breach the Refuge boundary fence, as well as from visitors who might unknowingly trample these plants.

During December 2014, Service biologists planted La Graciosa thistle seeds obtained from the Refuge at several locations near Myrtle Pond and Colorado Pond.

4.2 Wildlife Management

4.2.1 Sick or Injured Animals

When possible, sick or injured terrestrial mammals and birds are captured and transported to Pacific Wildlife Care in Morro Bay for treatment. For sick or injured marine mammals, the local office of the Marine Mammal Center is notified. If available, a rescue crew from the Marine Mammal Center will capture and transport marine mammals from the Refuge to their facility in Morro Bay for treatment. During the western snowy plover breeding season, biologists from the Refuge or California State Parks escort the Marine Mammal Center rescue crew into and out of the Refuge.

4.2.2 Predator Management

Wetland Exclosure Fences

Feral swine were first observed at the Refuge during 2009 (Applegate and Schultz 2009), and this was the first year that feral swine rooting and wallowing was detected in Refuge wetlands and along the edges of ponds.

Starting in 2009, enclosure fences were constructed around portions of six ponds and other wetlands on the Refuge to protect special status plant species (primarily marsh sandwort, Gambel's watercress, and La Graciosa thistle) and animal species (primarily California red-legged frog) from the adverse effects of feral swine. These fences were constructed with 6-foot steel T-posts and 39-inch-tall wire mesh game fencing. Additional fencing in 2013 encompassed newly created Myrtle Pond and Colorado Pond. Installation impeded access by swine, but they have dug and accessed the water and eat the listed plants; rabbits have eaten the plants, too. Other measures and fence improvements may need to be considered.

4.2.3 Surveying and Monitoring

Western Snowy Plover and California Least Tern Monitoring

Annual breeding season monitoring for western snowy plover and California least tern have been conducted on the Refuge since 2001, and an annual report has been drafted for each season. The primary goals of this monitoring are to acquire data on population, nesting success, and hatching success to inform Refuge management decisions involving snowy plover, least tern, and sensitive coastal habitats; and to assist with the recovery of these two federally listed bird species.

During the western snowy plover breeding season (March 1-September 30), monitoring is conducted a minimum of two days per week, with a primary focus on the beach and foredune areas located within a quarter-mile of the beach. Periodic checks (mostly done on foot) occur on the inland dune ridges, sand blowouts, sand sheets, and other non-vegetated or sparsely vegetated habitats. Observers record data such as nest locations, number of eggs, snowy plover presence, predator presence, brood locations, color band data, subsequent nest check data, nest fates, depredation events, low flying aircraft (visually estimated flying less than 2,000 feet above ground level), and human visitor activities. Daily field notes also contain notable observations of other wildlife species encountered or detected.

Cage enclosures (often called mini-enclosures) were first used to protect western snowy plover nests from predators on the Refuge in 2003. They have also protected western snowy plover nests on the Refuge from 2009 to the present. Since 2009, the two types of cage enclosures used on the Refuge are a 3-foot-diameter bottomless cube and a 4-foot-diameter bottomless cylinder. Both are 3 feet tall and constructed of 2-inch by 4-inch mesh, 12.5-gauge non-climb wire fencing connected with 70-pound strength ultraviolet, light-resistant plastic cable ties. All cage enclosures have wire mesh tops, using the same non-climb wire fencing as the sides. After centering a cage enclosure over a snowy plover nest, the edge of each enclosure is buried about 4 inches (one mesh unit height) into the sand. Metal reinforcing rods (also called rebar) are hammered into the sand to secure the enclosures in place.

Starting in 2010, cage enclosures have been deployed early in the western snowy plover breeding season before nests are established to serve as decoys. These decoy enclosures are scattered along the entire Refuge upper beach and foredunes in typical snowy plover breeding habitat. They accustom local predators to the presence of cage enclosures so they do not associate them with the presence of prey.

On the Refuge, cage enclosures successfully protected western snowy plover nests from such predators as coyote, gray fox, red fox, and feral swine (Applegate and Schultz 2009; USFWS 2011d; USFWS 2012b; USFWS 2013a; USFWS 2014a). Also, these cage enclosures help protect western snowy plover nests from accidental trampling by humans, especially those who trespass into posted plover breeding habitat.

Inversely, at other locations, enclosures have attracted peregrine falcon, red-tailed hawk, northern harrier, common raven, kestrel, merlin, American crow, and other birds that endanger adult snowy plover (Persons and Hutchinson 2003; Hardy and Colwell 2008; Applegate and Schultz 2009). The main potential adverse effects of nest enclosures on western snowy plover include increased adult mortality and increased nest abandonment that may result if the enclosures attract predators (Persons and Hutchinson 2003; Hardy and Colwell 2008). Even so, the cage enclosures are a valuable tool to increase the number of successful western snowy plover nests on the Refuge (Table 7).

During 2003, Refuge nest enclosures consisted of light 18-gauge wire, designed as 24-inch-wide by 20-inch-tall bottomless cube-shaped structures (Persons and Hutchinson 2003). In 2003, one adult western snowy plover was found dead inside a nest enclosure, likely killed by a predator (Persons and Hutchinson 2003). Due to this single mortality, the Refuge did not use consisted of light 18-gauge wire, designed as 24-inch-wide by 20-inch-tall bottomless cube-shaped structures (Persons and Hutchinson 2003). In 2003, one adult western snowy plover was found dead inside a nest enclosure, likely killed by a predator (Persons and Hutchinson 2003). Due to this single mortality, the Refuge did not use nest enclosures from 2003 until 2009.

To increase nest protection and help reduce the potential for adult mortality, in 2009, the Refuge made the nest enclosure larger and used heavier 12.5 gauge wire. These enclosures were 48-inch-diameter by 36-inch-tall bottomless cubes, 36-inch-diameter by 36-inch-tall bottomless cubes, or 48-inch-diameter by 36-inch-tall bottomless cylinders (Applegate and Schultz 2009). Through 2014, these larger, redesigned nest enclosures (primarily the 48-inch-diameter by 36-inch-tall bottomless cylinders) have been cautiously deployed on some nests each season on the Refuge, with no adult mortalities associated with nest enclosure detected since 2009 (Applegate and Schultz 2009; USFWS 2011d; USFWS 2012b; USFWS 2013a; USFWS 2014a).

A successful nest has at least one egg in a clutch hatch. These redesigned, larger nest enclosures substantially improved nest success on the Refuge. From 2009 to 2014, nest success for enclosed nests ranged from 40 to 89 percent. During this same period, nest success for unenclosed nests was substantially lower, ranging from 0 to 46 percent (Table 7). Other than installing the nest enclosures, no other predator management strategies have been employed on the Refuge for protection of western snowy plover.

Table 7. Comparison of Hatch Success for Enclosed Nests Versus Unenclosed Nest on Guadalupe-Nipomo Dunes National Wildlife Refuge, 2009-2014.

Year	Nests With Enclosures			Nests Without Enclosures		
	Number Enclosed	Number with Hatches	Percentage with Hatches	Number Not Enclosed	Number with Hatches	Percentage with Hatches
2009	8	6	75	42	4	10
2010	19	17	89	7	0	0
2011	23	11	48	17	2	12
2012	15	6	40	6	2	33
2013	12	9	75	14	4	29
2014	19	15	79	13	6	46

Source: 2009-2014 Final Monitoring Reports for the Guadalupe-Nipomo Dunes National Wildlife Refuge Western Snowy Plover Breeding Seasons (Applegate and Schultz 2009; USFWS 2012c; USFWS 2013a; USFWS 2014a).

Breeding for California least tern typically occurs from mid-April through early August, and monitoring for this federally endangered species occurs concurrently with western snowy plover monitoring. To date, breeding activities of California least tern have not been observed on the Refuge.

Abnormal Amphibian Monitoring

Abnormal amphibian monitoring was conducted from 2007 to 2010 at four Refuge ponds using a standardized Service protocol (USFWS 2007a). This protocol involves collecting tadpoles with a dip net and metamorphs with a dip net or by wetted hand. The Sierran chorus frog and California red-legged frog were the species of focus for detection of any abnormalities. The Service’s Contaminants Division and the Refuge Complex jointly conducted this project; California State Parks provided periodic field biologist support.

After collecting and examining 1,093 late-stage California red-legged and Sierran tree frog tadpoles and metamorphs over this four-year period, only 16 individuals exhibited abnormalities (1.5 percent abnormality rate). With six California red-legged frogs and 10 Sierran tree frogs (USFWS, unpublished field data, abnormal amphibian study, 2007–2010), the 1.5 percent abnormality rate detected on the Refuge was slightly lower than the 2.0 percent abnormality rate for all combined amphibian species in a nationwide study of 135 NWRs. However, it was substantially lower than the abnormality rate of greater than 5.0 percent detected for 15 NWRs in California (Reeves et al. 2013).

Botanical Inventory

Service biologists from the Refuge Complex and Ventura Fish and Wildlife Office have continually identified plant taxa on the Refuge as part of an ongoing inventory conducted since 2001. Most of the plants were found while conducting other Refuge activities. The majority of this work occurred from 2007 to the present. The focus of the botanical inventory is on identifying special status taxa, invasive taxa, and previously unreported taxa. These efforts resulted in a Refuge plant taxa list (Appendix E).

Invertebrate Inventory

Similarly, since 2001, Service biologists from the Refuge Complex and Ventura Fish and Wildlife Office have also identified invertebrate animal taxa on the Refuge, mostly invertebrates found incidentally while conducting other Refuge activities.

Surveys for invertebrates have also been periodically performed on the Refuge with assistance provided by biologists from the California Academy of Sciences and VAFB—a combined field effort that yielded a Refuge invertebrate taxa list (Appendix F). This inventory’s focus is on identifying special status taxa and previously unreported taxa.

Amphibian and Reptile Inventory

Service staff conducted surveys for amphibians and reptiles on the Refuge intermittently since 2006. Professors from San Diego State University; University of California, Santa Barbara; and California Polytechnic State University, San Luis Obispo provided periodic assistance. The focus of these surveys was primarily to provide an inventory of amphibian and reptile taxa present on the Refuge and to determine habitat preferences for these taxa. The primary sampling methods used were visual encounter surveys (VESs).

The use of such surveys (Foster 2012) on the Refuge used existing trails and the perimeters of ponds and other wetlands as transects. Amphibians and reptiles are detected by sight as these transects are walked. Many of the VES observations for amphibians and reptiles occurred incidentally while performing or hiking to other Refuge activities. Additional data for the amphibian and reptile inventory was provided during the field surveys performed for the abnormal amphibian monitoring previously mentioned. These combined VES and abnormal amphibian monitoring field efforts resulted in taxa lists for Refuge amphibians and reptiles (Appendix F).

Bird Inventory

An informal inventory of birds has occurred on the Refuge since 2006. Refuge staff, while performing other activities, incidentally gathered most of the bird observations. Bird observation data has also been gathered during public hikes, which are typically focused on general natural history observations. Planned bird surveys occurred on several occasions. These surveys consisted of VESs that used existing trails and the perimeters of riparian woodlands as transects and point counts conducted at wetlands and riparian forests. Bird taxa occurrence information is also obtained during the annual breeding season surveys for western snowy plover, which are conducted each year from March through September. During breeding season surveys, observers list all bird and other animal taxa sighted in daily field notes; the list is summarized as an appendix in a western snowy plover breeding season annual report. A Refuge bird taxa list (Appendix F) also comes from these combined efforts.

Mammal Inventory

Refuge staff has collected data on mammal presence since the Refuge was established. Most are incidental mammal observations by staff while they performing other activities. Mammal presence data is also gathered during public hikes. Mammal species detection is primarily by direct observation. However, the detection of mammals by sign (such as tracks, scat, digging marks, and burrows) also occurs.

Information on small mammals was also gathered during a Lompoc kangaroo rat study intermittently conducted on the Refuge from 2004 to 2013 by California Polytechnic State University, San Luis Obispo. In addition to successfully trapping and releasing Lompoc kangaroo rats, other small mammals were also observed. This kangaroo rat study is discussed in more detail in the next section.

While conducting western snowy plover breeding surveys each year, mammal species observations are included in the field notes. Most of these mammals are detected by sign such as tracks and scat. These combined field efforts resulted in a Refuge mammal taxa list (Appendix F).

4.3 Other Research and Monitoring Projects

Lompoc Kangaroo Rat Monitoring

The Department of Biological Sciences at California Polytechnic State University, San Luis Obispo, conducted a monitoring study for Lompoc kangaroo rat and other small mammals intermittently on the Refuge from 2004 to 2013. This undergraduate student-centered research project focused on the effects of perennial veldt grass cover on Lompoc kangaroo rat population densities. In general, kangaroo rats are considered keystone species; they are important seed dispersers, important builders of burrow habitats, and serve as an important food source for nocturnal predators (Villablanca 2011; Villablanca 2012).

Live-trapping using Sherman traps occurred over a three-night session, typically quarterly each year during March, June, September, and December. This trapping was conducted along a 1,300-meter-long transect, with 66 stations placed at 20-meter intervals, and two to three traps placed per station. Vegetation data was collected in December of each year, using two sampling plots superimposed on each of the trapping stations. In the 2-meter by 2-meter vegetation sampling plots, deer mouse, Lompoc kangaroo rat, and California vole were the most abundant species trapped.

In addition to gathering useful natural resource management data, this project also provided training in proper small mammal trapping procedures to dozens of students, volunteers, and natural resource agency biologists. In particular, the Lompoc kangaroo rat study on the Refuge trained biologists to conduct surveys in the Morro Bay area for the federally endangered Morro Bay kangaroo rat (*Dipodomys heermanni morroensis*).

Moth/Butterfly Surveys

Surveys for lepidopterans (butterflies and moths) were conducted on the Refuge in 2008 and 2009 as a joint effort between the Department of Entomology of the California Academy of Sciences and the Refuge Complex (Grinter 2009). This study focused on collecting rare butterfly and moth species using standard black light bucket traps. Incidental netting of butterflies occurred during daylight hours.

Trapping was conducted at two locations over four nights: one night each in May 2008, June 2008, April 2009, and June 2009. A standard 15-watt black light bucket trap placed at each sampling site prior to dusk was lit for approximately 11 hours using a motorcycle battery for power. Flying insects attracted to the trap dropped into the attached bucket. The next morning, specimens in the trap were transported to a laboratory for identification. The majority (about 80 percent) of all insects attracted to the trap were lepidopterans—188 individual butterflies and moths, represented by 50 taxa. In addition to target species, some beetles were captured; they were deposited in the Santa Barbara Museum of Natural History for an ongoing California beetle survey (Grinter 2009).

Nipomo Lupine Viability Study

A field study began on the Refuge in 2013 to assess several potential outplanting and seeding sites for establishing new populations of the federally endangered Nipomo lupine (*Lupinus nipomensis*). This study is expected to be conducted for two to three years. The Nipomo lupine is extant at one location in San Luis Obispo County (USFWS 2009f). The primary goal of this study is to determine if soil conditions and other environmental factors on the Refuge are suitable for outplanting Nipomo lupine seeds. Studied parameters include total percent plant cover, percent annual plant cover, percent perennial plant cover, average cover height (inches), topography description (convex, concave, flat, or undulating), slope exposure (aspect: north, northeast, east, southeast, south, southwest, west, or northwest), slope steepness (degrees), and general rating. Field surveyors give an objective rating of 1 to 10 based on their overall impression of the quality of the plot for Nipomo lupine, with 1 being the best and 10 being the worst (Stratton 2014).

The Cheadle Center for Biodiversity and Ecological Restoration at the University of California, Santa Barbara, is conducting the study with assistance from the Ventura Fish and Wildlife Office biologists and the Refuge. The Service funded the project through a \$44,800 cooperative agreement with the Cheadle Center, administered by the Ventura Fish and Wildlife Office.

In addition to the Refuge, several other locations in the Dunes Complex have been investigated as possible outplanting sites for Nipomo lupine. Out of all studied sites, the Refuge ranked highest due to its large physical size, variation in habitat characteristics, accessibility, and status as a Refuge dedicated to protecting listed species. Preliminary data indicate that soil conditions and other environmental factors may be favorable for outplanting Nipomo lupine seeds on the Refuge (Stratton 2014). However, study results have not yet been finalized. There are no current plans to introduce a new federally listed species to the Refuge due to staffing shortages and funding.

Hairy Lotus (*Acmispon strigosus*) Nitrogen Fixing Mutualism Study

A 2013 study initiated on the Refuge by the University of California, Riverside—in collaboration with the U.S. Forest Service, Pacific Southwest Research Station in Riverside—is part of five-year National Science Foundation grant for examining anthropogenic nitrogen deposition and the nitrogen fixing mutualism between legumes and rhizobia. The San Luis Obispo County coast line represents a potential key site for the study, since the targeted host plant, hairy lotus, occurs in this area and also because this area has historically experienced a relatively low impact from atmospheric nitrogen deposition. The Refuge represents a relatively pristine site for comparison with highly impacted sites (Sachs 2012).

This study involves collecting: data to quantify the nitrogen ion content in the atmosphere, specimens of strigose lotus, soil bacteria samples adjacent to strigose lotus plants, and soil core samples from plant collection sites for analysis of nitrogen content.

Strigose lotus specimens are harvested and transported to a laboratory at the University of California in Riverside, where bacteria are isolated and stored in a long-term -80 °C freezer. Soil cores are collected at each sampling site for nitrogen analysis. Soil and host plant specimens are analyzed for nitrogen content.

A sampling unit, mounted temporarily to a post on the Refuge (Sachs 2012) passively monitors nitrogen ion content in the atmosphere. This study was conducted at several locations along the central California coast from 2013 through 2014. To date, the Refuge holds the largest concentrations of strigose lotus found at any of the study locations. Several populations on the Refuge contain several hundred individual plants each. At other sites within the study, less than a dozen individual strigose lotus plants have been found.

Food Safety Wildlife Study

The CDFW collected samples at several locations in central California as part of the ongoing Food Safety Wildlife Study to determine if wild animals are carrying the *E. coli* O157:H7 and *Salmonella* bacteria. The data from this study will provide information about the extent to which local wildlife do or do not carry these bacteria. Further, this information will help provide a scientific baseline as government agencies, universities,

and private landowners work cooperatively to balance food safety concerns with wildlife management (Gordus 2011).

To start this study, three coastal counties in central California were divided into watersheds using Department of Water Resources watershed maps. The reason for a watershed based landscape is because *E. coli* O157:H7 is believed to wash down watersheds, most animals will have lived most of their lives within a particular watershed, and landownership does not need to be identified (Gordus 2011).

CDFW staff routinely collects colon or cloacal swabs from birds, small mammals, feral swine, and deer; they periodically collect such samples from elk, geese, and ducks. Small birds are captured using mist nets, and small mammals are captured using live-box traps and released unharmed after the collection of fecal specimens or cloacal swabs.

The northern portion of the Refuge was sampled for small mammals during 2010 as part of the Food Safety Wildlife Study. To collect these small mammals, CDFW biologists assisted a biology professor and student from California Polytechnic State University, San Luis Obispo, with three nights of live-trapping in Sherman traps on the Refuge during June 2010. The number of animals captured (93) were represented by two taxa, Lompoc kangaroo rat and deer mouse. After specimen collection was completed, all rodents were released unharmed (Gordus 2011).

Another part of this study required collecting passerine birds by mist net on the Refuge during June 2011, in the same general area where small mammal trapping was conducted. A total of 26 birds were collected over a two-day period and included white-crowned sparrow (*Zonotrichia leucophrys*), Bullock's oriole, chipping sparrow (*Spizella passerina*), and Wilson's warbler. The collected birds were removed from the mist net, and cloacal swabs were collected for laboratory analysis for *E. coli* O157:H7 and *Salmonella*. Afterward, the birds were released unharmed (Gordus 2011).

These fecal samples were sent to the analytical laboratory at the Western Institute for Food Safety and Security at the University of California, Davis, for bacteriological analysis. All animals tested negative for both *E. coli* O157:H7 and *Salmonella* (Gordus 2011).

4.4 Fire Prevention and Hazard Reduction

Due to the low potential for fires on the Refuge, the low probability that fires would affect human life, the lack of structures potentially burned by fires, and the historical lack of fire in the entire Dunes Complex, the Refuge has not developed a fire prevention plan. However, the Refuge participates in a regional fire management plan that would be enacted in the unlikely event of a fire occurring on the Refuge.

The Refuge participates in the California Master Cooperative Wildland Fire Management and Stafford Act Response Agreement, Annual Operating Plan, Central Coast Group (Annual Operating Plan) (CAL FIRE 2014), which is a cooperative agreement between:

- California Department of Forestry and Fire Protection (CAL FIRE), Southern Operations;
- U.S. Department of the Interior Bureau of Land Management, Bakersfield and Hollister Field Offices;
- U.S. Department of the Interior National Park Service, Pinnacles National Monument;
- U.S. Department of Agriculture Forest Service, Los Padres National Forest; and
- Service.

Additionally, Ventura County Fire Department and Santa Barbara County Fire Department are full partners in the Annual Operating Plan as official representatives of CAL FIRE.

The Annual Operating Plan classifies certain locations as Special Management Areas, where restrictions on normal fire suppression methods apply. These include such areas as Federal Wilderness Areas, Wilderness Study Areas, Federal Wild and Scenic Rivers, Areas of Critical Environmental Concern, designated critical

habitat for threatened and endangered species, sensitive cultural sites, designated state botanical areas, NWRs, national monuments, and areas with naturally occurring asbestos. Based on its status as a NWR, the presence of designated critical habitat, the presence of state and federally listed species, and the presence of cultural resources, the Refuge is classified as a Special Management Area in the Annual Operating Plan. In Special Management Areas, the use of dozers for fire line construction is typically the most damaging fire suppression activity. Therefore, the use of dozers is avoided in these areas unless human life and property is directly affected. The Annual Operating Plan also restricts other fire suppression activities, as indicated by the individual land managers.

Each year, participating land managers have an opportunity to update their individual fire management prescription for inclusion in the Annual Operating Plan. Each fire management prescription describes the priorities of the land manager and may include special instructions regarding the protection of sensitive natural resources. The focus of the Refuge fire prescription is protection of human life and sensitive natural resources.

4.5 Law Enforcement and Resource Protection

4.5.1 Safety

The Refuge is generally a safe place to visit and enjoy the outdoors, though visitors may encounter threats commonly found in the outdoors: rattlesnakes, poison oak, spiny plants, insects, etc. Potentially dangerous mammals, such as mountain lions and bears, have also been detected on the Refuge.

On several occasions, mostly during periods of heavy fog, Refuge visitors have gotten lost for a few hours. For this reason, Refuge visitors are encouraged not to start their hikes too late in the afternoon.

The geographic remoteness of the Refuge presents additional problems. No restroom facilities are available on the Refuge, and lack of road access into the Refuge makes emergency response difficult.

4.6 Public Uses

4.6.1 Wildlife Observation

To enhance wildlife viewing and photography opportunities on the Refuge, part of the Wildlife Ponds Project completed in 2013 included two wildlife viewing areas at Myrtle Pond. They consist of two flat areas of land adjacent to the protective exclusion fence on the north and south side of Myrtle Pond. Both areas offer excellent opportunities to view wildlife at Myrtle Pond from elevated locations.

The public can reach these two areas around Myrtle Pond by hiking about 300 yards inland from the beach. A natural trailhead exists to Myrtle Pond on the Refuge upper beach at a location about 250 yards south of the Refuge northern boundary. Visitors can also reach these areas by taking escorted hikes.

4.6.2 Interpretation and Environmental Education

Due to funding and staff limitations, the Refuge currently offers no regularly scheduled interpretative or environmental education programs. Periodically scheduled interpretive hikes are discussed in the next section.

During 2006 and 2007, the Dunes Center and the Refuge conducted an interpretive and educational project under a cooperative agreement. The project, entitled "*Take Refuge!*," exposed upper elementary through high school students to the Refuge and the Refuge System; it also provided an opportunity to explore the connections between wildlife and humans. An educational booklet and CD about ecology was created for students using the Refuge as a classroom.

Take Refuge! was presented to Cabrillo High School, Regional Occupational Program in Botany/Ornamental Horticulture, in Lompoc, California, and to Peoples' Self-Help Housing, After School Education Program (for upper elementary through middle school) in Guadalupe, California. The Program consisted of classroom

learning and field trips to the Refuge components, which introduced students to Refuge ecology and the importance of dune habitat to plants and animals.

Refuge Sign Project. Completed in 2007, the Refuge Sign Project included Refuge welcome signs, interpretive panels for the Refuge, interpretive panels for neighboring parks and preserves, and Dunes Complex map panels.

4.6.3 Special Events

Interpretive Hikes. Interpretive hikes, periodically conducted on the Refuge, are often jointly sponsored with the Dunes Center. Hike schedules are announced on the Refuge website, the Dunes Center website, by e-mail messages, and in local newspapers when possible.

During these hikes, Refuge staff present information on interpretive topics, such as plant identification, plant communities, animal identification, tracks and scats, Refuge history, wetlands, threatened and endangered species, habitat restoration, and sand dune formation. Staff members from the Dunes Center, California State Parks, California Polytechnic University at San Luis Obispo, CNPS, Land Conservancy, and other organizations often provide assistance during these hikes.

Annual Coreopsis Hill Hike. From 2001 to 2013, the Refuge worked closely with Mills Farms, California Native Plant Society, California State Parks, and the Dunes Center to sponsor a springtime (March or April) wildflower hike to Coreopsis Hill. Coreopsis Hill is approximately 90 percent on Mills Farms property and 10 percent on State of California property (managed by California State Parks). This was one of the most popular hikes on the Refuge and the entire Dunes Complex, with 30-40 hikers in attendance. The Refuge no longer co-sponsors this hike, as it is now conducted off-Refuge by CNPS.

Dune Quest. Dune Quest (2004 through 2010) was a periodically scheduled educational symposium presented by the Dunes Collaborative for the advancement of ecology, restoration, land management, history, and cultural arts related to sand dune ecosystems, with a focus on the Dunes Complex. Lectures, slideshows, classes, displays, field trips, and working lunches were typical Dune Quest activities. The Refuge helped organize and actively participated in Dune Quest, as the program also provided high-quality training for local natural history docents. Typically, more than 100 people attended each symposium. This activity is no longer conducted due to a lack of funding.

4.6.4 Offsite Public Outreach

Refuge staff has periodically presented lectures and slideshows to local elementary school classes and environmental docent groups. They also staffed booths at environmental centers, local environmental fairs, and Earth Day festivals. Topics presented at outreach events include Refuge history and management, the Refuge System, career opportunities with the Service, endangered species, amphibians, reptiles, and western snowy plover.

Since the Refuge has no on-site public facilities, the Dunes Center (located in nearby Guadalupe) provides an important public outreach point for the Refuge. The Dunes Center provides information to the public regarding Refuge access, regulations, and natural history. This information is also available by telephone and on the Dunes Center website. Refuge visitors may get their Refuge System Passport stamped at the Dunes Center.

4.7 Volunteer Programs

When possible, the Refuge uses volunteers for activities pertaining to wildlife and habitat management, wildlife-dependent or other recreation, environmental education, and cultural resources. From 2005 through 2013, volunteers worked about 4,870 hours on the Refuge. The number of volunteers ranged each year from 8 to 125. The primary volunteer activities included:

- Supporting wildlife and habitat management on such projects as hand pulling sea fig and freeway iceplant, installing habitat closure signage during western snowy plover breeding season, and outplanting endangered plants.
- Supporting environmental education projects by assisting with production and staffing of outreach events, and the production and editing of educational materials.

Working on Refuge maintenance projects such as repairing fence lines, replacing signs and sign posts, moving and organizing tools, repairing equipment, washing and repairing vehicles, and cleaning offices. Starting in 2013, volunteers assisted with weed control in the Beigle Flats portion of the Refuge. Volunteers worked with the Refuge manager hand pulling and using shovels, and string trimmers to control 2 acres of weeds.

4.8 Existing Partnerships

Even before the Refuge was officially established, the Refuge Complex had worked closely with many partners. The Refuge continues to work cooperatively with these partners to reach common goals. Some of the primary Refuge partners include:

- CAL FIRE
- California Academy of Sciences, Department of Entomology
- CDFW
- CNPS
- California Polytechnic State University, San Luis Obispo, Biological Sciences Department
- California Polytechnic State University, San Luis Obispo, Horticulture and Crop Sciences Department
- California State Coastal Commission
- California State Coastal Conservancy
- California State Department of Pesticide Regulation
- California State Water Resources Control Board
- California State Parks, ODSVRA
- Chevron Environmental Management Company, GRP
- City of Santa Maria, Department of Recreation and Parks
- Dunes Center
- Dunes Collaborative
- Guadalupe Natural Resources Restoration Trust
- Land Conservancy of San Luis Obispo County
- Mills Farms
- Morro Coast Audubon Society
- San Luis Obispo County Air Pollution Control District
- San Luis Obispo County Sheriff's Office
- Santa Barbara County Department of Parks and Recreation, Rancho Guadalupe Dunes County
- Teixeira Farms
- TNC
- University of California, Riverside, Department of Biology
- University of California, Santa Barbara, Cheadle Center for Biodiversity and Ecological Restoration
- University of California, Santa Barbara, Department of Ecology, Evolution, and Marine Biology
- University of California Santa Cruz, Department of Ecology and Evolutionary Biology
- U.S. Air Force, VAFB, Natural Resources Team
- U.S. Department of Homeland Security, United States Coast Guard
- U.S. Department of the Interior, National Park Service, National Natural Landmarks Program



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Chapter 5. Refuge Management Direction: Goals, Objectives and Strategies

5.1 Introduction

One of the most important parts of the CCP process is the development and refinement of the refuge vision and goals. This section contains the primary goals that will define the management direction of the Refuge for the next 15 years. In addition, as part of the CCP, refuges must develop objectives and strategies that, together, will help achieve the goals. Goals are broad statements of the desired future conditions for refuge resources. Refuge goals may or may not be feasible within the 15-year timeframe of the CCP. Whenever possible, objectives are quantified statements of a standard to be achieved or work to be accomplished. They should be specific, measurable, achievable, results-oriented, and time fixed; they should be feasible within the 15-year lifespan of the CCP. Strategies are specific actions, tools, or techniques that contribute to accomplishing the objectives. In some cases, strategies describe specific projects in enough detail to assess funding and staffing needs.

Goals, objectives, and strategies may evolve to adapt to changing environmental conditions or needs. The ability to achieve refuge goals and objectives and complete proposed strategies in the stated timeframe is also influenced by the availability of adequate staffing and funding. Since 2010, the Refuge System budget nationally has declined by over \$20 million while costs have continued to increase. Over the same period, staffing has been reduced by about 12 percent. Uncertainty about future budget appropriations will continue to influence the extent to which the following strategies can be implemented and goals and objectives can be realized.

5.2 Refuge Vision Statement

Propelled by relentless ocean waves and strong onshore winds, small grains of sand scour and accumulate to form the impressive migrating dunes of the Refuge. Harsh but dynamic processes create unique habitats among the dunes for imperiled plants and animals such as La Graciosa thistle, marsh sandwort, California red-legged frog, and western snowy plover.

The Refuge lies within the Dunes Complex, an 18-mile-long stretch of coastal dunes located north of Point Sal and south of Pismo Beach. To conserve the dynamic landscape and imperiled natural resources of the Refuge and the Dunes Complex, the Service works cooperatively with other agencies, non-profit organizations, local businesses, private landowners, and private citizens. Working together, we instill stewardship through activities that include habitat restoration, protection of cultural resources, recovery of threatened and endangered species, and opportunities for high-quality visitor experiences in this unique and spectacular dunes landscape. Such cooperative efforts enable all partners to share limited resources to meet common goals, thereby achieving much more together than we could alone.

Originally envisioned by conservation-minded individuals who valued solitude and the satisfaction of spending time outdoors, we protect the Dunes Complex for everyone's enjoyment, including future generations.

Together with our partners, we coalesce like grains of sand to ensure that wildlife-dependent recreation, environmental education, interpretation, and wildlife photography opportunities exist for the public and that these activities are balanced with our conservation goals for cultural resources, plants, and animals of this treasured landscape.

5.3 Refuge Goals

GOAL 1:

Protect, restore, and enhance native habitats to aid in the recovery of endangered, threatened, and other special status species.

GOAL 2:

Protect, manage, and restore coastal dune and other natural communities to support the diverse species of the central California coast.

GOAL 3:

Provide safe and high-quality opportunities for compatible wildlife-dependent educational and recreational activities to foster public appreciation of the natural heritage of the central California coast region.

5.4 Refuge Goals, Objectives, and Strategies

GOAL 1:

Protect, restore, and enhance native habitats to aid in the recovery of endangered, threatened, and other special status species.

Objective 1.1 Annually participate in regional monitoring efforts and minimize disturbance to western snowy plover habitat.

Rationale:

The western snowy plover is one of the threatened species for which the Refuge was established. This objective meets goals and objectives identified in the Western Snowy Plover Recovery Plan (USFWS 2007b), including monitoring, management of existing habitat, and reducing threats to survival and productivity. While the Refuge is not specifically named as a unit within Recovery Unit 5 for this species, it is located in that vicinity (San Luis Obispo and Ventura Counties), which has a recovery goal of 1,200 breeding adults (which has not been met).

Objective 1.1 – Monitor and Minimize Disturbance to Western Snowy Plover
<i>Strategy</i>
Annually conduct a one-day adult plover winter population count on the Refuge.
Participate in the Annual Western Snowy Plover Breeding Survey (window survey).
Minimize human disturbance to nests by closing snowy plover breeding habitat areas during the breeding season (March 1-September 30) using signage as needed.
Work with other partners monitoring snowy plovers to reassess monitoring protocols for efficiencies.

Objective 1.2 Opportunistically conduct invasive European beachgrass and other species control via herbicide, mechanical, and hand removal in coastal strand and coastal dune habitat (RPMA 1) (See Appendix H); conduct vegetation monitoring post-invasive weed control.

Rationale:

One of the primary threats identified in the Western Snowy Plover Recovery Plan (USFWS 2007b) is habitat loss and degradation attributed to introduced beachgrass (*Ammophila* spp.) and other grasses. Foredunes dominated by introduced beachgrass have replaced the original low, rounded, open mounds formed by the native American dunegrass (*Leymus mollis*) and other beach plants. Chestnut (1997), who studied the spread of European beachgrass at the Guadalupe-Nipomo Dunes in San Luis Obispo County, documented an increase in beachgrass from approximately 8 to 109 hectares (20 to 270 acres) between 1969 and 1997 and found that its rapid spread through native vegetation posed a serious threat to nesting western snowy plovers and rare plants. Refuge staff identified RPMA 1 as having 95 percent of western snowy plover breeding activity; therefore, its ability to provide weed-free nesting habitat may improve snowy plover breeding success.

The California Least Tern Recovery Plan (USFWS 1985) and five-year review (USFWS 2006) also points to non-native invasive plants as a threat to the least tern. An action of the plan included protecting important non-nesting, feeding, and roosting habitats from detrimental land or water use changes in San Luis Obispo County (primarily Oso Flaco and Dune Lakes), and Santa Barbara and Los Angeles Counties.

Objective 1.2 – Invasive Vegetation Control in Western Snowy Plover and California Least Tern Habitat
<i>Strategy</i>
Opportunistically control of beachgrass and other invasive weeds in nesting habitat with assistance from Refuge staff, partners, and volunteers.
Continue to develop partnerships with other land management organizations, such as the Land Conservancy of San Luis Obispo County, to control European beachgrass in the northern foredunes of the Refuge.

Objective 1.3 By 2018, develop and implement a predator management plan that includes relocation of avian species and lethal removal of some mammalian and avian species in coordination with efforts of other adjacent land managers.

Rationale:

Lands neighboring the Refuge have been conducting predator management to protect their populations of western snowy plover. Because the Refuge is not conducting predator management, we believe that the Refuge harbors predators which hinder our neighbors’ efforts. Conducting predator management will provide consistency along the Dunes Complex and support recovery of the western snowy plover. The Western Snowy Plover Recovery Plan (USFWS 2007b) identified predation as a significant threat and recommended preventing excessive predation for western snowy plovers. Moreover, refuge snowy plover monitoring reports indicate predation occurs by individuals of various avian and mammalian species. Between 2002 and 2013, an average of 33 percent of snowy plover nests on the Refuge were predated upon (USFWS 2014a).

Invasive native and non-native species have become a primary threat to native plants and wildlife protected within the Refuge System, as well as a threat to the Service’s wildlife conservation mission. Invasive species have the potential to alter foraging, nesting, and roosting habitat of endangered species and migratory birds that occur on the Refuge. The Service’s Biological Integrity, Diversity, and Environmental Health Policy (601 FW 3) directs us to prevent the introduction of invasive species, detect and control populations of invasive species, and provide for restoration of native species and habitat conditions in invaded ecosystems that interfere with the Refuge’s purposes. Many invasive animal species are predators that threaten native species. Furthermore, the National Strategy for Management of Invasive Species (April 2003) was developed within the context of the National Invasive Species Management Plan [EO 13112], which functions as the internal guidance document for invasive species management throughout the Refuge System.

The National Invasive Species Management Plan identifies four goals:

- 1) increase the awareness of invasive species issues, both internally and externally;
- 2) reduce the impacts of invasive species to allow the Refuge System to more effectively meet its fish and wildlife conservation mission and purpose;
- 3) reduce invasive species impacts on the Refuge System’s neighbors and communities; and
- 4) promote and support the development and use of safe and effective integrated management techniques to deal with invasive species.

Objective 1.3 – Predator Management
<i>Strategy</i>
Prepare and implement a step-down predator management plan that includes thresholds for predator management actions, appropriate control methods, and monitoring.
Contract predator control.
Control native and non-native avian and mammalian individuals using non-lethal and lethal methods when identified as a threat to snowy plovers.
Reduce beach vegetation to limit predator cover.
Work with partners to identify and implement new predator management techniques to protect snowy plover nests and young.

Objective 1.4 Annually monitor for presence/absence of La Graciosa thistle at all wetland areas, as well as maintain occurrences where possible.

Rationale:

As of this CCP, a recovery plan for La Graciosa thistle has not yet been developed, but a draft recovery outline has been initiated (USFWS 2008e). The draft outline includes the following recovery objectives: (1) expand the current range of La Graciosa thistle to its historical range; (2) increase the number of populations to maintain viable metapopulations (group of populations that are separated by space); (3) reduce threats from habitat alteration, competition with non-native species, and other threats so that populations are self-sustaining; and (4) maintain habitat of sufficient quality and configuration to support all life history stages (germination, growth, reproduction, and seed dispersal).

Currently, there is only one known occurrence of La Graciosa thistle on the southeast corner of the Refuge. The Refuge is believed to historically contain more than one occurrence of the species. However, it is believed that drought has significantly affected their occurrence. The five-year review (USFWS 2011c) of this species recommends the following activities to recover the species: conduct seed collections and propagate seed for introduction and re-introduction efforts. Providing several locations for La Graciosa thistle will act as insurance against effects of climate change, such as saltwater intrusion from sea-level rise increased storm events and frequency, and drought.

Objective 1.4 – Monitor and Maintain La Graciosa Thistle Occurrences on the Refuge
<i>Strategy</i>
With assistance from the Ventura Fish and Wildlife Office, intermittently monitor for presence/absence of previously known locations of La Graciosa thistle and search for previously undiscovered populations on the Refuge.
Annually conduct late summer surveys to determine occurrence of La Graciosa thistle on the Refuge.
Work with experts such as the Service’s Inventory and Monitoring Program to develop feasible monitoring goals and protocols.
When staff time permits, conduct seed collection and outplant the seed in appropriate locations on the Refuge.
Conduct weed control around La Graciosa thistle occurrences.

Objective 1.5 Annually maintain fencing to reduce animal disturbance in all wetland areas, particularly those areas with known occurrence of La Graciosa thistle, marsh sandwort, and California red-legged frog.

Rationale:

There is incidental observation or evidence of rabbits and feral swine eating or damaging La Graciosa and marsh sandwort plants (G. Greenwald, USFWS, personal observation, 2007). There is also evidence of these animals rooting and contaminating wetland areas with their waste, which may contribute to turbidity and eutrophication. Previously, cattle were known to predate upon La Graciosa thistle on the Refuge (M.A. Elvin, personal observation, 2007), but fencing and removal of cattle has recently eliminated cattle herbivory. While La Graciosa thistle and marsh sandwort may be able to withstand some herbivory, it may cause a reduction in those species’ reproductive success due to the loss of flowers and the correlated reduction in the production of seeds. The extent of this threat is not known, but the herbivory of even a few flowers may have a significant effect on the long-term survival of these species because there are so few individuals and in the case of marsh sandwort, only one known population remaining in the wild (USFWS 2008a; USFWS 2008d; USFWS 2011a; USFWS 2011c). Several native predators, including raccoons (*Procyon lotor*), great blue herons (*Ardea herodias*), American bitterns (*Botaurus lentiginosus*), black-crowned night herons (*Nycticorax nycticorax*), red-shouldered hawks (*Buteo lineatus*), and garter snakes (*Thamnophis* spp.) eat adult California red-legged frogs (Jennings and Hayes 1990; Rathbun and Murphy 1996). Other potential predators include opossums (*Didelphis virginiana*), striped skunks (*Mephitis mephitis*), and spotted skunks (*Spilogale putorius*) (Fitch 1940; Fox 1952; Jennings and Hayes 1990).

Objective 1.5 – Reduce Animal Disturbance to Federally Listed Species
<i>Strategy</i>
Maintain the existing Refuge boundary fence.
Maintain existing fencing around ponds and other wetland areas to reduce damage to La Graciosa thistle, marsh sandwort, and California red-legged frog habitat from mammals, including feral swine and deer.
Maintain the enclosure fence installed around the perimeter of the majority of the La Graciosa thistle (which are generally upland of wet areas) on the Refuge.

Objective 1.6 By 2017, implement a feral swine control and monitoring plan to reduce threats to La Graciosa thistle, marsh sandwort, California red-legged frog, western snowy plover, and California least tern.

Rationale:

The environmental and agricultural damage caused by feral swine has been widely documented in scientific literature and media reports (USDA Forest Service 2013). Feral swine cause substantial damage across the United States; conservative estimates of the financial cost of this damage nationwide are in the range of \$1.5 billion annually (West et al. 2009). As a result, several feral swine eradication and control efforts have been accomplished or are underway across the country.

Feral swine populations grow rapidly and as habitat generalists, these opportunistic omnivores can be found in a variety of habitats. They are known to eat almost anything from grass, worms, and insects to young fawns, small mammals, eggs and chicks of ground-nesting birds, and reptiles (CBI 2009; CDPR 2013), but their diet generally consists of plants (e.g., roots, tubers, fruit, acorns). Feral pigs cause extensive and severe soil disturbance due to rooting, wallowing, and trampling. Their foraging techniques can result in serious disturbance to soils and associated plants and animals (Sweitzer and Van Vuren 2002, 2008). The federally listed species on the Refuge are particularly vulnerable to disturbance and/or take as a result of their presence. Outplanted and other wetland areas on the Refuge have shown evidence of damage and consumption, most likely by feral swine (G. Greenwald, Refuge Manager, personal communication). The California red-legged frog recovery plan identifies non-natives as a threat to the Central Coast Recovery Unit, where the Refuge is located. Relevant recovery actions include removal of feral swine and the Service’s Biological Integrity, Diversity, and Environmental Health Policy (601 FW 3) directs us to detect and control populations of invasive species, and provide for restoration of native species and habitat conditions in invaded ecosystems that interfere with the Refuge’s purposes.

Objective 1.6 – Feral Swine Control and Monitoring Plan
<i>Strategy</i>
Implement a feral swine control and monitoring plan for the Refuge (see Appendix I).
Determine thresholds for predator management actions and appropriate control methods, as described in the feral swine control and monitoring plan.
Contract for control of feral swine.
Annually work with partners and contractors to reduce the feral swine population by conducting control of feral swine through trapping and shooting (determine seasonality and frequency).
Continually work with partners and experts to identify and improve predator management techniques.

Objective 1.7

Annually monitor for presence/absence of marsh sandwort at all wetland areas, as well as maintain occurrences where possible.

Rationale:

The recovery strategy for marsh sandwort involves six major steps, described in detail in the next section. These steps are to (1) protect, maintain, and enhance habitats; (2) monitor and document species populations and habitat characteristics; (3) conduct research on the ecology and biology of the species; (4) expand existing

populations; (5) establish new populations; and (6) evaluate progress and update management and recovery guidelines (USFWS 1998).

Marsh sandwort is known to occur in the San Luis Obispo County area and was rediscovered at nearby Oso Flaco Lake in 1998 (USFWS 2008a). The Refuge has several wetland areas appropriate for marsh sandwort and several outplantings have occurred since 2006; however, the status of marsh sandwort on the Refuge is currently uncertain. It is believed that drought has significantly impacted their occurrence. Providing several locations for marsh sandwort will act as insurance against effects of climate change, such as saltwater intrusion from sea-level rise increased storm events and frequency, and drought.

Objective 1.7 – Monitor and Maintain Marsh Sandwort on the Refuge
<i>Strategy</i>
With assistance from the Ventura Fish and Wildlife Office, intermittently monitor for presence/absence of previously known locations of marsh sandwort and search for previously undiscovered populations on the Refuge.
Monitor annually during summer for presence of marsh sandwort, particularly where 2008 and 2013 plantings occurred.
Work with experts such as the Service’s Inventory and Monitoring Program to develop feasible monitoring goals and protocols.
When staff time permits, conduct seed collection and outplant marsh sandwort in appropriate locations on the Refuge.
Conduct weed control around occurrences of marsh sandwort.

Objective 1.8 Opportunistically monitor California red-legged frog in Refuge wetland areas.

Rationale:

The Refuge is located in Recovery Unit 2 (Central Coast) for this species. The Central Coast ranges from San Mateo and Santa Clara Counties south to Ventura and Los Angeles Counties (delineated by watershed boundaries as defined by U.S. Geological Survey hydrologic units and the limits of the range of the species). The Refuge is also located in the revised Recovery Unit 7 for this species, Northern Transverse Ranges and Tehachapi Mountains Watersheds (defined by the U.S. Geological Survey hydrologic units included in each recovery unit). Within the recovery and revised recovery unit, the Refuge is located in the Santa Maria River-Santa Ynez River core area and has the following recovery objectives: protect existing populations; reduce contamination of habitat (e.g., clean contaminated ponds on VAFB); control non-native predators; implement management guidelines for recreation; cease stocking dune ponds with non-native, warm water fish; manage flows to decrease impacts of water diversions; implement guidelines for channel maintenance activities; and preserve buffers from agriculture (e.g., in lower reaches of Santa Ynez River and San Antonio Creek). The core areas are distributed throughout portions of the historic and current range; they represent a system of areas that, when protected and managed for California red-legged frogs, will allow for long-term viability of existing populations and reestablishment of populations within the historic range.

California red-legged frogs have occurred and bred in at least six ponds on the Refuge. Monitoring these occurrences will support presence in the core area and allow for long-term viability to the species’ historic range.

Objective 1.8 – Monitor California Red-legged Frog
<i>Strategy</i>
Opportunistically record sightings of California red-legged frog within all ponds and marshes on the Refuge where this species is known to have occurred in the past.
Continue to conduct intermittent weed management activities to benefit wildlife resources, including the red-legged frog and its habitat.
Record threats (e.g., bullfrog presence, feral swine).

GOAL 2:

Protect, manage, and restore coastal dune and other natural communities to support the diverse species of the central California coast.

Objective 2.1 Over the life of the CCP, focus invasive vegetation control efforts over the existing 200-acre spatial extent of naturally shifting, primarily unvegetated open sand cover in RPMAs 4, 5, 7, and 9.

Rationale:

Non-native and invasive species have become the primary threat of the Refuge System and the Service’s wildlife conservation mission. The National Strategy for Management of Invasive Species (April 2003) has been developed within the context of the National Invasive Species Management Plan [EO 13112], which functions as the internal guidance document for invasive species management throughout the Refuge System. Also, the 2008–2012 National Invasive Species Management Plan (a revision to the 2003 National Strategy for Management of Invasive Species) (NISC 2008) identifies five strategic goals to prevent, control, and minimize invasive species and their impacts. Refuge management strategies will support these goals.

Refuge staff identified the following invasive vegetation as priority for control: European beachgrass, perennial veldt grass, iceplant species, jubata grass, purple ragwort, and sea fig. In light of staff and funding limitations, the Refuge staff identified important and unique habitat types on which to focus conservation efforts. The Refuge’s unvegetated open sand dunes are a declining habitat resource to the region requiring active protection.

Objective 2.1 – Maintain Natural Shifting Open Sand Cover on the Refuge
<i>Strategy</i>
Continue beach grass control using herbicides as funding and partners permit.
Map and estimate the occurrence of veldt grass, beachgrass, jubata grass, purple ragwort, iceplant, and other known highly invasive plant species to establish a baseline amount of weeds present on all RPMAs.
Opportunistically remove invasive plant species using manual and chemical methods—most notably iceplant species, jubata grass, purple ragwort, and sea fig.
Remove woody vegetation (e.g., lupine) from these areas.
Conduct post-control monitoring.

Objective 2.2 Within the life of the CCP, develop and achieve a feasible target rate of reduction for perennial veldt grass (of 2017 baseline survey) in RPMAs to protect high-quality sand sheet, willow forest, wetland pond, dune swale, and coastal dune scrub habitat.

Rationale:

Non-native and invasive species have become the primary threat of the Refuge System and the Service’s wildlife conservation mission. The National Strategy for Management of Invasive Species (April 2003) has been developed within the context of the National Invasive Species Management Plan [EO 13112], which functions as the internal guidance document for invasive species management throughout the Refuge System. Also, the 2008–2012 National Invasive Species Management Plan (a revision to the 2003 National Strategy for Management of Invasive Species) (NISC 2008) identifies five strategic goals to prevent, control, and minimize invasive species and their impacts. Refuge management strategies will support these goals.

In light of staff and funding limitations, the Refuge staff identified important and unique habitat types called RPMAs on which to focus conservation efforts. These RPMAs are threatened by highly invasive perennial veldt grass. Invasive plant experts at the neighboring State Vehicular Recreation Area and Service staff (pers. comm., Andrea Pickart) recommend establishing and focusing on "protection zones" of high value habitat areas (e.g., giant coreopsis) instead of trying to control all patches of veldt grass, Refuge staff should consider attacking those smaller patches of veldt grass before focusing on large, dense stands.

In addition, this objective will meet management needs and the directives in the Service’s Biological Integrity, Diversity, and Environmental Health Policy (601 FW 3) to restore lost or severely degraded elements of integrity, diversity, environmental health at the Refuge scale, and other appropriate landscape scales where it is feasible.

Objective 2.2 – Reduce Cover of Perennial Veldt Grass
<i>Strategy</i>
Continue to work with partners to conduct intermittent and experimental weed control using herbicide, mechanical, and hand-pulling methods.
Map and estimate the amount of veldt grass on the RPMAs by 2017.
Select the RPMAs to be controlled based on the feasibility of control actions, the risks to sensitive species, and size of the infestation.
Implement a contract-based control program to achieve maintenance level control of veldt grass.
Coordinate our prioritization of RPMAs with the Dunes Complex’s prioritization of Dune Protected Areas (when it becomes available).

Objective 2.3 Within 10 years of CCP approval, develop and implement an early detection and rapid response program to address the introduction of new invasive weeds on the Refuge.

Rationale:

The National Strategy for Management of Invasive Species (USFWS 2003) identifies invasive and non-native species as one of the greatest threats to native plant communities. The 2008-2012 National Invasive Species Management Plan (NISC 2008) also identifies early detection and rapid response as one of the strategic goals for prevention, control, and minimization of invasive species and their impacts. Early detection and rapid response prevention are one of the most effective means of avoiding costly long-term control measures. Identifying threats at an early stage and at an ecosystem level improves effectiveness and reduces costs. As ownership boundaries do not limit invasive species, it will be important to work with neighboring landowners and the regional invasive plant organizations to develop and communicate a unified response to invasive threats to reduce costs and effort.

Objective 2.3 – Early Detection and Rapid Response Program for Invasive Weeds
<i>Strategy</i>
Develop an early detection and rapid response plan to quickly identify and control new invasive weeds on the Refuge.
Conduct baseline monitoring for invasive weed occurrences and establish monitoring intervals.
Assemble volunteers, interns, and/or other groups to conduct monitoring for invasive weeds.
Coordinate with neighboring land agencies and related invasive weed agencies on a regular basis to keep current with potential introductions and response methods.
Immediately eradicate all new occurrences of non-native, invasive, introduced species using hand pulling, herbicide treatment, mowing, disking, or other proven techniques as prescribed in the early detection and rapid response plan.

GOAL 3:

Provide safe and high-quality opportunities for compatible wildlife-dependent educational and recreational activities to foster public appreciation of the natural heritage of the central California coast region.

Objective 3.1 Beginning in 2017, annually conduct four interpretive walks.

Rationale:

Interpretation is one of the priority public uses on Refuges, per the 1997 Improvement Act. Because of the difficulty in accessing the Refuge, interpretive walks will provide safe and supervised opportunities to

experience the Refuge. This objective also supports the California Wildlife Action Plan (CDFG 2005), which calls for state and federal governments to give greater priority to wildlife and natural resources conservation education through both formal and non-formal educational means.

Objective 3.1 – Interpretive Walks
<i>Strategy</i>
Continue to offer guided interpretive walks to the public, when staff time or support from partners permits; and continue to provide guided, interpretive walks for private and non-profit entities as requested when staff time or support from partners permits.
Maintain existing interpretive signage.
Install a sign at Beigle Road to identify the Refuge.
Use docents and/or volunteers through partners to conduct outreach about the Refuge in their own programs.

Objective 3.2 Continue current research partnerships and allow additional research to benefit Refuge resources.

Rationale:

An urgent need for data on plant and wildlife resources is outstripping our staffing ability to collect it. Identifying research projects is one method to sustain support of specific Refuge sites through self-directed academics and school groups. In light of staff and funding limitations, the Refuge staff identified researchers and students as a source for conducting Refuge surveys and research to inform management activities. In addition, several nearby universities could support this effort (e.g., University of California, Santa Barbara and California Polytechnic University at San Luis Obispo). The Refuge has existing relationships with these universities.

Objective 3.2 – Research Partnership
<i>Strategy</i>
Develop a list of research topics (as they relate to priority species or habitats) for partners to study.
Continue relationships with local universities and researchers to conduct research to support Refuge management needs.

Objective 3.3 Beginning in 2017, annually conduct at least two environmental education programs through collaboration with a non-profit education organization such as the Dunes Center.

Rationale:

Environmental education is one of the priority public uses on Refuges, per the 1997 Improvement Act. Because of the long hike required to access the Refuge, access for school-age children could be onerous. Environmental education may be conducted on- or off-site through partner facilities.

Objective 3.3 –Elementary School-age Environmental Education Programs
<i>Strategy</i>
Work through partners to periodically present lectures and slideshows about the Refuge to local elementary school classes.

Objective 3.4 By 2020, establish and maintain a relationship with local law enforcement to increase law enforcement presence on the Refuge.

Rationale:

Given the limited staffing and funding of the Refuge, maintaining a relationship with local law enforcement is critical to protecting Refuge resources and human safety.

Objective 3.4 –Law Enforcement
<i>Strategy</i>
Develop a relationship with local law enforcement agencies and provide them with information about the Refuge location, purposes, and regulations.
Develop an agreement to support surveillance on the Refuge.



USFWS

Chapter 6. Plan Implementation

6.1 Implementation

CCPs provide long-term guidance for management decisions and set forth goals, objectives, and strategies needed to accomplish Refuge purposes and identify the Service's best estimate of future needs. This chapter summarizes the actions, funding, coordination, and monitoring required for implementing this CCP.

The CCP will serve as the primary management reference document for Refuge planning, operations, and management for the next 15 years or until it is formally revised or amended within that period. Detailed step-down plans that follow the CCP process and describe how management strategies are implemented could also be prepared during the 15-year period. The Service will implement the CCP with assistance from existing and new partner agencies and organizations and from the public. The timing and achievement of management strategies proposed for the various alternatives are contingent upon a variety of factors, including:

- Funding and Personnel
- Step-Down Management Plans
- Appropriate Uses and Compatibility Determinations
- Compliance Requirements
- Monitoring and Evaluation
- Partnerships and Opportunities
- Adaptive Management
- Plan Amendment and Revision

The objectives and strategies selected for implementation are primarily for Service strategic planning and program prioritization purposes, which may exceed current and/or future budget allocations. The CCP does not constitute a commitment for staffing increases, operational and maintenance increases, or funding for future land acquisition. Decisions about the aforementioned commitments are at the discretion of Congress in overall appropriations and in budget allocation decisions made at the Washington, regional, and Refuge Complex levels of the Service.

6.2 Funding and Personnel

To implement prescribed actions and achieve the objectives and goals of this CCP, the Service must consider available funding and staffing. Some CCP funding needs may be recorded in the Service Asset Maintenance Management System for the Refuge System. Maintenance projects include repair and replacement of existing buildings and facilities and removal of unneeded infrastructure. The estimated startup cost to implement the CCP is described as follows.

As of 2015, the Refuge had one dedicated permanent staff position, a Refuge Manager; that position is currently vacant. Based on forecasted Service budget, the Refuge Manager position will not be refilled. The Refuge will continue to receive administrative, biological, and maintenance staff support from the Refuge Complex.

Table 8 summarizes the staffing needs associated with implementing the CCP. Some strategies to be implemented would likely be accomplished in partnership with others, including other Dunes Complex land managers.

Table 8. Staffing Plan and Needs for the Guadalupe-Nipomo Dunes National Wildlife Refuge CCP

<i>Current Staffing Level</i>	<i>% of time¹</i>	<i>Estimated Costs (\$, includes 35% for overhead and benefits)</i>
Project Leader GS-0485-13	10%	14,000
Deputy Project Leader GS-0485-12	15%	18,000
Wildlife Biologist GS-0486-11	20%	20,000
Wildlife Refuge Specialist GS-0485-9 (0.5, shared with Bitter Creek Refuge)	50%	42,000
Maintenance Worker WG-7/8	20%	12,000
TOTAL STAFF COST:		106,000

¹ % of time dedicated to Guadalupe –Nipomo Dunes Refuge. Less than 100% means the position supports multiple Refuges in the Refuge Complex.

Table 9 describes the budget proposal needed to implement the CCP. The needs and costs shown are best estimates and may not entirely reflect the costs of managing the Refuge. Some contracts or cooperative agreements will be needed to provide specialized services beyond the core Refuge functions for which staff are required.

Table 9. Budget Proposal for the Guadalupe-Nipomo Dunes National Wildlife Refuge CCP

<i>Project Description</i>	<i>Operational Cost for Startup</i>	<i>Average Annual Cost</i>
Contract for continued control of beachgrass in Refuge foredunes (multi-year project; includes herbicide and labor costs) [Objective 1.2]		\$10,000
Maintain seasonal closure signage in plover nesting areas [Objective 1.1]		\$1,000
Maintain existing fencing (including exclosures) around listed plants, wetland areas and ponds [Objective 1.5]		\$2,000
Contract for veldt grass control [Objective 2.2]		\$15,000
Maintain existing interpretive signage [Objective 3.1]		\$5,000
Print and distribute environmental education material, offsite supplies [Objective 3.3]		\$2,000
Sign at Beigle Road [Objective 3.1]	\$25,000	
Contract feral swine control and monitoring; contract avian and mammalian predator management [Objective 1.6, 1.3]		\$15,000*
TOTAL	\$25,000	\$50,500

* To be conducted in partnership with other Dunes Complex land managers

6.3 Step-down Management Plans

Some objectives in the CCP require more detailed planning than the CCP process provides. For these projects, the Service will refer to step-down management plans and other plans to provide additional details necessary to implement objectives and strategies in the CCP. Some of these plans require NEPA documentation. One step-down plan, A Feral Swine Control and Monitoring Plan, has been prepared in association with the CCP and is provided as Appendix I.

An avian and mammalian predator management plan is proposed for completion in the future as part of CCP, as funding and staff time becomes available.

6.4 Appropriate Use and Compatibility Determinations

Federal law and policy provide the direction and planning framework to protect the Refuge System from inappropriate, incompatible, or harmful human activities and to ensure that Americans can enjoy Refuge System lands and waters. The 1997 Improvement Act is the key legislation on managing appropriate public uses and compatibility.

Before activities or uses are allowed on a refuge, uses must be found to be appropriate and then compatible through a written appropriate use and compatibility determination. An *appropriate use* is defined as a proposed or existing use on a refuge that meets at least one of the following four conditions: (1) use is a wildlife-dependent recreational use; (2) use contributes to fulfilling the refuge purposes, Refuge System mission, or goals or objectives of the refuge; (3) use involves the take of fish and/or wildlife under state regulations; or (4) use has been found appropriate in prior determinations (603 FW 1 of the Service Manual). Uses that have been administratively determined to be appropriate are the six wildlife-dependent recreational uses (hunting, fishing, wildlife observation and photography, environmental education, and interpretation) and the take of fish and wildlife under state regulations.

A *compatible use* is defined as a proposed or existing wildlife-dependent recreational use or any other use of a refuge that, based on sound professional judgment, will not materially interfere with or detract from the fulfillment of the Refuge System mission or the purposes of the refuge. *Sound professional judgment* is defined as a decision that is consistent with the principles of the Service's management and administration, available science and resources, and adherence to the requirements of the 1997 Improvement Act and other applicable laws. Wildlife-dependent recreational uses may be authorized on a refuge when they are compatible and not inconsistent with public safety.

An appropriate use determination for research is included in Appendix C. Compatibility determinations are included in Appendix D for wildlife observation and photography, environmental education and interpretation, and research.

6.5 Compliance Requirements

This CCP was developed to comply with all federal laws, EOs, and legislative acts. Some activities (particularly those that involve a major revision to an existing step-down management plan or preparing a new plan) would need to comply with additional laws and/or regulations besides NEPA and the Improvement Act.

The Refuge System has established laws that guide the identification and evaluation of accidentally discovered archaeological resources. Any discovered resources will be handled in accordance with regulations that include the Native American Graves Protection and Repatriation Act, NHPA, Antiquities Act of 1906, Archaeological Resource Protection Act of 1979, and Historic Sites Act of 1935.

6.6 Monitoring and Evaluation

The CCP is designed to be effective for a 15-year period. The Plan will be reviewed and revised as required to ensure that established goals and objectives are still applicable and that the CCP is implemented as scheduled. The monitoring program will focus on wildlife and plant inventory. Monitoring and evaluation will use the adaptive management process. This process includes setting goals and objectives, applying management tools and strategies, and subsequently conducting monitoring and analysis to measure achievement of objectives and refine management techniques.

Under the selected action, some collection of baseline data will continue. This data, as available, will be used to update existing species lists, wildlife habitat requirements, and seasonal use patterns. Where information gaps exist, a concerted effort will be made to identify funding and/or partners to assist the Refuge in obtaining needed information. With new information, goals and objectives may need modification. Public involvement will be encouraged during the evaluation process. Land use changes, invasive species, wildfires, disease outbreaks, and climate changes may alter expected outcomes; only through monitoring can we detect and react to changing conditions.

Monitoring of public use would be conducted opportunistically to evaluate the effects of visitor service on Refuge habitat, wildlife populations, and the visitor experience.

6.7 Partnership Opportunities

As described in Chapter 1, private and public partners currently play an important role in helping the Service achieve its goals and objectives for the Refuge. The Dunes Collaborative and other landowners within the 18-mile Dunes Complex have been vital partners to the Refuge. Under the selected action, the Service would continue to rely on these and other partners to help implement the CCP and to provide input for future CCP revisions. Other Service programs such as Ecological Services will also play a key role in CCP implementation.

6.8 Adaptive Management

Adaptive management is the process of implementing policy decisions as scientifically driven experiments that test predictions and assumptions about management plans, and using the resulting information to improve the plans. Adaptive management provides the framework within which biological measures and public use can be evaluated by comparing the results of management to results expected from objectives. Management direction is periodically evaluated within a system that applies several options, monitors the objectives, and adapts original strategies to reach desired objectives. Habitat and wildlife management techniques and specific objectives would be regularly evaluated as results of a monitoring program and other new technology and information become available. These periodic evaluations would be used over time to adapt management objectives and strategies to better achieve management goals. Such a system embraces uncertainty and provides new information for future decision making while allowing resource use. The management scenario proposed in this CCP provides for ongoing adaptive management of the Refuge. The CCP may be amended as necessary at any time in keeping with the adaptive management strategy. For example, actions considered in one or more of the CCP alternatives may be implemented given changing environmental conditions or funding sources. Any major changes to the CCP may require additional NEPA documentation and public involvement processes.

6.9 Plan Amendment and Revision

The CCP is intended to evolve as the Refuge changes, and the 1997 Improvement Act specifically requires that CCPs be formally revised and updated at least every 15 years. The formal revision process would follow the same steps as the CCP creation process. In the meantime, the Service will review and update this CCP periodically based on the results of the adaptive management program, which uses monitoring, evaluation, and experimentation to learn and change aspects of the management plan as needed. While preparing annual work plans and updating the Refuge database, the Refuge staff will also review the CCP. It may also be reviewed during routine inspections or programmatic evaluations. Results of any or all of these reviews may indicate a need to modify the CCP. The goals described in this CCP will not change until they are re-evaluated as part of the formal CCP revision process. However, the objectives and strategies may be revised to better address changing circumstances or to take advantage of increased knowledge of the resources on the Refuge. It is the intent of the Service to have this CCP apply to any new lands that may be acquired. If changes are needed, the refuge manager will determine the appropriate public involvement and associated NEPA documentation.

The intent of the CCP is for progress and/or achievement of Refuge objectives during the lifetime of this CCP. Management activities would be phased in over time, and implementation is contingent upon and subject to results of monitoring and evaluation, funding through Congressional appropriations and other sources, and staffing.



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