U.S. Fish & Wildlife Service

Protection Island and San Juan Islands National Wildlife Refuges

Comprehensive Conservation Plan and San Juan Islands Wilderness Stewardship Plan

A Vision of Conservation

Protection Island NWR

Protection Island's unique combination of shoreline, spits, and sandy bluffs are a safe haven for thousands of nesting rhinoceros auklets as well as tufted puffins, pigeon guillemots, and pelagic cormorants. Bald eagles roost and nest in the forested uplands while harbor seals and elephant seals haul out and raise their pups on the shoreline. Environmental education opportunities are available to dedicated college students and volunteers through research and stewardship projects. Staff and partners cooperatively conduct monitoring and research on the flora and fauna, providing sound science to inform management. Refuge staff and year-round resident caretakers maintain minimal infrastructure. Although the island is located close to human population centers, people respect wildlife's need for refugia and maintain a distance from shorelines while viewing the abundant seabird and marine mammals that can be found on the island. Amid the cacophony of wildlife, a sense of peace nurtures the desire to care for the natural treasure that is Protection Island.

Protection Island/USFWS

San Juan Islands NWR

The San Juan Islands NWR is a sanctuary for a dazzling array of marine life including black oystercatchers, pigeon guillemots, tufted puffins, pelagic and double-crested cormorants, glaucous-winged gulls, and pinnipeds. Nestled among large islands and marine waters abuzz with human activity, the refuge encompasses many small islands, rocks, and reefs scattered throughout the San Juan Archipelago. The breathtaking forces of nature shaped this marine wilderness embracing many miles of shoreline, reefs, lichened rocks, bluffs and old-growth forests. These wild lands inhabited by wild creatures and supporting healthy breeding seabird colonies provide the backdrop for folks to enjoy, appreciate and understand the refuge's valuable place in the Salish Sea ecosystem. Working with partners, we provide opportunities for researchers, boaters, birders, and other nature lovers to develop a stewardship ethic for our refuge islands.

Cormorants/©Peter Hodum

Comprehensive Conservation Plans provide long-term guidance for management decisions and set forth goals, objectives, and strategies needed to accomplish refuge purposes and identify the U.S. Fish and Wildlife Service's best estimates of future needs. These plans detail program planning levels that are sometimes substantially above current budget allocations, and as such, are primarily used for 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.

Protection Island and San Juan Islands National Wildlife Refuges Comprehensive Conservation Plan and San Juan Islands Wilderness Stewardship Plan

Prepared by:

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and

U.S. Fish and Wildlife Service
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Approved: _____ 9/28/10

Acting Regional Director, Region 1
Portland, Oregon

Date

U.S. Fish and Wildlife Service
Protection Island and San Juan Islands National Wildlife Refuges
Comprehensive Conservation Plan and San Juan Islands Wilderness Stewardship Plan
Approval Submission

In accordance with the National Wildlife Refuge System Administration Act, as amended, the U.S. Fish and Wildlife Service completed a Comprehensive Conservation Plan (CCP) for Protection Island and San Juan Islands National Wildlife Refuges (Refuges) and a Wilderness Stewardship Plan (WSP) for the San Juan Islands Wilderness. The purpose of this CCP/WSP is to specify a management direction for the Refuges for the next 15 years. The goals, objectives, and strategies for improving refuge conditions—including the types of habitat we will provide, partnership opportunities, and management actions needed to achieve desired future conditions—are described in the CCP/WSP. The environmental consequences of implementing the CCP/WSP were described in the Draft CCP/WSP and Environmental Assessment.

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

Kevin Ryan, Project Leader — Date: 9/27/2010
Washington Maritime National Wildlife Refuge Complex

Concur: Forrest Cameron — Date: 9/27/2010
Forrest Cameron
Refuge Supervisor

Concur: Carolyn Bohan — Date: 9/27/10
Carolyn Bohan
Regional Chief, National Wildlife Refuge System

Finding of No Significant Impact
for
Protection Island and San Juan Islands National Wildlife Refuges
Comprehensive Conservation Plan and San Juan Islands Wilderness Stewardship Plan
Jefferson, Island, San Juan, Skagit, and Whatcom Counties, Washington

The U.S. Fish and Wildlife Service (Service) has completed a Comprehensive Conservation Plan (CCP), Wilderness Stewardship Plan (WSP) and Environmental Assessment (EA) for Protection Island and San Juan Islands National Wildlife Refuges (Refuges). The CCP will guide management of the Refuges for approximately the next 15 years. The CCP and EA describe the Service's proposals for managing the Refuges and their effects on the human environment under three alternatives, including the no action alternative.

Decision

Based on our comprehensive review and analysis in the CCP/EA, we selected Alternative B for implementation, because it will guide management of the Refuges in a manner that:

- Achieves the mission of the National Wildlife Refuge System, and the purposes, vision, and goals of the Refuge.
- Maintains and restores the ecological integrity of the Refuge's habitats and populations.
- Addresses the important issues identified during the CCP scoping process.
- Addresses the legal mandates of the Service and the Refuge.
- Is consistent with the scientific principles of sound wildlife management and endangered species recovery.
- Facilitates priority public uses appropriate and compatible with the Refuge's purposes and the Refuge System mission.

Summary of the Actions to be Implemented

Management of the Refuges under the selected alternative (Alternative B) will protect, maintain, and enhance habitat for priority species and resources of concern; protect cultural and paleontological resources; and maintain the integrity of the San Juan Islands Wilderness Area. The availability and quality of wildlife-dependent recreation both on and off the Refuges will increase over time under the selected alternative.

Under Alternative B, the Service and partners will:

- Protect, maintain, and where feasible, restore habitats including shoreline; sandy bluffs; grasslands and balds; forests and woodlands; and wetlands for priority species including seabirds, shorebirds, bald eagles, marine mammals, and endemic plants.
- Minimize human-caused wildlife disturbance on and near closed refuge islands, rocks, and shorelines.
- Manage invasive species and State- and county-listed noxious weeds.
- Survey and protect paleontological and cultural resources.
- Increase inventory and monitoring efforts.
- Encourage and facilitate research that answers refuge management questions.
- Design and implement a site plan for refuge administration and research facilities on

Protection Island in order to reduce the human "footprint", improve refuge management capability, improve research coordination, and reduce liquid fuel consumption by expanding solar power capabilities.

- Reduce the number of campsites on Turn Island and limit camping on both Turn and Matia Islands to visitors arriving by human-powered boats.
- Enhance and increase both on- and off-refuge environmental education and interpretation as well as wildlife observation and photography opportunities.
- Increase outreach to boaters, schoolchildren, local residents, and tourists.
- Use signs and other management techniques efficiently and effectively on wilderness rocks and islands to assist in maintaining their wildlife and intrinsic values while minimizing impacts to wilderness character.

Public Involvement

We provided a variety of opportunities for the public to be involved in the development and review of the CCP/WSP. This included two open houses, State and federal agency meetings, numerous meetings with partners and elected officials, three planning updates, three news releases, public review and comments on potential management options, and a 30-day public comment period for the Draft CCP/WSP/EA. The details of our public involvement program are described in Appendix K.

Changes Made to the CCP based on Comments

Based on public comments received, the CCP has been slightly modified. Changes include: coordination with Treaty Tribes regarding step-down planning for deer removal on Protection Island was added to a strategy used in several places in Chapter 2; the Service "may" rather than "will" initiate a new camping reservation system pending additional monitoring of the use; Appendix E the Integrated Pest Management Program was updated with information from a new Service policy (569 FW 1); several more potential partners were added to Appendix G.

Conclusion

Based on review and evaluation of the information contained in the supporting references, I have determined that implementing Alternative B as the CCP for Protection Island and San Juan Islands National Wildlife Refuges and the San Juan Islands Wilderness Stewardship Plan is not a major Federal action that would significantly affect the quality of the human environment within the meaning of section 102(2)(c) of the National Environmental Policy Act of 1969. Accordingly, we are not required to prepare an environmental impact statement.

Acting Regional Director, Region 1
Portland Oregon

9/28/10
Date

Supporting References

U.S. Fish and Wildlife Service. August 2010. *Protection Island and San Juan Islands National Wildlife Refuges Draft Comprehensive Conservation Plan, Draft Wilderness Stewardship Plan and Environmental Assessment* (Draft CCP/WSP/EA).

Summary of Changes between the Draft and Final Protection Island and San Juan Islands National Wildlife Refuges Comprehensive Conservation Plan, Wilderness Stewardship Plan and Environmental Assessment.

Appendix L. Public Comments on the Draft CCP/WSP/EA and Service Responses.

Note: This Finding of No Significant Impact and supporting references are available for public review at U.S. Fish and Wildlife Service, Washington Maritime National Wildlife Refuge Complex, 715 Holgerson Road, Sequim, Washington 98382, and U.S. Fish and Wildlife Service, Division of Planning, Visitor Services, and Transportation, 911 NE 11th Avenue, Portland, Oregon 97232.

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Chapter 1. Introduction and Background

1.1 Introduction

Protection Island National Wildlife Refuge and San Juan Islands National Wildlife Refuge (NWR or Refuge or Refuges) are managed by the U.S. Fish and Wildlife Service (USFWS or Service) as part of the National Wildlife Refuge System (NWRS or System). They are two of the six refuges that comprise the Washington Maritime National Wildlife Refuge Complex. Both of these Refuges are within a geographic area now known as the Salish Sea (Figure 1.1). The Salish Sea is a single estuarine ecosystem that extends from the north end of the Strait of Georgia to the west end of the Strait of Juan de Fuca and south to the southern extent of Puget Sound. It encompasses the inland marine waters of Southern British Columbia, Canada, and northern Washington, USA (WWU 2009).

Protection Island NWR is located in the Strait of Juan de Fuca near the entrance to Discovery Bay in Jefferson County, Washington. It includes 659 acres of land and tideland lease. Kanem Point, the part of Protection Island closest to the mainland, is 1.4 miles due north of Diamond Point and 5 miles due west of Port Townsend, Washington (Figure 1.2).

Most of the San Juan Islands NWR consists of rocks, reefs, and islands scattered throughout the San Juan Archipelago. Two islands, Smith and Minor, however, are located south of the archipelago within the Strait of Juan de Fuca. The Refuge consists of approximately 449 acres in Island, San Juan, Skagit, and Whatcom Counties, Washington. Most (353 acres) of San Juan Islands NWR is also designated wilderness known as the San Juan Islands Wilderness Area (see Figure 1.3).

1.2 Significance of the Refuges

Protection Island NWR

Protection Island was given its present name by Captain George Vancouver, who visited in May 1792 and described the landscape "as enchantingly beautiful as any of the most elegantly finished pleasure grounds in Europe" (Meany 1907). An early naturalist, Suckley (1859), referred to Protection Island as a "favored breeding ground of the rhinoceros auklet." Subsequent farming and livestock grazing for over 100 years, introduction of domestic cats, establishment of a Coast Artillery battery during WWII, major fires that burned much of the island during the 1940s and 50s, plus subdivision for summer homes and a resort during the late 1960s-70s, took their toll on the native plants and wildlife of Protection Island. Despite habitat alteration, local naturalists and conservation organizations recognized the significant wildlife values of the island and lobbied for its protection. In 1975 Washington State established the Zella M. Schultz Seabird Sanctuary on the southwestern tip of the island, and in 1982 Congress established the Protection Island NWR on the remaining portions of the island.

Native wildlife recovered such that today six species of seabirds (rhinoceros auklets, tufted puffin, pigeon guillemot, pelagic cormorant, double-crested cormorant, and glaucous-winged gulls) nest on Protection Island. This island continues to be particularly important for rhinoceros auklets. A recent survey indicates that the breeding colony on Protection Island may be the third largest in North America (Pearson et al. 2009) and it is one of just eight islands that support more than 95% of the North American breeding population of rhinoceros auklets (Gaston and Deschesne 1996). The island also supports a nesting pair of bald eagles, several black oystercatcher territories, resting and feeding areas for harlequin ducks and black brant, and many forest and grassland birds. In 1997, Protection Island became the first

location in Washington State where a few northern elephant seals were observed to haul-out and have pups (Jeffries et al 2000). The island is also a haul-out and pupping site for hundreds of the much smaller harbor seal. Paleontological materials, including remains of a mammoth and a giant beaver, have been seen on Protection Island and at other nearby sites, indicating there may be much more to learn about prehistoric wildlife from this nonrenewable resource.

Protection Island has been a center for learning and research since before the Refuge was established and continues to the present. The Service, along with other Federal and State agencies, as well as university professors and their students have conducted many studies on Protection Island. While Protection Island remains closed to the public to provide wildlife sanctuary, visitors and local residents can enjoy observing and listening to birds and marine mammals at a distance, from boats and points on the mainland.

San Juan Islands NWR

Though small in size, the scattered islands, rocks, and reefs of the San Juan Islands NWR are important for marine wildlife. An estimated 80 percent of the breeding population of black oystercatchers in Washington's inland marine waters are using the rocks and islands within the San Juan Islands NWR for nesting (Nysewander 2003). There is a rhinoceros auklet colony on Smith Island, which although much smaller than the Protection Island colony, is still important for this species. Several pairs of Brandt's cormorants were recently confirmed nesting and tending their young on an island within the Refuge. There are also 11 bald eagle nesting territories on Refuge islands. A few northern elephant seals and hundreds of harbor seals haul-out and care for their pups on Smith Island (Hayward 2003, Jeffries et al 2000). Federally threatened Steller sea lions as well as California sea lions haul out on a few Refuge rocks from fall through spring.

Matia Island, the largest within the Refuge, has a magnificent old-growth forest of Douglas-fir, cedars, and hemlocks. Refuge rocks and islands are also home to a number of rare and endemic plants including brittle prickly-pear cactus, California buttercup, and bear's foot sanicle. Refuge islands have significantly more species of native plants and fewer introduced species compared to adjacent islands (Bennett 2007).

The natural resources, recreational opportunities, and scenic beauty of the Salish Sea, including the San Juan Archipelago, have resulted in several special designations of the area. In addition to establishing the San Juan Islands NWR, most of this Refuge is also designated as the San Juan Islands Wilderness and therefore part of the National Wilderness Preservation System. The Refuge is within the Cascadia Marine Trail which is a National Recreation Trail and one of the premier water trails for non-motorized boaters in the United States. Two Refuge islands, one of them a wilderness island, provide opportunities to camp overnight. This facilitates wildlife observation and photography via non-motorized boats throughout the area. The Refuge is also an important part of the San Juan Islands Scenic Byway. Residents and tourists enjoy opportunities to learn about the Salish Sea and its natural resources as well as view wildlife and Refuge islands from ferries, commercial tour boats, and private boats.

Figure 1.1. Salish Sea

Data Sources: Populated Places and Country Boundaries from Natural Earth; Imagery from NASA Blue Marble; Elevation from NASA/CGIAR-CSI

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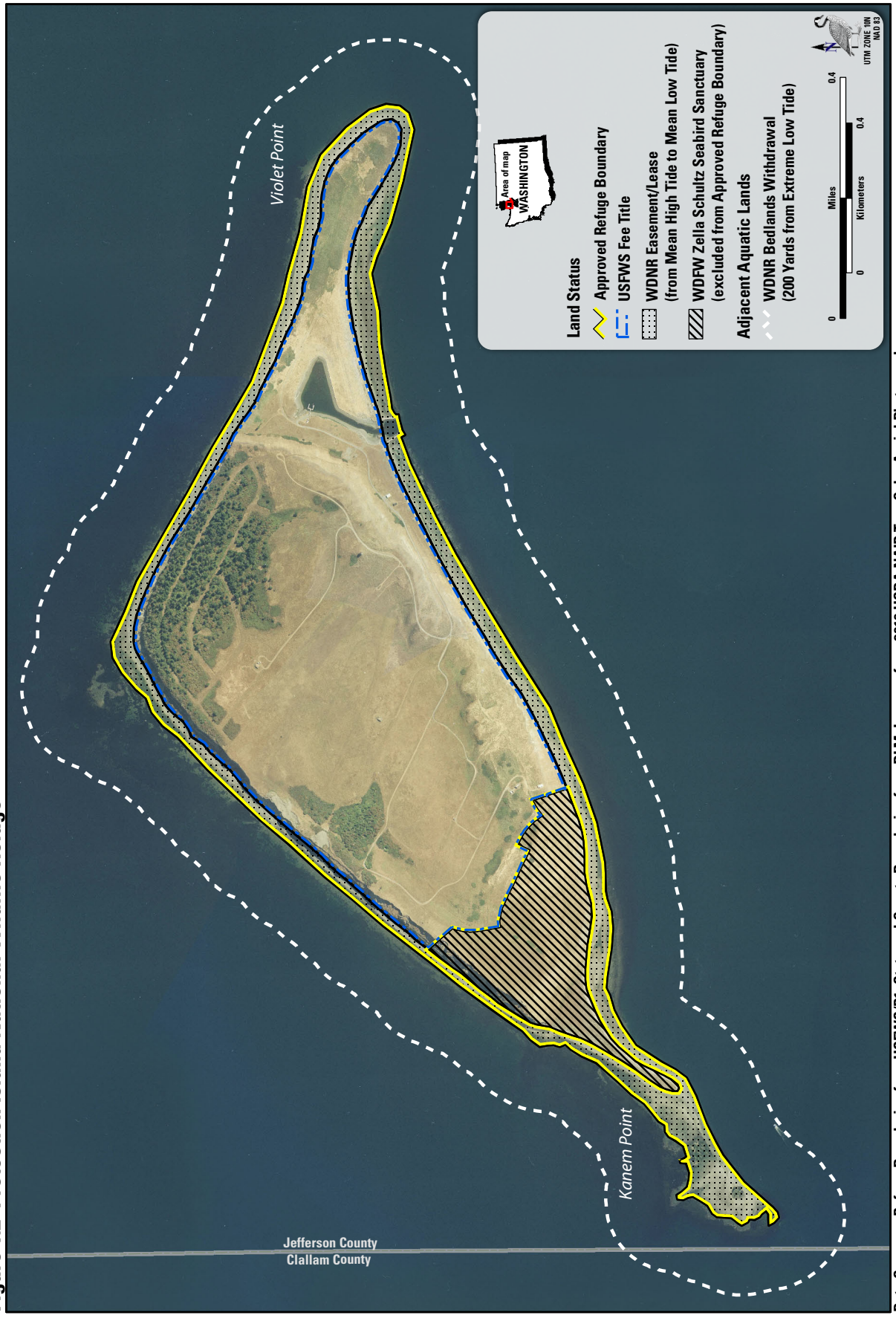

Figure 1.2 Protection Island National Wildlife Refuge

Data Sources: Refuge Boundaries from USFWS/R1; State and County Boundaries from BLM; Imagery from 2010 USDA NAIP True Color Aerial Photography

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Figure 1.3 San Juan Islands National Wildlife Refuge

San Juan Islands Refuge ID and Name

1. Small Island
2. Rum & Rim Islands
3. Fortress Island
4. Skull Island
5. Crab Island
6. Boulder Island
7. Davidson Rock
8. Castle Island
9. Blind Islands
10. Aleck Rocks
11. Swirl Island
12. Unnamed Rock
13. Unnamed
14. Unnamed
15. Hall Island
16. Unnamed
17. Secar Rock
18. Unnamed
19. Unnamed
20. Unnamed
21. Mummy Rocks
22. Unnamed
23. Shark Reef
24. Harbor Rock
25. North Pacific Rock
26. Halftide Rocks
27. Unnamed
28. Low Island
29. Pole Island
30. Barren Island
31. Battleship Island
32. Sentinel Rock
33. Center Reef
34. Gull Reef
35. Ripple Island
36. Unnamed (Shag Reef)
37. Unnamed (Little Cactus Island)
38. Gull Rock
39. Flattop Island
40. White Rocks
41. Mouatt Reef
42. Skipjack Island
43. Unnamed
44. Clements Reef
45. Unnamed
46. Parker Reef
47. The Sisters
48. Unnamed (Little Sister Island)
49. Unnamed
50. Tift Rocks
51. Reef Point
52. Turn Rock
53. Shag Rock
54. Flower Island
55. Willow Island
56. Lawson Rock
57. Pointer Island
58. Black Rock
59. Spindle Rock
60. Brown Rock
61. Unnamed
62. South Peapod Rock
63. Peapod Rocks
64. North Peapod Rock
65. Eliza Rock
66. Viti Rocks
68. Bird Rock
69. Unnamed
70. Low Island
71. Nob Island
72. Unnamed
73. Unnamed
74. Unnamed
75. Smith Island
76. Minor Island
77. Matia Island
78. Puffin Island
79. Turn Island
80. Bird Rocks
81. Williamson Rocks
82. Colville Island
83. Buck Island
84. Bare Island

Data Sources: Refuge Boundaries from USFWS/R1; State and County Boundaries from BLM; Elevation from USGS; Bathymetry from UW PRISM, NOAA, and NWIC; Roads from ESRI

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1.3 Purpose of and Need for the Plan

National Wildlife Refuge System (Refuge System) planning policy (Service Manual Part 602 FW3, June 21, 2000) states that the purpose of CCPs is to "describe the desired future conditions of a refuge and provide long-range guidance and management direction to achieve refuge purposes; help fulfill the National Wildlife Refuge System mission; maintain and, where appropriate, restore the ecological integrity of each refuge and the Refuge System; . . . and meet other mandates." The plan is expected to serve as a management guide for approximately the next 15 years.

Long-range management direction for the Refuges is needed to address Refuge management concerns for wildlife and habitats, including human-caused wildlife disturbance, the risk of oil spills, marine debris, the increasing deer herd on Protection Island, invasive species, and where possible, to anticipate management concerns related to climate change including sea level rise. There is a need to re-evaluate the research activities and facilities on Protection Island to see if they can be improved in ways that better support Refuge management. There is also a need to evaluate the quality, appropriateness, and compatibility of visitor services programs and activities.

Prior management plans for these Refuges were developed in the 1980s. These older plans are now outdated both in terms of Refuge resources and conditions, as well as current policies and mandates. This CCP supersedes the Master Plan for Protection Island National Wildlife Refuge (USFWS 1985), Refuge Management Plan for San Juan Islands National Wildlife Refuge (USFWS 1986) and the San Juan Islands Wilderness Plan (USFWS 1978).

1.4 Content and Scope of the Plan

The content and scope of this plan is based on meeting the requirements of the Administration Act, NEPA, and Service policies within the context of the purposes of the Refuges and the natural, cultural, and wilderness resources they contain. This plan includes:

- A long-term vision for each Refuge (inside cover and Chapter 1).
- Goals and objectives for Refuge resources, wilderness values, and public use programs, as well as strategies for achieving the objectives (Chapter 2).
- A description of the physical environment including geology and climate change (Chapter 3).
- A description of the Refuge biological resources, their conditions, and trends on the Refuges and within the ecosystem (Chapter 4).
- A description of the cultural resources and public use programs on and near the Refuges, as well as Refuge facilities, and local socioeconomic conditions (Chapter 5).
- Detailed information about Refuge establishment, land status, and habitat protection priorities (Appendix A).
- Information regarding specific rocks, islands, and reefs within the San Juan Islands NWR (Appendix B).
- Additional information about Priority Resources of Concern and Ecological Systems (Appendix C).
- Sign Plans for each of the Refuges (Appendix D) and an Integrated Pest Management Plan for the entire Complex (Appendix E).
- Descriptions of area beaches (Appendix F).
- Staffing, funding, and partnerships necessary to implement the plan (Appendix G).
- Wilderness Reviews and Minimum Requirements Analyses (Appendix H).

- Appropriateness Findings (Appendix I) and Compatibility Determinations (Appendix J) for Refuge uses.
- Summary of public involvement activities as well as legal compliance information (Appendix K).
- Public comments and Services responses on the Draft CCP (Appendix L).
- Guide to acronyms used in the document and well as some definitions (Appendix M).

1.5 Legal and Policy Guidance

Protection Island NWR and San Juan Islands NWR are managed as part of the National Wildlife Refuge System within the legal and policy framework of the U.S. Fish and Wildlife Service within the Department of the Interior. The Refuge System Administration Act of 1966, as amended, serves as the primary guidance for management of the System. The Wilderness Act also guides the management of the San Juan Islands NWR because most of this Refuge is included in the designated San Juan Islands Wilderness Area.

1.5.1 U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service is the principal Federal agency responsible for conserving, protecting and enhancing fish, wildlife, and plants and their habitats for the continuing benefit of the American people. The Service manages the National Wildlife Refuge System which includes Protection Island NWR and San Juan Islands NWR. It also operates national fish hatcheries, fishery resources offices, and ecological services field stations. The agency enforces federal wildlife laws, administers the Endangered Species Act, manages migratory bird populations, restores nationally significant fisheries, conserves and restores wildlife habitat such as wetlands, and helps foreign and Native American tribal governments with their conservation efforts. It also oversees the Federal Assistance program, which distributes hundreds of millions of dollars in excise taxes on fishing and hunting equipment to state fish and wildlife agencies.

The mission of the U.S. Fish and Wildlife Service is:

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

1.5.2 National Wildlife Refuge System

Starting with the first refuge, Florida's Pelican Island, established in 1903 by President Theodore Roosevelt, the National Wildlife Refuge System has grown to more than 150 million acres in size. It includes more than 520 refuges, at least one in every state, and thousands of small wetlands and other special management areas. The needs of wildlife and their habitats come first on refuges, in contrast to other public lands managed for multiple uses.

The National Wildlife Refuge System Administration Act

The National Wildlife Refuge System Administration Act of 1966, as amended (16 U.S.C. 668dd et seq.), serves as the primary guidance for management of the System. One very important amendment to the Administration Act was the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57). This amendment included a unifying mission for the Refuge System; a new process for determining compatible uses on refuges; and a requirement that each refuge will be managed under a Comprehensive Conservation Plan. It also states that wildlife conservation is the priority of NWRS lands and that the Secretary of the Interior shall ensure that the biological integrity, diversity, and environmental health of

refuge lands are maintained. Each refuge must be managed to fulfill the Refuge System mission and the specific purposes for which it was established. The Service is required to monitor the status and trends of fish, wildlife, and plants on each refuge. Additionally, the Act identifies six wildlife-dependent recreational uses. These uses are hunting, fishing, wildlife observation and photography, environmental education and interpretation. As priority public uses of the Refuge System, these uses will receive enhanced consideration over other uses in planning and management. Lands within the National Wildlife Refuge System are different from other, multiple-use public lands in that they are closed to all public uses unless specifically and legally opened. No refuge use may be allowed unless it is determined to be compatible with refuge purposes and the System Mission.

The Mission of the National Wildlife Refuge System is:

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

The Goals of the National Wildlife Refuge System are:

- 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. (Fish and Wildlife Service Manual Part 601 FW 1 sec1.8, June 2006)

1.5.3 National Wilderness Preservation System

The Wilderness Act of 1964 (16 U.S.C. 1131-1136, 78 Stat. 890) -- Public Law 88-577, approved September 3, 1964, directed the Secretary of the Interior and the Secretary of Agriculture to review every roadless area of 5,000 or more acres and every roadless island (regardless of size) within National Wildlife Refuges, National Parks, and National Forests and to recommend to the President the suitability of each such area or island for inclusion in the National Wilderness Preservation System, with final decisions made by Congress. The Act provides criteria for determining suitability and establishes restrictions on activities that can be undertaken on a designated area.

Under the authority of the Wilderness Act, over 20 million acres of land and water in 66 National Wildlife Refuges have been designated as part of the National Wilderness Preservation System by special Acts of Congress. The San Juan Islands Wilderness area, which includes 353 acres within the San Juan Islands NWR, was established in 1976 under Public law 94-557 (USFWS 2009a). The only parts of this Refuge that are not designated wilderness are Smith and Minor Islands, Turn Island, and a small portion

of Matia Island.

1.5.4 Other laws and mandates

Many other Federal laws, executive orders, Service policies, and international treaties govern the U.S. Fish and Wildlife Service and Refuge System lands. Examples include the Migratory Bird Treaty Act of 1918, Refuge Recreation Act of 1962, National Historic Preservation Act of 1966, and the Endangered Species Act of 1973. A list and brief description of Federal laws of interest to the Service can be found in the Laws Digest at http://www.fws.gov/laws.

Over the last few years, the Service has developed or revised numerous policies to reflect the mandates and intent of the Improvement Act. Some of these key policies include Comprehensive Conservation Planning process (602 FW 3); Appropriate Refuge Uses (603 FW 1); Compatibility (603 FW 2); Wildlife-Dependent Recreation (605 FW 1-7); Biological Integrity, Diversity, and Environmental Health (601 FW 3); and Pesticide Safety (242 FW 7). In addition, the Service has recently revised the Wilderness Stewardship policy (610 FW 2). These and many other policies that guide the U.S. Fish and Wildlife Service and management of Refuge System lands can be found within the Service Manual which can be accessed at http://www.fws.gov/policy/manuals/.

1.6 Refuge Establishment and Purposes

The Service defines the purposes of a National Wildlife Refuge when the refuge 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. Each refuge must be managed to fulfill the Refuge System mission and the specific purposes for which the refuge was established. Managers must consider all refuge purposes; however, purposes dealing with the conservation, management, and restoration of fish, wildlife and plants, and their habitats, take precedence over other purposes. If a conflict exists between the Refuge System mission and the refuge purposes, the purposes may supersede the mission. The following paragraphs identify refuge purposes with bold italics and provide a brief description of refuge establishment history related to those purposes. For more details on refuge establishment history, see Appendix A.

Protection Island NWR Establishment and Purposes (*purposes are bold and italicized*)

Refuge establishment was authorized by the Protection Island National Wildlife Refuge Act, Public Law 97 – 333, Oct 15, 1982 (96 Stat. 1623): "***The purposes of the refuge are to provide habitat for a broad diversity of bird species, with particular emphasis on protecting the nesting habitat of the bald eagle, tufted puffin, rhinoceros auklet, pigeon guillemot, and pelagic cormorant; to protect the hauling-out area of harbor seals; and to provide for scientific research and wildlife-oriented public education and interpretation*** (96 Stat. 1623)" and applies to all portions of Protection Island NWR. The first 1.42 acres of the Refuge were donated by Admiralty Audubon Society ". . ***in accordance with Public law 97-333 (96 Stat. 1623) Protection Island National Wildlife Refuge Act*** (Donation Warranty Deed, December 22, 1982)." Most of the over 800 tracts that make up the Refuge were authorized by the same act and purchased from 1983-1987 with funds authorized by the Land and Water Conservation Fund Act of 1965, as amended. Purposes of this fund include ***"acquisition of …(d) any areas authorized for the National Wildlife Refuge System by specific Acts"*** (16 U.S.C. 460l-9). The Service also has a 20-year aquatic lands lease for the second class tidelands around Protection Island (No 20-013245) from the Washington Department of Natural Resources (WDNR). This lease is authorized by the Fish and Wildlife Act of

1956, "*. . . **for the development, advancement, management, conservation, and protection of fish and wildlife resources** . . .*" (16 U.S.C.742 f(a)(4)).

San Juan Islands NWR Establishment and Purposes (*purposes are bold and italicized*)

San Juan Islands NWR was first established in 1960 to be ***". . . reserved under jurisdiction of the Bureau of Sport Fisheries and Wildlife, United States Fish and Wildlife Service. . ."*** (PLO 2249). In 1975, the San Juan Islands NWR was consolidated with Smith Island NWR (est. 1914), Matia Island NWR (est. 1937) and Jones Island NWR (est. 1937) and additional lands were reserved under the name of San Juan Islands NWR (PLO 5515). PLO 5515 does not state a purpose for this newly consolidated Refuge but an earlier proposal published in 38 FR 29831 on Oct 29, 1973, stated it was to ***". . .facilitate the management of migratory birds for which the United States has a responsibility under international treaties and to further effectuate the purposes of the Migratory Bird Conservation Act."*** Smith and Minor Islands also retain their original establishing purpose from E.O. 1959 ***"as a preserve, breeding ground and winter sanctuary for native birds."*** Similarly, Matia Island retains its original establishing purpose from E.O. 7595 ***". . . as a refuge and breeding ground for migratory birds and other wildlife."*** In October 1976, the San Juan Islands Wilderness was established (P.L. 94-557) which added the purposes of the Wilderness Act (P.L. 88-577, Sept. 3, 1964) including ***". . .to secure for the American people of present and future generations the benefits of an enduring resource of wilderness"*** to all units of the Refuge except for Smith, Minor, Turn, and Jones Islands, and a small portion of Matia Island. Under P.L. 97-333 (1982) and PLO 6489 (1983) Jones Island was removed from the San Juan Islands NWR and transferred to the State of Washington for use as a public recreation area. Under executive orders since the mid-to-late 1800s and in the Refuge establishing documents, it was stated that some islands which are now units of the San Juan Islands NWR retain ***"lighthouse purposes."*** These "lighthouse purposes" today translate into a variety of navigation aids which are maintained under the jurisdiction of the U.S. Coast Guard.

1.7 Relationship to Other Planning Efforts

When developing a CCP, the Service considers the goals, objectives, strategies, and other information available in existing national, regional, and ecosystem plans, state fish and wildlife conservation plans, and other landscape-scale plans developed for the same watershed or ecosystem in which the Refuges are located. To the extent possible, the CCP is expected to be consistent with the existing plans and assist in meeting their conservation goals and objectives. The following table identifies some of the key plans which were reviewed by members of the core team while developing the CCP. Columns indicate portions of the CCP/WSP where these plans were applicable.

Relationship of Other Planning Efforts to the Protection Island and San Juan Islands CCP/WSP **Plans Reviewed**	**Refuge Management Directon(Chapter 2)**	**Physical, Biological and Human**	**Appendices**
State of Washington Comprehensive Wildlife Conservation Strategy (WDFW 2005)	✓	✓	✓
Willamette Valley, Puget Trough, Georgia Basin Ecoregional Assessment (Floberg et al 2004)	✓	✓	
San Juan County Marine Stewardship Area Plan (Evans and	✓	✓	

Kennedy 2007)			
Strait of Juan de Fuca Geographic Response Plan (WDOE 2008)	✓		✓
San Juan Islands and North Puget Sound Geographic Response Plans (WDOE 2009)	✓		
DRAFT Rising to the Challenge: Strategic Plan for Responding to Accelerating Climate Change (USFWS 2009b)	✓		
DRAFT Strategic Plan for Inventories and Monitoring on National Wildlife Refuges: Adapting to Environmental Change (USFWS 2010)	✓		
The California Current Marine Bird Conservation Plan (Mills et al 2005)	✓	✓	
Seabird Conservation Plan (USFWS 2005)	✓	✓	✓
Black Oystercatcher (Haematopus bachmani) Conservation Action Plan (Tessler et al 2007)	✓	✓	
National Bald Eagle Management Guidelines (USFWS 2007)	✓	✓	
Recovery Plan for the Stellar Sea Lion (NMFS 2008)		✓	✓
2009-2015 Game Management Plan (WDFW 2008)		✓	
Recovery Plan For The Golden Paintbrush (Castilleja levisecta). (USFWS 2000)	✓	✓	

1.8 Issues Addressed in the CCP/WSP

The Service defines an issue as "Any unsettled matter that requires a management decision, e.g., an initiative, opportunity, resource management problem, threat to the resources of the unit, conflict in uses, public concern, or the presence of an undesirable resource condition (602 FW 1 1.6 K)." The following issues were addressed in the Draft CCP/WSP/EA (2010) and decisions regarding them are reflected in this CCP/WSP.

Human-caused wildlife disturbance: *How do we reduce the incidences of human-caused wildlife disturbance? How do we keep people and their pets off closed Refuge islands? How do we encourage boaters to stay far enough away from closed shorelines and closed islands to not disturb wildlife? How do we discourage low-flying aircraft?*

Oil and other contaminant spills: *What can the Service do to reduce the risk of oil and other contaminant spills? In the event of a spill, is there anything the Service can do to change or modify the impacts? How can we reduce the amount of liquid fuel transported to Protection Island? What can be done about local contaminants affecting Refuge resources (i.e., rogue creosote logs and marine pilings)?*

Marine debris and derelict fishing gear: *What role can the Service play in reducing the presence of marine debris and derelict fishing gear from the Refuge and adjacent marine areas?*

Invasive Species: *What can the Service do to prevent the introduction and dispersal of invasive plants and animals and facilitate their removal from the Refuges?*

Climate Change: *What monitoring is needed to better prepare for and address climate change impacts to species and habitats?*

Deer Management: *Should the Service eliminate deer on Protection Island to enhance seabird nesting habitat and reduce erosion?*

Habitat Restoration: *Should we actively restore native plant communities on the bluffs, shoreline, grasslands, and forests of the Refuges, and if so, which areas should be restored?*

Camping: *Should we continue to allow camping on Matia and Turn Islands? Are there ways of modifying the camping program to make it more appropriate for San Juan Islands Refuge and to better facilitate wildlife-dependent uses? How do we prevent illegal camping?*

Boat Access: *What is the best way to manage watercraft access to Refuge islands and still provide undisturbed shoreline for wildlife use? How do we reduce the incidences of unauthorized landings and trespass on closed shorelines and closed islands?*

Wildlife-Dependent Uses: *How do we educate Refuge visitors and the communities around the Refuges about the natural and cultural resources of the Salish Sea? How can we enhance visitors' abilities and opportunities to observe and photograph wildlife both on- and off-Refuge?*

Community Outreach: *How can we use community outreach to enhance Salish Sea conservation efforts?*

Wilderness: *How do we identify Refuge islands or inform the public to maintain a distance from the islands to prevent disturbance with Refuge signs and still meet the intent of wilderness? How do we maintain or enhance the visitor's wilderness experience on Matia Island and within the San Juan Archipelago?*

Research: *How can the Service improve coordination with the larger research community? What research studies would assist in answering Refuge management questions? How can impacts to wildlife and habitats from research activities be minimized? How can the Service encourage off-Refuge research which benefits Refuge resources?*

1.9 Refuge Vision Statements

Protection Island NWR

Protection Island's unique combination of shoreline, spits, and sandy bluffs are a safe haven for thousands of nesting rhinoceros auklets, as well as tufted puffins, pigeon guillemots, and pelagic cormorants. Bald eagles roost and nest in the forested uplands while harbor seals and elephant seals haul out and raise their pups on the shoreline. Environmental education opportunities are available to dedicated college students and volunteers through research and stewardship projects. Staff and partners cooperatively conduct monitoring and research on the flora and fauna, providing sound science to inform management. Refuge staff and year-round resident caretakers maintain minimal infrastructure. Although the island is located close to human population centers, people respect wildlife's need for refugia and maintain a distance from shorelines while viewing the abundant seabird and marine mammals that can be found on the island. Amid the cacophony of wildlife, a sense of peace nurtures the desire to care for the natural treasure that is Protection Island.

San Juan Islands NWR

The San Juan Islands NWR is a sanctuary for a dazzling array of marine life, including black oystercatchers, pigeon guillemots, tufted puffins, pelagic and double-crested cormorants, glaucous-winged gulls, and pinnipeds. Nestled among large islands and marine waters abuzz with human activity, the Refuge encompasses many small islands, rocks, and reefs scattered throughout the San Juan Archipelago. The breathtaking forces of nature shaped this marine wilderness embracing many miles of

shoreline, reefs, lichened rocks, bluffs and old-growth forests. These wild lands inhabited by wild creatures and supporting healthy breeding seabird colonies provide the backdrop for folks to enjoy, appreciate, and understand the Refuge's valuable place in the Salish Sea ecosystem. Working with partners, we provide opportunities for researchers, boaters, birders, and other nature lovers to develop a stewardship ethic for our Refuge islands.

1.10 Refuge Goals

Goal 1: Protect, maintain, and restore high quality natural shoreline and rocky cliff habitats for optimum productivity and abundance of seabirds, marine mammals, waterfowl, and shorebirds.

Goal 2: Protect, maintain, and restore the native vegetative communities and structure of sandy bluffs to maximize habitat for breeding seabirds.

Goal 3: Restore, maintain, and protect high quality native savanna, grasslands, and herbaceous bald habitat to increase the species diversity, richness, and population levels of associated flora and fauna.

Goal 4: Restore, maintain, and protect the species richness and diversity of the forests and woodlands by fostering a complex understory and diversity of tree age classes.

Goal 5: Restore, maintain, and protect the biological integrity of natural, small wetlands to increase species diversity and productivity.

Goal 6: Increase Refuge visitors' knowledge of the natural and cultural resources of the Salish Sea ecosystem; help visitors understand the role of the National Wildlife Refuge System; and encourage them to contribute to the stewardship of Protection Island and San Juan Islands NWRs.

Goal 7: Increase Salish Sea residents' and visitors' knowledge of the natural and cultural resources of the ecosystem; help them understand the Refuges' role in protecting those resources, and learn how they can reduce their impacts to those resources.

Goal 8: Promote the wilderness character and experience of the San Juan Islands Wilderness Area.

Goal 9: Encourage and support collection of scientific information that assists in managing Refuge resources and contributes to a greater understanding of the natural and cultural resources of the Salish Sea ecosystem.

1.11 Planning Process

The Service began the process of gathering information needed in developing a CCP/WSP for these Refuges in 2006. The core planning team consists of a project leader, deputy project leader, biologist, public use/law enforcement officer, GIS specialist, and a regional planner. An extended team assisted in the development of the CCP by providing special expertise and/or by reviewing and commenting on early drafts of the plan. The extended team consisted of various professionals from other agencies and within the Service. A list of core and extended team members is located in Appendix K.

The National Wildlife Refuge System Improvement Act requires that the public have an opportunity for active involvement in CCP development and revision. Service policy also states that CCPs are to be developed in an open, public process and the agency is committed to securing public input throughout the

process. A Notice of Intent (NOI) was published in the Federal Register on August 14, 2007, to invite the public to participate in the planning process and solicit their comments. Additional outreach efforts during initial scoping (Aug 2007-April 2008) emphasized face-to-face meetings with key state and federal agencies, marine resource committees, federally elected officials, tribal governments, non-governmental organizations, and the research community. After initial public scoping, preliminary management options were presented at two public open house meetings in September 2008, and additional agency coordination occurred. A Notice of Availability of the Draft CCP/WSP/EA was published in the Federal Register on August 18, 2010 followed by a 30-day public comment period. The Service also distributed planning updates, initiated news releases, and gave presentations at community and other non-governmental organizations to inform the public, invite discussion and solicit feedback. Planning issues, preliminary management alternatives and internal and public drafts of the CCP and this final CCP were developed taking into consideration comments received throughout the planning process. Additional information regarding public involvement activities is located in Appendix K.

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Chapter 2. Refuge Management Direction

2.1 Considerations in the Design of the CCP

During development of the CCP, the Service reviewed and considered a variety of local and regional physical and biological resource conditions, as well as social, economic, and organizational aspects important for managing the Refuges. This background information is described more fully in Chapters 3, 4, and 5. As is appropriate for a National Wildlife Refuge, natural resource considerations were fundamental in designing the management plan. House Report 105-106, accompanying the National Wildlife Refuge System Improvement Act of 1997 (Pubic Law 105-57), states "…the fundamental mission of our System is wildlife conservation: wildlife and wildlife conservation must come first."

Public involvement was an important part of the planning process. Local, State, and Federal agencies and elected officials were contacted by the Refuge planning team to ascertain priorities and problems as perceived by others. The team also contacted Refuge users, nonprofit groups, and community organizations to ensure that their comments and ideas were considered during the development of the CCP. Preliminary management concepts and strategies were presented to the public in a planning update and at two public meetings in September 2008. The Draft CCP/WSP/EA, which described three management alternatives for the refuges, was released in August 2010. More details regarding public involvement can be found in Appendix K. Changes to the plan were made based on comments throughout the planning process. The goals, objectives, and strategies in this chapter comprise the adopted management direction for the two refuges.

2.2 General Guidelines

2.2.1 Implementation Subject to Funding Availability

Actions will be implemented over a period of 15 years as funding becomes available. Priorities are identified in Appendix G although special funding initiatives, unforeseeable management issues, and other budget issues will likely require adjustments to the implementation schedule. The CCP will be reviewed at least every five years and updated as necessary.

2.2.2 Integrated Pest Management (IPM)

In accordance with Department of the Interior and Service Policies (517 DM 1, 569 FW 1) and with state law RCW 17.10, an integrated pest management (IPM) approach will be utilized to eradicate, control, or contain pest, nuisance, and invasive species on the Washington Maritime National Wildlife Refuge Complex (Complex). IPM would involve determining the best control methods based upon effectiveness, cost, and minimal ecological disruption. These methods may include physical, cultural, biological, and chemical treatments which may be used alone or in combinations. If a pesticide would be needed on a Refuge, the most specific (selective) chemical available for the target species would be used unless considerations of persistence or other environmental and/or biotic hazards would preclude it. Appendix E provides more details regarding the selective use of pesticides for pest management on the Refuges.

2.2.3 Minimizing Human-caused Wildlife Disturbance

Current staffing and funding levels limit staff presence in this very popular boating area. As a result, enforcement of regulations, including no trespassing on closed islands and no harassment of Refuge wildlife, is limited. Limited staff also means there are few contacts with boaters and other visitors and limited capacity to educate the public about "why a closer look hurts." Refuge staff and partners have

identified the reduction of human disturbance to be one of the highest priorities for seabird and marine mammal management (USFWS 2005, WDFW 2005, NMFS 2008, Evans and Kennedy 2007, Mills et al. 2005). Given the increasing levels of recreation in the area (see Chapter 5) and limited places of refuge for wildlife in the San Juan Archipelago, efforts must be made to protect wildlife from human disturbance on Refuge islands. Throughout the term of this plan, Refuge staff will continue to prohibit public access on Refuge lands except for designated areas of Matia and Turn Islands; work with volunteers and partners (U.S. Coast Guard, Washington State Parks and Recreation Commission, Washington Department of Fish and Wildlife (WDFW), Sheriff's Office, Sound Watch, commercial cruise boats, etc.) to adequately patrol Refuge islands and to report incidences of non-compliance; and cooperate with Washington Department of Natural Resources (WDNR) to maintain a 200-yard conservation lease and tideland withdrawal at Protection Island NWR to reduce human disturbance. Also see Chapter 4 for more information regarding the threat of human-caused disturbance.

2.2.4 Participation in Regional Planning and Conservation Efforts

Refuge staff will actively participate in and contribute to planning and conservation efforts for ongoing and future land and energy development projects, monitoring and research associated with climate change, oil spill response, removal of derelict fishing gear, and other activities that may affect Refuge wildlife resources and habitats. Pre-spill planning and preparedness is required by the Federal Oil and Pollution Act of 1990. Refuge staff have been involved with Washington State Department of Ecology and others in preparing Area Geographic Response Plans, as part of the oil and hazardous substance spill prevention and response (RCW Title 90 Chapter 90.56). Participation in the North Pacific Coast Landscape Conservation Cooperative will provide Refuge staff with a means to tie in with a larger scale assessment of the impacts of climate change (USFWS 2009a). Protecting focal resources by supporting partners' efforts to reduce or eliminate fisheries bycatch and the removal of derelict fishing gear continues to be a priority for the Refuges. Staff will cultivate working relationships with pertinent local, county, State, and Federal agencies to stay abreast of current and potential developments, and will utilize outreach, education, and information as needed to raise awareness of Refuge resources and their dependence on a healthy local environment.

2.2.5 Cultural Resources Protection

The Service will continue to uphold Federal laws protecting cultural resources, including the National Historic Preservation Act (NHPA), Archaeological Resources Protection Act (ARPA), and Native American Graves Protection and Repatriation Act (NAGPRA). These laws also mandate consultation with Native American tribes, the State Historic Preservation Office (SHPO), and other preservation partners. The NHPA mandates that all projects that use federal funding, permitting, or licensing be reviewed by a cultural resource professional to determine if there is the potential to affect cultural resources. An inventory will be conducted as necessary, and appropriate actions to mitigate effects will be identified prior to implementation of the project. A project-specific determination will be conducted for all undertakings as defined by NHPA, including habitat maintenance and restoration projects as well as new or expanded trails, roads, facilities, and public use areas.

2.2.6 Paleontological Resources Protection

The Service will continue to uphold laws protecting paleontological resources. These include the National Environmental Policy Act of 1969 (NEPA), the Paleontological Resources Preservation Act of 2009 (PRPA), and various sections of Fish and Wildlife Service regulations. If found in direct association with archaeological resources, they are also protected by the Archaeological Resources Protection Act (ARPA Section 3).

2.2.7 Maintenance of Existing Facilities

Periodic maintenance and upgrading of refuge buildings and facilities is necessary for safety and accessibility and to support management and visitor needs, and is incorporated in the Service Asset Management System.

2.2.8 State Coordination

The Service will continue to coordinate with Washington State agencies regarding areas of mutual interest. This includes communications with WDFW regarding management of state wildlife resources, and in particular, the state-owned Zella Schultz Seabird Sanctuary on Protection Island; WDNR regarding aquatic lands management; Washington State Parks and Recreation Commission regarding Visitor Services programs on Turn and Matia Islands.

2.2.9 Tribal Coordination

Communication with Native American Tribes who have an interest in the Refuges would continue. The Service seeks assistance from Tribes on NAGPRA and NHPA and related issues. The Service is also interested in partnering with Tribes to provide cultural resources education and interpretation opportunities.

2.2.10 Protection Island Site Plan Development and Implementation

Many Refuge buildings on Protection Island NWR need to be removed, upgraded, or replaced. Expanding solar power capabilities and reducing the need to transport liquid fuels to the island is another high priority. Several roads associated with prior resort development on the island have been decommissioned while others are still being used for Refuge management purposes, however their locations may not be ideal. At the same time, some seabird areas have expanded or changed locations and are now in close proximity to buildings. The CCP includes the development and implementation of a site plan for all Refuge administration and research facilities, buildings, roads, and trails on Protection Island NWR to improve Refuge management capability, facilitate research activities, and reduce disturbance to important wildlife habitat areas.

2.2.11 Increase Land and Resource Protection

Due to the high level of management concern, Refuge staff will work in cooperation with the State to increase protection of Refuge islands. Protections include coordinating with WDFW to include Zella M. Schultz Seabird Sanctuary in the Protection Island Refuge boundary; allowing the enforcement of Refuge laws and regulations throughout the island; cooperating with WDNR in establishing an aquatic reserve designation around Protection and Smith/Minor Islands; working with WDNR to acquire tideland and bedland leases/withdrawls around Refuge islands; and limiting or eliminating aquaculture activities near Refuge islands.

2.2.12 Fire Management

The overall objective for fire management on the Refuges is to promote a program that provides for firefighter and public safety, reduces the occurrence of human-caused fires, and ensures appropriate suppression response capability to meet expected wildland fire complexity. A Fire Management Plan was completed for the entire Complex, including Protection Island and San Juan Islands Refuges, in 2004. The use of prescribed fire as a management tool was not included in that plan. Because the CCP describes habitat restoration projects and IPM techniques that may include the use of prescibed fire, the Fire Management Plan will be updated to reflect this.

2.2.13 Increase Staffing Levels

Increased staffing is needed to accomplish the actions identified in the CCP. While increased staffing is never guaranteed, it is anticipated that over the 15-year life of the CCP there will be some increase in staffing levels. For additional information regarding staffing levels, see Appendix G.

2.3 Summary of CCP Actions

The CCP will continue many current management practices, such as removing unnecessary roads and human structures; monitoring wildlife species; and working with partners to reduce the risk of oil spills, clean up marine debris, and educate boaters to minimize human-caused wildlife disturbance. The Plan also furthers Refuge management with more active habitat management projects, such as removing deer from Protection Island to enhance seabird nesting habitat and forest habitat; restoration projects on the spits, grasslands, and forests to increase native plant diversity; and the facilitation of research studies that answer Refuge management questions.

Public use changes include enforcing no-pets regulations on all San Juan Islands Refuge lands and closing some areas on Turn Island, including all of the rocky shoreline to the east and the south east "pocket" beach as well as some of the Island's interior. Overnight camping on Turn and Matia Islands would be limited to visitors arriving by human-powered craft only. There would be more emphasis on enhancing the public's understanding and appreciation of the Refuges' natural, cultural, and wilderness resources through both on- and off-Refuge interpretation and education programs. There would be fewer large signs but more medium sized signs installed on San Juan Islands Refuge units to discourage close approach or trespassing on closed islands. There would also be more emphasis on working with existing partners and developing new partnerships to accomplish objectives. Table 2.1 contains additional details regarding actions associated with the CCP.

Table 2.1 Summary of CCP Actions (PI = Protection Island Refuge and SJI = San Juan Islands Refuge)

HABITAT MANAGEMENT	
Multiple Habitats	- Increase efforts to work with partners to minimize human disturbance to wildlife and habitats. - Work with WDNR to renew and enhance the Service's ability to manage the tidelands and protect bedlands up to 200 yards waterward from the low water line around PI and SJI. - Participate in oil spill prevention and preparedness planning and activities in PI and SJI vicinity. - Regularly work with partners and volunteers to conduct yearly shoreline clean-up activities on all Refuge islands. Support off-Refuge efforts to remove derelict fishing gear from the marine environment surrounding the Refuges. - Survey and use IPM strategies on invasive species. Include prescribed burning as a potential restoration and IPM tool. - Coordinate with WDFW and the Point No Point Treaty Tribes in the development of a step-down plan to remove deer from Protection Island. - Monitor for and remove non-native rats, rabbits, and red fox. - Conduct a survey of mammalian predators, assess impacts, and develop a management plan if necessary.
Shoreline	- Restore a total of approximately 41 acres of spit habitat on PI, Smith, and Minor Islands to native-species-dominated strand community and manage spits for more open vegetation. - Occasional mowing of spits on PI. - Continue shoreline nourishment with gravel stockpiles on PI. - Remove marine debris and contaminated materials. - Conduct a survey of herbivores and predators of management concern, assess impacts, and develop a management plan if necessary.
Sandy Bluffs	- Control invasive plants and increase native plants. - At end of lease term, remove structures and improve habitat conditions in the expanding area of the auklet colony. - Enhance vegetation characteristics on up to 20 acres of bluffs on PI.
Savanna Grasslands and Herbaceous Balds	- Removal of unnecessary roads and structures on PI. - Restore up to 200 acres of savanna grassland on PI and up to 20 acres on Smith and Turn Islands to increase native species composition to benefit a variety of wildlife. - Maintain herbaceous bald patches, and where appropriate, associated rare plants on 28 islands within SJI.
Forests and Woodlands	- Removal of unnecessary roads on PI. - Restore connectivity, crown closure, regeneration, and associated understory of 80 acres of forest and woodland on PI. - Increase protection and maintenance of mature and old-growth forests and associated understory on 6 islands within SJI.
Wetlands	- Determine if it is feasible to restore part of the historic wetlands on PI. - Conduct hydrologic study, and if needed, restore natural hydrology to Smith and Matia Islands wetlands. - Monitor and control invasive plants and animals.
RESEARCH AND MONITORING	
Research Program Management	- Increase collaboration between the Service and the larger research community. - Place more emphasis on studies that answer Refuge management questions and species information gaps. - Replace old buildings with a single bunkhouse relocated on PI to serve researchers and short-term volunteers. -Develop Refuge databases, GIS layers, and integrate data into regional databases.

Research	- Conduct research to determine best habitat restoration methods. - Study erosion rates of bluffs and deposition on spits. - Research to evaluate wildlife response to habitat restoration. - Demography studies of seabirds and marine mammals. - Hydrology studies of wetlands. - Glaucous-winged gull behavior studies. - Studies on a variety of other topics.
Surveys	- Long-term monitoring of rhinoceros auklets, pigeon guillemots, glaucous-winged gulls, and marine mammals. - Summer wildlife surveys. - Refuge and ecosystem-wide monitoring of nesting seabirds and black oystercatchers. - Bald eagle surveys. - Periodic surveys for rare butterflies and rare plants. -Winter wildlife surveys. - Breeding bird survey on PI.
Scientific Assessments	- Systematically complete plant surveys on SJI. - Determine and map Refuge vegetation types to the association level. - Conduct assessment of reptiles and amphibians. - Conduct assessment of invasive wetland species as well as herbivores and predators of management concern.
Cultural and Paleontological Resources	- Complete prioritized systematic cultural resource surveys of all Refuge lands and resurvey known sites approximately every 5 years. - Systematic paleontological survey on PI. - Develop GIS layer for paleontological resources.
Effectiveness Monitoring	- As strategies are implemented, monitor progress toward meeting CCP objectives under Goals 1-8.
ON-REFUGE VISITOR SERVICES AND FACILITIES	
Protection Island	No public access.
SJI - Refuge entry areas and open and closed areas.	Turn Island - West and southwest beaches are the only authorized entry and boat landing areas. - Southeast beach is closed to landing and public use. - Designated public use area and loop trail are open to visitors; the rest of the island is closed.
	Matia Island - Rolfe Cove dock and beach are the only authorized entrances to the island. - Refuge access and camping prohibited at or from the 4 other pocket beaches. - 2-acre public use area adjacent to Rolfe Cove is open to day-use and camping. - Wilderness loop trail is open to visitors; the rest of the island (wilderness area and island perimeter) is closed. - All other Refuge islands and rocks are closed.
SJI - Public Use Times and Other Restrictions	. - Turn and Matia public use areas open to day-use. - Outside of day-use hours, only authorized campers arriving via human-powered boats are allowed on Turn and Matia Islands.

	- No pets allowed.
SJI - WA State Parks Seasonal Dock and Mooring Buoys	Dock on Matia Island at Rolfe Cove from mid-April to mid/late-October. Turn – 3 buoys off N. beach – available year round. Matia – 2 buoys in Rolfe Cove - available year round.
SJI - Camping	- Camping allowed only in designated campsites: Turn Is. - 8 campsites. Matia Is. - 6 campsites. - Only visitors arriving by human-powered boats are permitted to camp on the Refuge. - New camping reservation system may be initiated pending additional monitoring of camping compliance.
SJI - Campfires	Matia and Turn – Better enforcement of no fires. Liquid fuel or gel camp stoves allowed.
SJI - Trails	Re-evaluate trail locations for impacts to cultural resources and small meadow. Reroute if necessary but continue to provide a loop trail on both Turn and Matia Islands.
Wildlife Observation, Photography, and Interpretation	- Design and install informational and interpretive signs at Turn and Matia Islands. - Develop interpretive trail at Turn Island. - Local experts and/or trained volunteers provide short "ranger" programs during some summer weekends.
Environmental Education - Scientific Studies	At least 3 college students/5 years given opportunities to do scientific studies on PI and SJI.
Environmental Education - Stewardship Projects	PI - 1+ projects per year SJI - 1+ projects per year
SJI - Commercial Outfitters	Outfitters allowed for camping and day-use on Turn and Matia Islands. Special use permit required.
Visitor Services Facilities and Maintenance	WA State Parks provides public-use facilities (toilets, picnic tables, campsite markers, etc.) and maintenance on Turn and Matia Islands.
SJI - Law enforcement for public safety/resource protection on Turn and Matia.	WA State Parks enforces State Parks regulations and new Service regulations on all of Turn and Matia Islands. The Service enforces regulations on all Refuge lands.
OFF-REFUGE VISITOR SERVICES	
Wildlife Observation and Photography	- Increased Refuge staff time, volunteers, and partners facilitate and educate many individuals, organizations, and ecotourism businesses to enhance wildlife observation and appreciation of Refuge wildlife and minimize human-caused wildlife disturbance.
Natural and Cultural Resource Interpretation	- PI – 1 panel at John Wayne Marina,1 panel in Port Townsend area, and 2 additional interpretive venues. - SJI – Panels at 5 marina locations and 2 additional interpretive venues.
Environmental Education Materials	- Provide educational materials prepared for use by local teachers. - Provide information at local community events, tourist agencies, ferries, etc. - SJI - Refuge poster at marinas.

	- SJI - Refuge poster at marinas.
Boater Education to Reduce Human-Caused Wildlife Disturbance	PI - Continue direct boater education. PI & SJI - Increase educational materials, working with partners, and direct contacts with boaters to improve education regarding human-caused disturbance to wildlife.
SAN JUAN ISLANDS WILDERNESS	
Many of the above actions apply to wilderness as well as non-wilderness lands. The following items are more specific to wilderness concerns.	
Refuge Signs to Reduce Human-Caused Wildlife Disturbance	Improve text and increase size of boundary/ closure signs to medium (15'' x 20'') on most islands and a larger version (22" x 28") on some islands. Use very large "stay away 200 yds" signs on up to 10 of the most sensitive islands.
Sights and Sounds	- Use only tools authorized for wilderness areas (e.g., no chainsaws) to maintain a narrow and natural appearing trail on Matia Island. - Conduct garbage and marine debris cleanups. - Promote 2000-foot aircraft ceiling over wilderness islands.
Solitude and Numbers of Visitors	- Enhance enforcement of limited landing and camping areas. - Limit the size of commercial day-use groups to not more than 20 people.
Wilderness Education	Integrate wilderness themes and messages in new or updated Refuge information products, interpretive panels, volunteer training, and outreach programs whenever appropriate.

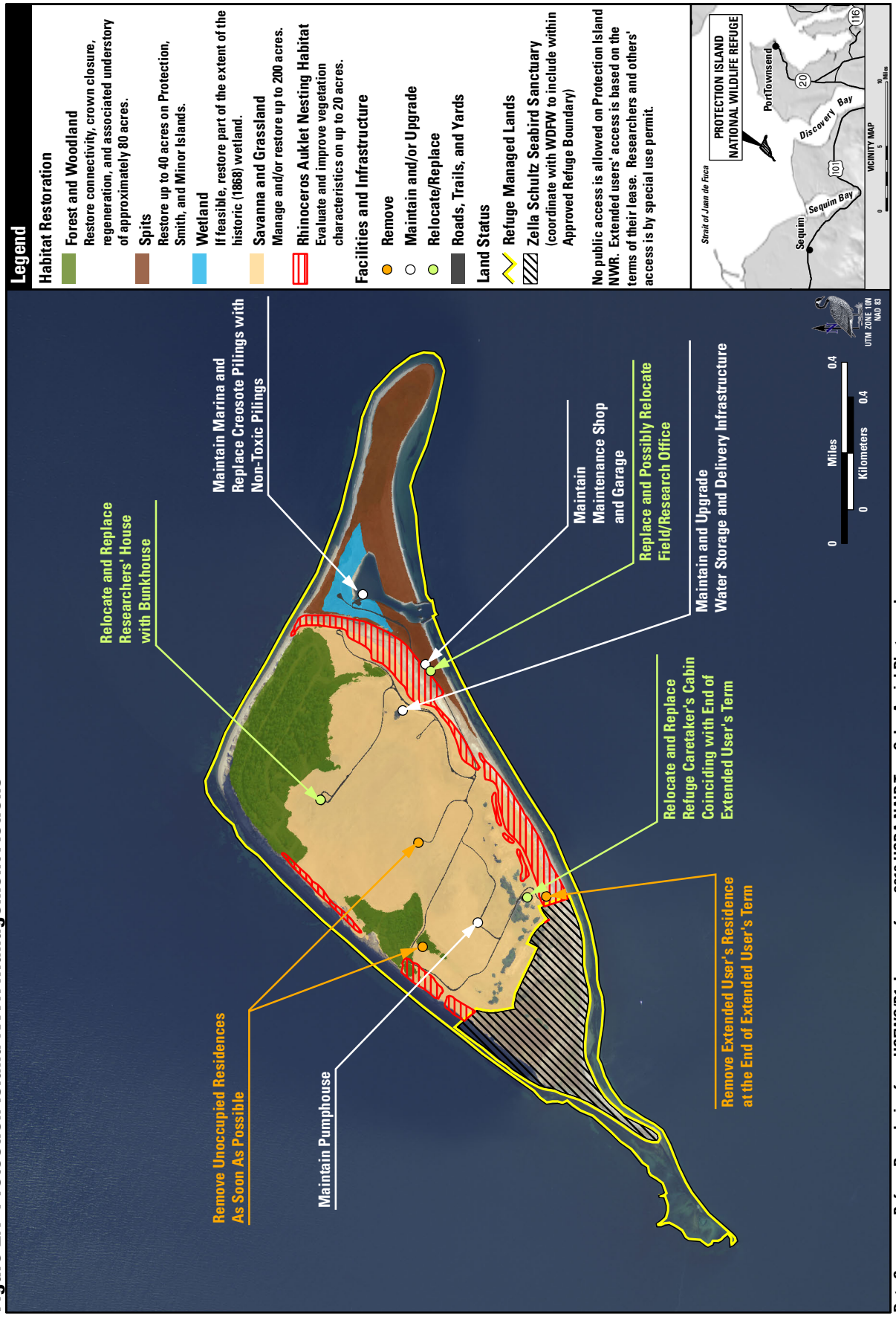

Figure 2.1 Protection Island NWR Management Actions

Data Sources: Refuge Boundaries from USFWS/R1; Imagery from 2010 USDA NAIP True Color Aerial Photography

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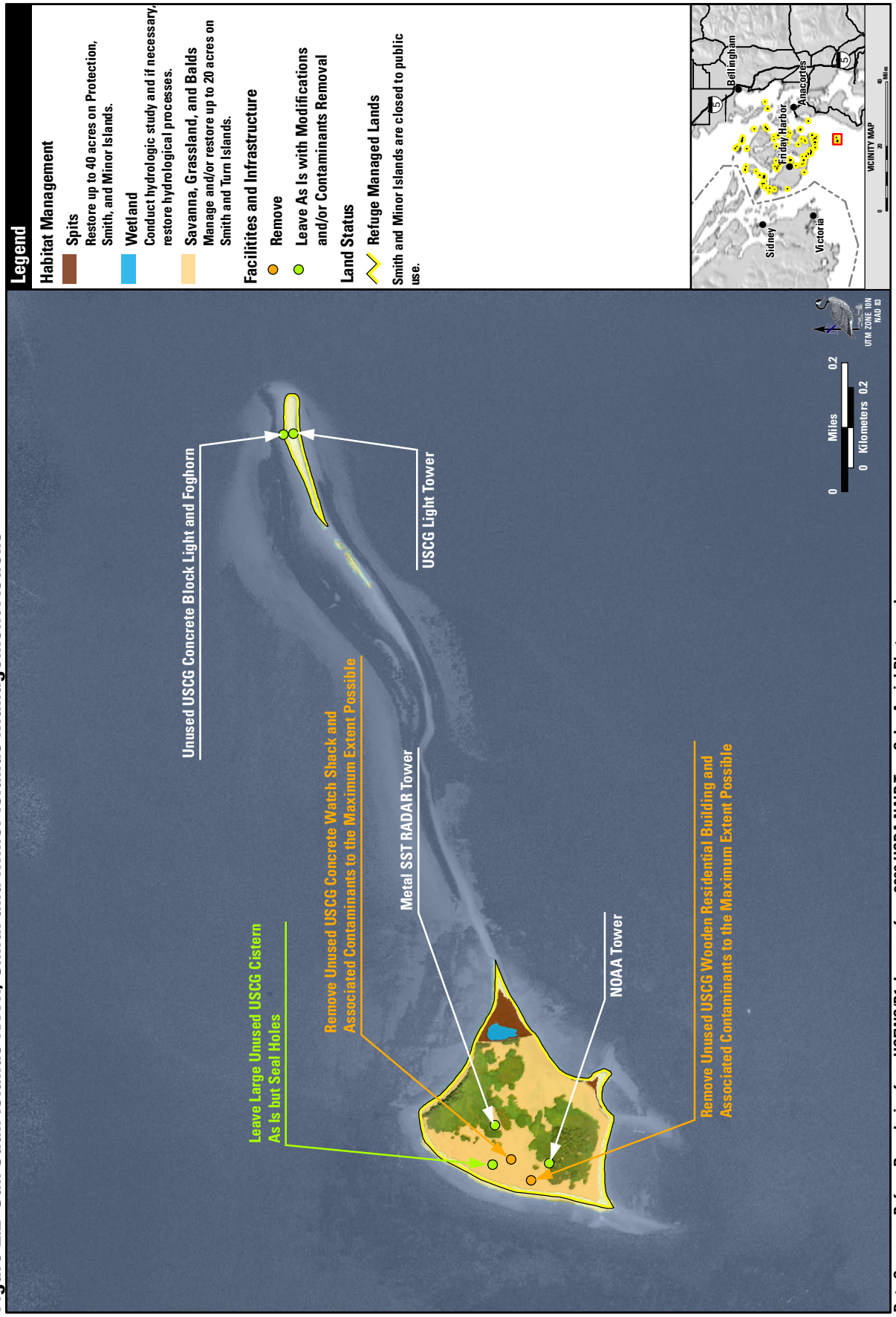

Figure 2.2 San Juan Islands NWR, Smith and Minor Islands Management Actions

Data Sources: Refuge Boundaries from USFWS/R1; Imagery from 2006 USDA NAIP True Color Aerial Photography

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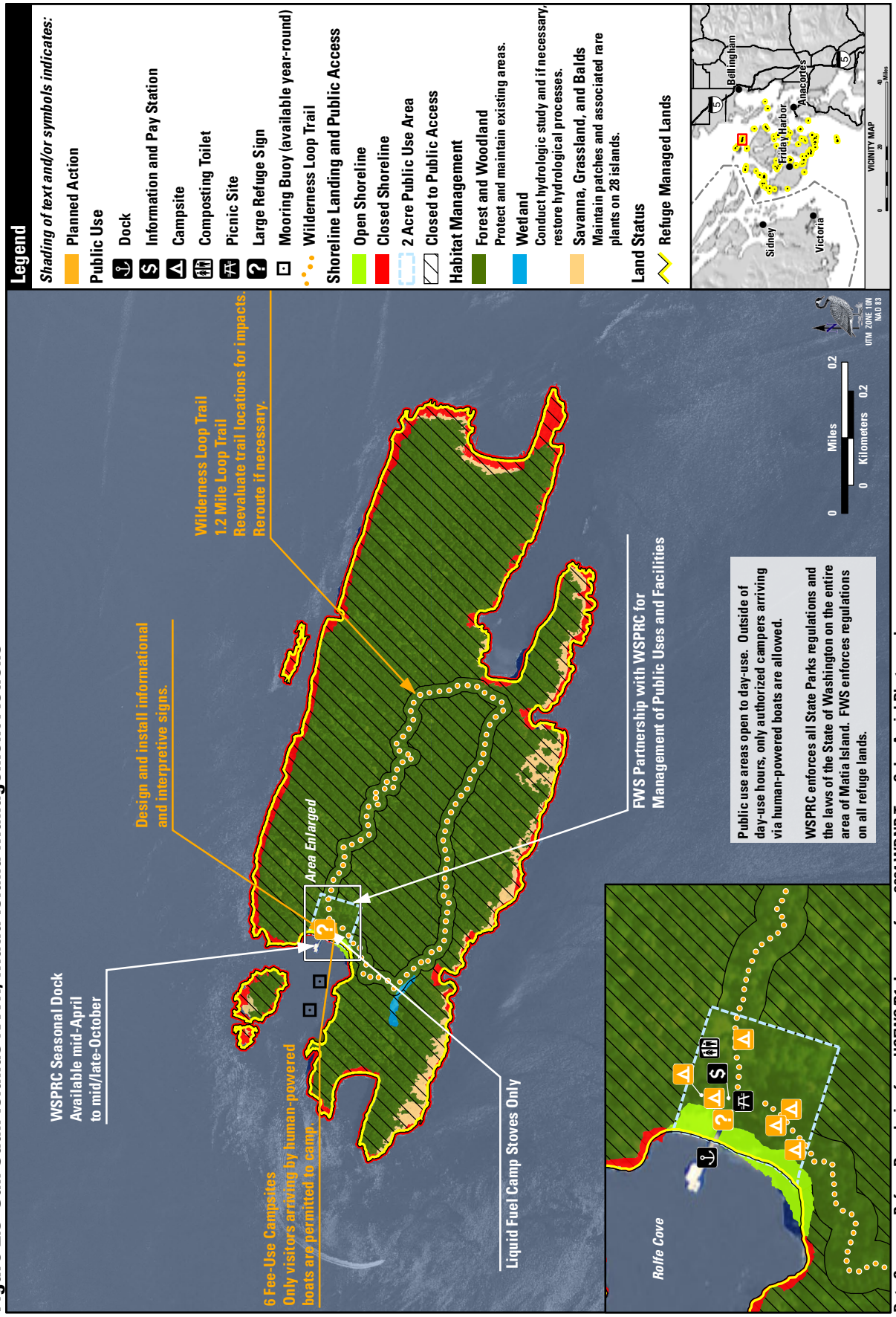

Data Sources: Refuge Boundaries from USFWS/R1; Imagery from 2004 WDNR True Color Aerial Photography

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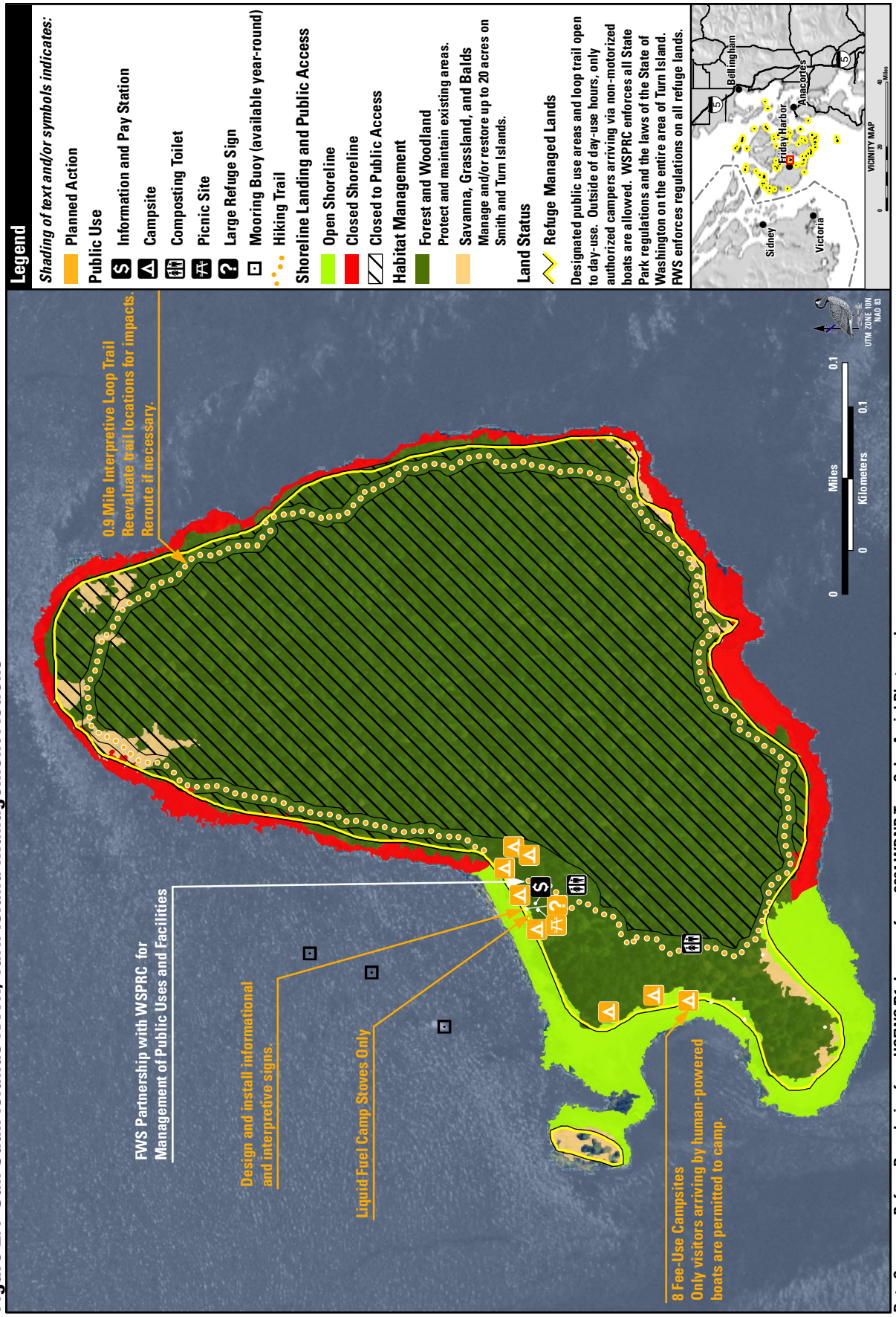

Figure 2.4 San Juan Islands NWR, Turn Island Management Actions

Data Sources: Refuge Boundaries from USFWS/R1; Imagery from 2004 WDNR True Color Aerial Photography

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2.4 Goals, Objectives, and Strategies

Goals and objectives are the unifying elements of successful refuge management. They focus and describe management priorities and actions that resolve issues and help bring a refuge closer to its vision. A vision broadly reflects the refuge purposes, the Refuge System mission and goals, other statutory requirements, and larger-scale plans as appropriate. Public use and wildlife/habitat management goals then define general targets in support of the vision, followed by objectives that direct effort into incremental and measurable steps toward achieving those goals. Finally, strategies identify specific tools and actions to accomplish objectives.

The goals for Protection Island and San Juan Islands Refuges over the next 15 years under the CCP are presented on the following pages. The goal order does not imply any priority. Each goal is followed by the objectives that pertain to that goal. Some objectives pertain to multiple goals and have simply been placed in the most appropriate spot. Similarly, some strategies pertain to multiple objectives. The "Rationale" section provides additional information and the reasoning behind the objectives and strategies. The timeframe for accomplishing CCP objectives is the 15-year life of the CCP, unless otherwise specified in the objective.

GOAL 1: Protect, maintain, and restore high quality, natural shoreline and cliff habitats for optimum productivity and abundance of seabirds, marine mammals, waterfowl, and shorebirds.

Objective 1.1 Restore Spit Habitat

Restore and manage up to 41 acres on Violet Spit, Protection Island, and spits associated with Smith/Minor Islands for nesting glaucous-winged gulls, breeding and molting elephant seals, and other native wildlife and plant species with the following attributes:

- Sparse (<30% cover), medium to low (max. 3-4 feet in height) grasses interspersed with vegetation composed of species associated with the North Pacific Maritime Coastal Sand Dune and Strand ecological system (e.g., gum weed, dune grass, sand verbena, plantain, and yarrow).
- Natural screens (e.g., driftwood or variation in topography) for concealment of nearest nests.
- <25% invasive species on spit habitat.
- Eliminate disturbance and impacts to seabird nesting habitats from deer.
- No non-native rats, rabbits, or red fox.
- No feral cats or trespassing domestic cats or dogs.
- Reduce impacts from other native mammalian predators (e.g., coyote, raccoon, mink, and river otter).

Strategies Applied to Achieve Objective	Refuge/Unit
a. Remove, control, and prevent establishment of invasive non-native plant species and treat infestations with IPM techniques using cultural, mechanical, physical, biological, or chemical means.	PI and Smith/Minor
b. Restore the strand vegetation community using prescribed burns and mechanical techniques (e.g., mowing, grading), planting, and maintenance. Update the fire management plan to include prescribed fires and wildfire suppression tactics.	PI
c. Monitor response of glaucous-winged gull fledgling rates and predation after restoration.	PI
d. Coordinate with WDFW and the Point No Point Treaty Tribes in the development of a step-down plan to remove deer from Protection Island.	PI

e. Continue to survey for presence of non-native rats, rabbits, red foxes, dogs, feral cats, and use appropriate tools to maintain zero population levels.	PI and Smith/Minor
f. Conduct a survey of native mammalian predators (e.g., coyote, raccoon, mink, and river otter), determine impacts, and if necessary develop management actions under a separate step-down management plan.	PI and Smith/Minor
g. Monitor, and when found, remove marine debris and contaminated material.	PI and Smith/Minor

Rationale: This objective will preserve this rare habitat type in the Salish Sea and restore the plant communities found there. These spits are formed when marine currents sweep large volumes of sand and gravel from the sandy cliffs and bluffs of Protection and Smith Islands and deposit them onto the shoreline. Armoring of the shorelines with jetties, bulkheads, and seawalls has often resulted in the alteration or disappearance of these unique habitats in the Salish Sea. The distal end of Violet Spit on Protection Island is densely choked with non-native beach grass that fills deep ruts left from machinery. Closer to the marina, a remnant population of native plants can be found that are associated with spit habitats (called strand communities) such as gum weed, yarrow, beach morning glory, sea plantain, thrift, and yellow sand verbena. Strand communities typically grow in sand, have low density of vegetation, and provide open spaces between plants.

This objective will also reduce gull chick mortality through habitat management. An invasion by non-native plant species (i.e., beach grass) has rendered sections of the spit that once supported the highest abundance of gull nests as unsuitable. Researchers have noted that gull nests located in or near the taller, dense vegetation are more susceptible to bald eagle predation (80%), while those located in more open strand communities appear to be more successful (Hayward and Henson 2010, Hayward et. al. 2010,15%, J Galusha, pers. comm.). This is due, in part, because the open space allows better access to eagles on the ground by mobbing gulls. In addition, research in other colonies has shown that a high degree of heterogeneity (i.e., debris) around nests provides concealment from predation and natural screens from nearby nests (Good 2002). These components are particularly important in areas with high disturbance and predation pressure, as is the case on Violet Spit, where disturbance or predation from bald eagles, other gulls, and deer can limit reproductive success (Hayward and Henson 2008, Galusha et al. 2005). Restoration should be conducted in a manner that maintains the cohesion of the colony because the colony is less likely to shift to new, disjointed areas (J. Galousha, pers. comm.). In addition, this objective will also benefit elephant seals which have recently pupped on Protection and Smith/Minor Islands. Replacing the thick European beach grass with more open vegetation will provide more habitat for elephant seals, which prefer open sandy beaches, dunes, and spits for breeding and molting.

Approximately 93% of bird species or subspecies that have become extinct since the 1800s were found on island habitats and 42% of those occurred due to predation by introduced mammals (Courchamp et al. 2003). Rats are present on approximately 80% of the world's islands and are responsible for at least 50% of global extinctions and countless local extinctions (Dolan and Heneman, 2007). There is no indication that rats are present on Refuge islands, however they could potentially colonize an island via a shipwreck or by accessing the island via authorized vessels. Given that they reproduce quickly and can have a devastating effect on island breeding seabirds, detection and control must be rapid. Rabbits are ubiquitous on San Juan and Lopez Islands and pellets have been observed on Nob Island within the San Juan Islands NWR (Murphy pers. comm.), however, they have not been found on Protection Island. Rabbits can denude small islands of vegetation leading to erosion and loss of nesting habitat, compete for nesting burrows and eject eggs from occupied burrows, and serve as a year-round food resource for predators (USFWS 2005, McChesney & Tershy 1998, Hodum & Wainstein 2002, Donlan

& Heneman 2007). Rabbits also reproduce rapidly and control measures must be rapid to be effective. Other non-native mammalian predators include red fox, feral cats, and domestic cats and dogs; native mammalian predators of concern are coyote, raccoon, mink, and river otter.

Deer populations can thrive with an increase in abundance of forage as will be the case with intensive revegetation efforts planned for the island. In fact, Simberloff (2008) noted that deer can reduce biological diversity in an area while at just 25% of their carrying capacity depending on the habitat type and environmental conditions. In addition, Simberloff (2008) noted that deer can foster the invasion of weedy exotics by ingestion and dispersing seed of non-native plants (Donlan et al. 2002, Waller 2008). Given the abundance of deer in Northwestern Washington, removing deer from Protection Island in order to protect this unique seabird habitat would have little impact on the deer population of the area. Also see rationale for objective 2.1 for impacts of deer to seabirds.

Objective 1.2 Protect and Maintain Sandy/Gravel Shoreline

Increase protection and maintenance of sandy/gravel shoreline on Protection and Smith/Minor Islands for the benefit of harbor and elephant seals, pigeon guillemots, black oystercatchers, and harlequin ducks with the following attributes:

- Continued long shore sandy/gravelly movement and deposition.
- Presence of large continuous expanses of driftwood piles with cavities suitable for pigeon guillemot nesting and camouflage of guillemot and oystercatcher chicks.
- No creosote pilings in marina on Protection Island.
- No marine debris on PI or Smith/Minor shorelines.
- No non-native rats, rabbits, or red fox.
- No feral cats or trespassing domestic cats or dogs.
- Reduce impacts from other native mammalian predators (e.g., coyote, raccoon, mink, and river otter).

Strategies Applied to Achieve Objective	Refuge/Unit
a. Continue nourishing shoreline to the west of the marina by using remaining gravel stockpiles left from marina dredging.	PI
b. Facilitate the removal and replacement of the creosote pilings used in the marina at Protection Island.	PI
c. Monitor, and when found, remove marine debris and contaminated material.	PI and Smith/Minor
d. Continue to prohibit collection of driftwood from shorelines and within the marina on Protection Island.	PI
e. Continue to survey for presence of non-native rats, rabbits, red foxes, dogs, and feral cats and use appropriate tools to maintain zero population levels.	PI and Smith/Minor
f. Conduct a survey of native mammalian predators (e.g., coyote, raccoon, mink, and river otter), determine impacts, and if necessary develop management actions under a separate step-down management plan.	PI and Smith/Minor

Rationale: Wildlife use this type of shoreline to varying degrees. Pigeon guillemots use the shoreline for nesting under driftwood and to roost; black oystercatchers nest and forage here; harbor and elephant seals haulout and pup in this habitat. Forage fish, such as sand lance and surf smelt, spawn in the gravel within the shallow water adjacent to the shoreline. They in turn provide a rich food source, close to the colony, for breeding seabirds. Black brant collect small pieces of gravel that they require for grit to digest their food.

One third of the Salish Sea shoreline has been modified by human use, interrupting the processes that move sediment and nourish beaches and vegetation along the shorelines (WDNR 2001, Evens and Kennedy 2007). On Protection Island, the marina entrance breakwater impedes the flow of sediment to the adjacent shoreline to the west. In 2002, 4000 yd^3 of gravel stockpiled from dredging the marina were placed on the shoreline to the west to mimic the natural process. Removing the remainder of the gravel stockpile will restore the spit and nourish the shoreline that is impacted by the marina's breakwater.

Creosote is of concern because, according to the EPA, it is toxic to fish, shellfish, and aquatic invertebrates, all important forage for seabirds, oystercatchers, and marine mammals. There are currently creosote coated logs forming old pilings in the marina of Protection Island and creosote impregnated logs are relatively common on the shorelines of all islands. More than 100 tons were removed from nearby Dungeness Spit in 2006. Marine debris (e.g., Styrofoam, nets, and plastics) poses a more direct threat to seabirds and marine mammals as it can entangle seals or be fed to seabird chicks causing mortality. Marine debris is removed from the shoreline of Protection Island by staff and volunteers annually, but because they are more difficult to access, regular clean-up of debris is limited in the San Juan Islands NWR (including Smith/Minor).

Extensive logging throughout the past century has reduced the supply of large trees with intact roots that support the upper shoreline, provide nesting sites for pigeon guillemots and cover for black oystercatcher chicks from predators. Harbor development, firewood collection, and human-caused beach fires have reduced driftwood on the shorelines of Protection Island. Maintaining the current amount of driftwood on the island's rocky shoreline would provide concealment from predators and potentially increase productivity of guillemots and oystercatchers on Protection Island.

For more information about rats, rabbits, and mammalian predators, see rationale for objective 1.1.

Objective 1.3 Protect and Maintain Rocky Shoreline and Cliff Habitats

Increase protection and maintenance of rocky shoreline and cliff habitats in the San Juan Islands NWR for the benefit of marine mammals, cormorants, and black oystercatchers by managing for the following attributes:

- No marine debris on shorelines on islands of San Juan Islands NWR.
- Viable populations of brittle prickly pear cactus are established on 5 Refuge islands.
- No non-native rats, rabbits, or red fox.
- No feral cats or trespassing domestic cats or dogs.
- Reduce impacts from other native mammalian predators (e.g., coyote, raccoon, mink, and river otter)
- Human disturbance on Matia and Turn Islands is minimized during oystercatcher nesting and brood rearing periods (April – Sept).
- Human disturbance is minimized near rocky shoreline and cliff habitats used by breeding cormorants, oystercatchers, and marine mammals year-round on all Refuge islands.

Strategies Applied to Achieve Objective

a. Coordinate with DNR to establish appropriate shoreline buffers (conservation leases and/or withdrawals) to minimize disturbance from boat landings and tideland development.

b. Grow and outplant populations of brittle prickly-pear cactus on 5 Refuge islands and monitor to

ensure success of restoration.
c. Monitor, and when found, remove marine debris and contaminated material.
d. Continue to survey for presence of non-native rats, rabbits, red foxes, dogs, and feral cats and use appropriate tools to maintain zero population levels.
e. Conduct a survey of native mammalian predators (e.g., coyote, raccoon, mink, and river otter), determine impacts, and if necessary develop management actions under a separate step-down management plan.
f. Provide shoreline access Matia: Allow shoreline access at Rolfe Cove and maintain closure on remainder of shoreline. Turn: Allow shoreline access on West and Southwest beaches; close Southeast beach and remainder of shoreline to protect wildlife and habitat.
Rationale: With a few exceptions, most marine birds use the rocky shorelines for foraging and roosting and the marine mammals use them to pup and molt. Cormorants primarily nest on cliffs, rocky islands, or human-made structures such as towers or navigational aids. They are very sensitive to human disturbance during the nesting season and will abandon eggs or young if disturbance is too great. Marine mammal pups can be separated from their mothers or crushed during a stampede to the water if boaters approach too closely. Brittle prickly-pear cactus was once more common on Refuge islands. Given minimal amounts of disturbance due to closed access, Refuge islands would serve as an ideal site for reestablishment of this rare plant. Reducing disturbance from humans (shoreline closure and creation of buffer zones) in the San Juan Archipelago has also been identified by San Juan County as a strategy to conserve two of their conservation target species: black oystercatchers and pelagic cormorants (Evans and Kennedy 2007). The black oystercatcher is considered an obligate species of the rocky shoreline and a strong indicator of the ecological integrity of this habitat type. Recent surveys of 95 potential islands in the inner marine waters revealed that 40 islands, islets, and rocks within the San Juan Islands NWR supported approximately 80% of breeding pairs (Nysewander 2003). However, there are no breeding black oystercatchers nesting on Turn Island and limited nesting on Matia. In fact, there are very limited reports of marine mammal or other wildlife use of Turn Island with the exception of raccoons. Growing pressure from recreational activities on and around breeding areas can have negative effects on oystercatcher productivity (Tessler et al. 2007). For more information about rats, rabbits, and mammalian predators, see rationale for objective 1.1.

Goal 2: Protect, maintain, and restore the native vegetative communities and structure of sandy bluffs to maximize habitat for breeding seabirds.

Objective 2.1 Restore Burrow Nesting Seabird Habitat
Restore up to 5 acres of sandy bluff habitat on Protection Island NWR in areas where human structures (roads, homes, etc.) have been removed for the benefit of nesting rhinoceros auklets with the following characteristics: • No roads, buildings, or other human structures within the restoration area unless they are essential for research or Refuge management purposes. • Presence of suitable slope angle and soil compaction to facilitate auklet burrow construction. • ≥75% of the vegetation is composed of species associated with the Willamette Valley Upland

Prairie and Savanna and North Pacific Maritime Coastal Sand Dune and Strand ecological systems. • ≥50% vegetative cover present at the beginning of the rainy season. • <25% cover of invasive plant species (e.g., cheat grass). • No Scotch broom or other invasive shrub species. • Eliminate disturbance and impacts to seabird nesting habitats from deer. • No non-native rats, rabbits, or red fox. • No feral cats or trespassing domestic cats or dogs. • Reduce impacts from other native mammalian predators (e.g., coyote, raccoon, mink, and river otter).
Strategies Applied to Achieve Objective
a. Develop a site plan for infrastructure on Protection Island NWR that minimizes impacts to wildlife. Consider current and future administrative, research, and volunteer needs. Establish new transportation routes and modes for necessary activities to minimize impacts in burrow nesting areas.
b. Develop handbook of Refuge guidelines that includes maps of breeding areas and distribute to all authorized people on islands to prevent unintentional disturbance or trampling.
c. Remove buildings associated with the Refuge caretaker's cabin and at the end of the extended user's term, eliminate building and associated access roads within the restoration area.
d. Expand use of solar energy to reduce transport of gas, oil, and propane.
e. Determine the best restoration techniques within test plots and monitor prior to full-scale restoration.
f. Conduct studies to determine which native plant species will provide the best erosion control throughout the year.
g. Prevent wildfires by continuing to prohibit public access and open fires by all island users.
h. Pre-wash equipment before bringing to islands to prevent the establishment of invasive plant species. Treat existing and new infestations with IPM techniques; See Appendix E.
i. Coordinate with WDFW and the Point No Point Treaty Tribes in the development of a step-down plan to remove deer from Protection Island.
j. Search equipment and supplies to prevent the establishment of non-native species.
k. Continue to survey for presence of non-native rats, rabbits, red foxes, dogs, and feral cats and use appropriate tools to maintain zero population levels.
l. Conduct a survey of native mammalian predators (e.g., coyote, raccoon, mink, and river otter), determine impacts, and if necessary develop management actions under a separate step-down management plan.
Rationale: Prior to Refuge establishment, Protection Island was developed as a residential and resort area. After Refuge establishment, much of the prior development was removed to improve wildlife habitat. Some of the roads and buildings were retained by the Service and retrofitted to serve Refuge management or research purposes and are in need of major repair or replacement. A few of the former landowners, known as extended users, retained their residences under various terms, but most of the terms have or will expire. Now is the ideal time to assess future Refuge management and research needs and develop a site plan for building and transportation routes that meets those needs while minimizing impact to wildlife and habitats. Refuge staff transport gasoline, oil, and propane for Protection Island

vehicles, cabin appliances, and generators. There is always a risk of spills when moving the 50-gallon drums from the boat to the shore. Converting to solar power to produce electricity would reduce the amount of fuel needed on the island.

Approximately 90% of the North American rhinoceros auklet breeding population occurs on 8 islands (Gaston and Dechesne 1996), with Protection Island NWR supporting the third largest colony (Pearson et.al. 2009). However, in recent years the area occupied by the rhinoceros auklet colony has expanded into an area of approximately 5 acres that is currently occupied by the Refuge caretaker's cabin and an extended user's residence. At the end of the extended user's life term, all buildings and access roads will be removed in this area in order to restore burrow-nesting seabird habitat quality, reduce human disturbance and physical obstructions. One important feature of all known rhinoceros auklet colonies is a well-developed soil to support burrow excavation (Leschner 1976, Speich and Wahl 1989, Richardson 1961). Thus, soil compaction will be an important component in habitat restoration. Specific measures are currently not available; however, research has been initiated to qualify soil characteristics near burrows on the island. In addition, Wilson (1977) and Leschner (1976) note that auklets do not burrow far into the level, interior portion of the islands, primarily because slope aids take-off. Wilson and Manuwal (1986) noted that burrow density was 'significantly correlated with angle of slope,' thus where feasible, every effort should be made to establish a slope angle within the preferred range for the species or consider placing artificial nest boxes in flat surfaces.

Vegetation varies greatly among auklet colony sites in North America and serves a key role in providing stability and support for burrows and entrances (Leschner 1976). The vegetation on PI has been highly altered from an extensive pre-Refuge history of grazing and agriculture (Richardson 1961). Further information is needed to determine the best native species to use in revegetation efforts. Those providing the best soil stabilizing qualities without impeding burrow construction will be sought. These would include a mix of native annual and perennial, bunch and sod-forming grasses, as well cool and warm season grasses, interspersed with native low growing shrubs. This heterogeneous plant community would provide the bluffs with the greatest adaptive responses to maintain slope stability, drought tolerance, and fire resistance. Annual plants which typically have a shorter root system, die after reproduction and may not germinate at all if conditions are unfavorable, therefore are not the preferred long-term cover for slope stabilization. Perennials, with a more developed root system, can persist during unfavorable times and are generally better at holding the soil than annuals. Annuals such as cheat grass can increase the frequency of natural fire regimes. An increase in the number of wildfires may in turn reduce or alter the beneficial perennial component of this habitat (Young 1987).

On Protection Island, a high-density herd of black-tailed deer are using suitable rhinoceros auklet burrow nesting habitat to browse and bed down. Rhinoceros auklet burrows collapsed by deer hoofs have been observed by researchers and Refuge staff. When deer bed down on top of rhinoceros auklet burrow entrances, they prevent these nocturnal birds from leaving or entering burrows to feed their young and have been observed to startle auklets, causing them to lose a beak-load of fish for their young. Given the many threats to auklet populations that cannot be addressed by Refuge management (e.g., climate change, fisheries interactions, oil spills), the importance of the colony to the North American population and its unique location, the Refuge must consider all possible conservation actions to protect auklet breeding habitat, including the reduction of deer on Protection Island. Black-tailed deer are abundant in Northwestern Washington with the Washington Natural Heritage Program ranking of 'demonstrably secure' both globally and by state (WDNR 2009). Removing deer from Protection Island in order to protect this unique seabird habitat would have little impact on the deer population of the area. However, it will benefit the preservation of auklet burrows, increase the success of native plant revegetation and the potential for establishing threatened plant species on the island. For more information about rats, rabbits, and mammalian predators, see the rationale for objective 1.1.

Objective 2.2 Enhance Rhinoceros Auklet and Tufted Puffin Nesting Habitat Quality

Enhance sandy bluff habitat quality on up to 20 acres of Protection Island NWR for the benefit of breeding rhinoceros auklets and tufted puffins with the following attributes:

- ≥ 75% of the vegetation is composed of species associated with the Willamette Valley Upland Prairie and Savanna and North Pacific Maritime Coastal Sand Dune and Strand ecological systems.
- ≥50% vegetative cover at the beginning of the rainy season.
- <25% cover of invasive plant species (e.g., cheat grass).
- No Scotch broom or other invasive shrub species.
- Eliminate disturbance and impacts to seabird nesting habitats from deer.
- No non-native rats, rabbits, or red fox.
- No feral cats or trespassing domestic cats or dogs.
- Reduce impacts from other native mammalian predators (e.g., coyote, raccoon, mink, and river otter).

Strategies Applied to Achieve Objective

a. Establish vegetation restoration test plots for non-native plant removal and develop techniques for establishing native vegetation.

b. Conduct studies to determine which native plant species will provide the best erosion control throughout the year.

c. Prevent wildfires by continuing to prohibit public access and open fires by island users.

d. Pre-wash equipment before bringing to the islands to prevent the establishment of invasive plant species. Treat existing and new infestations with IPM techniques.

e. Coordinate with WDFW and the Point No Point Treaty Tribes in the development of a step-down plan to remove deer from Protection Island.

f. Search equipment and supplies to prevent the establishment of non-native species.

g. Continue to survey for presence of non-native rats, rabbits, red foxes, dogs, and feral cats and use appropriate tools to maintain zero population levels.

h. Conduct a survey of native mammalian predators (e.g., coyote, raccoon, mink, and river otter), determine impacts, and if necessary develop management actions under a separate step-down management plan.

Rationale: This objective is very similar to Objective 2.1; however, it is focused on enhancing existing bluff habitat with extremely limited access on foot. Therefore any means that can be employed to facilitate successful competition by native species on the sandy bluffs and minimize access to the area on foot will be considered for management action. This is primarily because removal would be impossible without damaging established burrows. Planting appropriate species on the edge of the bluff habitat so that continual beneficial seeding by upwind natives is one option under consideration. This option will be especially successful if those natives go to seed during the most appropriate season to out-compete invasive species (i.e., cheat grass). Broadcast seeding into sandy bluff habitat by helicopter is another option since no access to the colony would be necessary. However some species, such as scotch broom, are much more difficult to eliminate and management would necessitate access to the colony for removal as soon as it is detected. Aerial application of an herbicide may be considered for more abundant invasive species if injury to non-target vegetation is acceptable. For further details, see the IPM Strategy.

For more information on habitat characteristics of interest in this restoration and the effects of deer on auklets and their habitat, see objective 2.1. For more information on rats, rabbits, and mammalian predators, see the rationale for objective 1.1.

Goal 3: Restore, maintain, and protect high quality, native savanna, grasslands, and herbaceous bald habitat to increase the species diversity, richness, and population levels of associated flora and fauna.

Objective 3.1 Restore Savanna, Grassland, and Herbaceous Bald Habitat

Manage and/or restore, where necessary, up to 200 acres of the savanna, grassland, and herbaceous bald habitat on Protection Island NWR for the benefit of native plants, butterflies, and passerines by providing habitat with the following attributes:

- <15-20% canopy cover of trees (e.g., Douglas-fir, madrone, Garry oak) and native shrubs (e.g., ocean spray, Nootka rose).
- >50% cover of native grasses (e.g., Roemer's and red fescue, California oatgrass) and native forbs (e.g., camas) of the Willamette Valley Upland Prairie and Savanna ecological system.
- <25% cover of non-native plant species.
- Establish one or more populations of priority resource of concern plant species (e.g., California buttercup and golden paintbrush).
- At least three locations of larval host plants and nectar host plants suitable for adult Taylor's checkerspot butterfly.
- <10% cover of invasive plant species (e.g., Himalayan blackberry, Canada thistle, cheat grass, Kentucky bluegrass, and European beach grass).
- No English ivy, Scotch broom, Dalmatian toadflax, or new invasions of noxious weeds.
- Eliminate disturbance and impacts to seabird nesting habitats from deer.
- No non-native rats, rabbits, or red fox.
- No feral cats or trespassing domestic cats or dogs.
- Reduce impacts from other native mammalian predators (e.g., coyote, raccoon, mink, and river otter).

Strategies Applied to Achieve Objective

a. Determine extent and composition of historical (pre-farming) savanna, grassland, and herbaceous bald habitat.

b. Evaluate restoration techniques, such as prescribed fire or mechanical means for up to 20-40 acres of grassland. Use results for restoration of additional areas on the island.

c. Update fire plan to outline Refuge response to wildfires and use of prescribed burns. All prescribed burns will be conducted under an approved burn plan.

d. Control or eradicate invasive and non-native plants with IPM techniques using cultural, mechanical, physical, biological and/or chemical means. Prohibit off-road vehicle use to the greatest extent possible to prevent the spread of noxious weed seed, particularly in restoration sites.

e. Re-introduce rare plant species (such as golden paintbrush and California buttercup) and Taylor's checkerspot larval host plants and nectar sources for adults either from seed sources or live plant material.

f. Develop partnerships to propagate difficult to obtain plant materials for re-introductions.

g. Standard vegetation surveys conducted pre- and post-restoration; conduct surveys for Taylor's checkerspot butterfly; continue conducting breeding bird and Christmas bird count surveys with Refuge

volunteers.

h. Coordinate with WDFW and the Point No Point Treaty Tribes in the development of a step-down plan to remove deer from Protection Island.

i. Continue to survey for presence of non-native rats, rabbits, red foxes, dogs, and feral cats and use appropriate tools to maintain zero population levels.

j. Conduct a survey of native mammalian predators (e.g., coyote, raccoon, mink, and river otter), determine impacts, and if necessary develop management actions under a separate step-down management plan.

Rationale: In 1792, Captain George Vancouver described the island as having luxuriant grasses mixed with an abundance of flowers. Pre-Refuge grazing, farming, and development have eliminated all but a small remnant of this rare system on the upland plateau. Although a daunting challenge, the Service's policy for Biological Integrity, Diversity, and Environmental Health (601 FW 3.3 [3.6D]) establishes historic conditions "prior to substantial human related changes to the landscape" as the basic reference for protecting, mimicking, or restoring natural processes. The vegetative community now found where the native savanna, grassland, and herbaceous bald habitats existed in the past has been radically changed through more than a century of grazing and farming. Rare or threatened species of savanna, grassland, and herbaceous balds include golden paintbrush, slender crazyweed, Bear's foot sanicle, and California buttercup. The golden paintbrush is threatened by competition with native and non-native plant species, habitat conversion by humans and natural succession, and grazing by herbivores (Federal Register / Vol. 62, No. 112 / June 1997). Restoration techniques under consideration include: 1) cultural—prescribed fire as part of a one-two method with another tool such as mechanical or chemical; 2) mechanical —plowing, discing, mowing, and rototilling; 3) physical—hand plant removal and planting; 4) biological—for non-native plant control using approved and proven biological agents (e.g., insects); 5) chemical—herbicide applications. Prescribed fire would also be used once restoration is completed to maintain grassland vigor and diversity.

Throughout the term of this CCP, management will focus on restoring larval host plants and adult nectar sources in the event that rare butterflies should recolonize the islands. Some of these plants include mustard, verbena, plantain, and hairy Indian paintbrush. The Taylor's checkerspot butterfly has been a candidate species for Federal listing since 2001 (USFWS 2009b). Currently, this species is found at only four sites in Washington and two sites in Oregon, yet it was historically found throughout the grasslands of the Willamette Valley, Puget Sound, and south Vancouver Island (Butterfly Conservation Initiative 2006, Draft Benton County Taylor's Checkerspot Management Plan 2009, Stinson 2005). The site with the largest concentration of this species in Washington can be found on the mainland less than two miles from Protection Island. Actions identified in this plan are geared toward enhancing habitat on Protection Island given the close proximity of checkerspots on the mainland.

For more information about the effects of deer on native vegetation and restoration efforts, see the rationale for objective 1.1; for more information on rats and rabbits, see the rationale for objective 1.1.

Objective 3.2 Protect and Maintain Savanna, Grassland, and Herbaceous Bald Habitat

Increase protection and maintenance for the characteristics of savanna, grassland, and herbaceous bald patches on 28 islands (e.g., Boulder, Peapods) in the San Juan Islands NWR for the benefit of rare native plants with the following attributes:

- > 75% cover of the grasslands support native shrubs, grasses, and forbs associated with the

Willamette Valley Upland Prairie and Savanna and North Pacific Herbaceous Bald and Bluff ecological systems.
- <25% cover of non-native plant species.
- Maintain populations of rare plant species (e.g., California buttercup).
- <10% cover of invasive plant species (e.g., Himalayan blackberry and Canada thistle).
- No presence of English ivy, Scotch broom, yellow toadflax, or St. John's wort.
- No non-native rats, rabbits, or red fox.
- No feral cats or trespassing domestic cats or dogs.
- Reduce impacts from other native mammalian predators (e.g., coyote, raccoon, mink, and river otter).

Strategies Applied to Achieve Objective

a. Where appropriate, use prescribed fire strategies to promote native grasses and forbs by removing invasive and non-native plants and reducing canopy cover.

b. Use IPM strategies to control or eradicate invasive and non-native plants (e.g., Himalayan blackberry, Canadian thistle, English Ivy, Scotch broom, or yellow toadflax; see IPM Appendix E).

c. Use non-motorized hand tools for removal of woody species to promote native grasses and forbs by reducing canopy cover.

d. Monitor response of native savanna, grassland, herbaceous bald plants, and especially rare plant species to vegetation management treatments, such as reintroduction, controlled burning, clipping, and herbicide application.

e. Continue baseline vegetation inventories with partners (TNC and UW) on Refuge islands. Visit 14 of the islands annually to monitor and respond with IPM strategies to the presence of invasive plants and animals and maintain closure signs.

f. Continue to survey for presence of non-native rats, rabbits, red foxes, dogs, and feral cats and use appropriate tools to maintain zero population levels.

g. Conduct a survey of native mammalian predators (e.g., coyote, raccoon, mink, and river otter), determine impacts, and if necessary develop management actions under a separate step-down management plan.

Rationale: Considered one of the rarest ecosystems in the United States, less than 10% of historic native savanna, grassland, and herbaceous bald habitat remains in the Puget Sound (WDFW 2005). About ¼ of islands have been surveyed since 2005 for vegetation characterization and composition. Although Refuge patch sizes are small (island sizes range from 0.5–30 acres), these relatively intact island communities form a mosaic throughout the Archipelago landscape. Trampling, invasive species, and canopy closure from woody species are serious threats. Herbivores could potentially have a severe impact on smaller islands.

For more information about rats and rabbits, see the rationale for objective 1.1.

Objective 3.3 Restore and Improve Savanna, Grassland, and Herbaceous Bald Habitat

Restore and improve the following savanna/grassland characteristics on up to 20 acres on Smith and Turn Islands for the benefit of plant species (e.g., golden paintbrush) and rare native wildlife (e.g., Island marble or valley silverspot butterflies) with the following attributes:
- <30% canopy cover of native shrubs (e.g., ocean spray, Nootka rose).
- >50% cover of native grasses (e.g., Roemer's and red fescue, California oatgrass), native forbs (e.g., camas) and butterfly larval host plants and adult nectar sources of the Willamette Valley Upland Prairie and Savanna and North Pacific Herbaceous Bald and Bluff ecological systems.

- Maintain populations of rare plant species (e.g., California buttercup).
- <10% cover of invasive plant species (e.g., Himalayan blackberry, Canada thistle, lawn weed).
- <25% cover of other non-native plant species.
- No presence of English ivy, Scotch broom, yellow toadflax, or St. John's wort.
- No non-native rats, rabbits, or red fox.
- No feral cats or trespassing domestic cats or dogs.
- Reduce impacts from other native mammalian predators (e.g., coyote, raccoon, mink, and river otter).

Strategies Applied to Achieve Objective

a. Introduce rare plant species (e.g., golden paintbrush and California buttercup).

b. Restore or enhance (where appropriate) populations of host plants for rare butterflies (e.g., mustard, verbena, plantain, and hairy Indian paintbrush).

c. Use prescribed fire strategies to promote native plants by removing invasive and non-native plants and reducing shrub and tree cover.

d. Use IPM strategies to control or eradicate invasive and non-native plants (e.g., Himalayan blackberry, Canada thistle, English Ivy, Scotch broom, or yellow toadflax; see IPM Appendix E).

e. Use mechanical removal of woody species to promote native grasses and forbs by reducing canopy cover.

f. Monitor response of native savanna, grassland, herbaceous bald plants, and especially rare plant species to vegetation management treatments such as reintroduction, prescribed burns, clipping, and herbicide application.

g. Continue to survey for presence of non-native rats, rabbits, red foxes, dogs, and feral cats and use appropriate tools to maintain zero population levels.

h. Conduct a survey of native mammalian predators (e.g., coyote, raccoon, mink, and river otter), determine impacts, and if necessary develop management actions under a separate step-down management plan.

i. Reroute trail system on Turn Island to minimize trampling through sensitive camas community (see Objective 7.1).

Rationale: See Objective 3.2. Since 1980, The Nature Conservancy has conducted extensive research on applicable grassland restoration methodologies for small islands within the San Juan Archipelago at Yellow Island (Dunwiddie 2005). Many rare species, such as golden paintbrush, do not compete well with invasive species and closed canopy cover. At Yellow Island, small prescribed fires, mechanical clearing, and plant propagation have been used to restore more than 50 species of wildflowers native to the Puget Sound grassland community. Refuge islands already have some populations of rare species. Enhancing these populations and reintroducing additional populations on other appropriate islands would increase their conservation. In addition, about fifty species of native butterflies are closely associated with the savanna, grassland, and herbaceous bald habitat in the Puget Sound (WDFW 2005). The islands have potential habitat for two rare butterfly species: valley silverspot and Island marble (Miskelly and Potter 2009). Although patch sizes may be too small to sustain a population, restoration of host plant species on Refuge islands that are adjacent to existing populations on larger islands could be beneficial.

For more information about rats and rabbits, see the rationale for objective 1.1.

Goal 4: Restore, maintain, and protect the species richness and diversity of the forests and woodlands by fostering a complex understory and diversity of tree age classes.

Objective 4.1 Restore and Maintain Forest and Woodlands
Restore continuity of up to 80 acres of historic/potential forest and woodlands on Protection Island NWR with the following attributes: • >25% canopy cover of trees (e.g., Douglas-fir, madrone, Garry Oak, lodgepole pine) of the North Pacific Douglas-Fir Forest and Woodland and the North Pacific Maritime Dry Mesic Douglas-Fir - Western Hemlock Forest. • >50% cover of native shrubs (e.g., ocean spray, Nootka rose) in understory. • <10% cover of invasive plant species (e.g., Himalayan blackberry and Evergreen blackberry). • Forest patches are connected. • No presence of English ivy, English holly, Scotch broom, Dalmatian toadflax, garlic mustard, or other new noxious weed invaders. • Eliminate disturbance and impacts to habitats from deer. • No non-native rats, rabbits, or red fox. • No feral cats or trespassing domestic cats or dogs. • Reduce impacts from other native mammalian predators (e.g., coyote, raccoon, mink, and river otter).
Strategies Applied to Achieve Objective
a. Control or eradicate invasive and non-native plants with IPM techniques using cultural, mechanical, physical, biological and/or chemical means.
b. Conduct vegetative and wildlife surveys to establish baseline diversity and monitor change over time.
c. Implement total wildfire suppression tactics on all wildfires on the island.
d. Focus opportunistic restoration activities on the shrub layer within the "gap area" between the forest patches on the north side of the island.
e. Coordinate with WDFW and the Point No Point Treaty Tribes in the development of a step-down plan to remove deer from Protection Island.
f. Continue to survey for presence of non-native rats, rabbits, red foxes, dogs, and feral cats and use appropriate tools to maintain zero population levels.
g. Conduct a survey of native mammalian predators (e.g., coyote, raccoon, mink, and river otter), determine impacts, and if necessary develop management actions under a separate step-down management plan.
Rationale: This system has been degraded on Protection Island. A number of fires occurred on the island in the past century and private developers constructed dirt roads and an air strip through the forest. In recent years, the high density of deer and subsequent heavy browsing has decreased the amount of small trees and shrub understory. Those small trees and shrubs provide important nesting and roosting habitat for eagles and other migratory birds, such as American kestrels, and downy and hairy woodpeckers. Small trees also contribute to regeneration of mature forest. Opportunistic restoration of this habitat will involve transplanting native stock seedlings to the restoration area as funding and logistics allow. Given the long period of time required for re-growth, all wildfires would be suppressed to maintain the characteristics of old growth forest and prevent erosion along the bluffs to the north. All activities on the island will be carried out in accordance with USFWS National Bald Eagle

Management Guidelines (USFWS 2007). A bald eagle pair has maintained nests on Protection Island since prior to Refuge establishment. The stand that the nest trees are in is relatively small, however, the size of the forest surrounding a nest tree is less important than isolation from human development and disturbance (minimum distance is <328 feet, average distance is >1,640 feet, Buehler 2000). Important characteristics of nest and roost areas include availability of trees that are located in forests with open canopies providing good visibility, access to the tree (i.e., on the forest edge, near a clearing, or above the canopy) and in close proximity to open water foraging habitats. Roost and nest trees are usually prominent, large trees 200 to 300 years old in the Pacific Northwest. Most roosts are located in areas that are protected from prevailing winter winds. Winter habitat suitability is defined by food availability, the presence of roost sites that provide protection from inclement weather, and the absence of human disturbance (Buehler 2000).

For more information about rats, rabbits, and the effects of deer on native vegetation and restoration efforts, see the rationale for objective 1.1.

Objective 4.2 Protect and Maintain Forest and Woodlands

Increase protection and maintenance of forests and woodlands on 10 islands (including Matia, Flattop, Ripple, Willow, Turn, and Skipjack) in the San Juan Islands NWR with the following attributes:

- Maintain current acres (~ 127) of North Pacific Dry Douglas-Fir Forest and Woodland
- Maintain current acres (~105) of North Pacific Maritime Dry Mesic Douglas-Fir -Western Hemlock Forest on Matia, including old growth.
- >50% cover of native shrubs (e.g., ocean spray, Nootka rose).
- <10% cover of invasive plant species (e.g., Himalayan and Evergreen blackberry).
- No presence of English ivy, English holly, Scotch broom, or yellow toadflax.
- No non-native rats, rabbits, or red fox.
- No feral cats or trespassing domestic cats or dogs.
- Reduce impacts from other native mammalian predators (e.g., coyote, raccoon, mink, and river otter).

Strategies Applied to Achieve Objective	Refuge/Unit
a. Use IPM strategies to control invasive and non-native plants.	SJI
b. Re-vegetate closed campsites with trees or shrubs.	Turn
c. Implement total wildfire suppression tactics on all forested islands.	SJI
d. Reduce the risk of fire and the impacts of illegally collected firewood by eliminating open fires. Allow liquid fuel camp stoves only. Increase fire regulation enforcement and education.	Matia and Turn
e. Continue to survey for presence of non-native rats, rabbits, red foxes, dogs, and feral cats and use appropriate tools to maintain zero population levels.	SJI
f. Conduct a survey of native mammalian predators (e.g., coyote, raccoon, mink, and river otter), determine impacts, and if necessary develop management actions under a separate step-down management plan.	SJI

Rationale: These ecosystems are in precipitous decline due to extensive logging and human settlement, resulting in almost no remaining old-growth (200-400 years old) conifer-hardwood stands in the westside lowland of Puget Sound (WDFW 2005). Very old stands exhibit multi-layered canopies, with western hemlock becoming dominant. Additional old growth characteristics include an understory of downed, moss-covered logs, along with salal, ocean spray, sword fern, red currant, and dwarf Oregon grape as well as snags. These stands are important for at least 1,000 species (WDFW 2005). The flora

of this ecosystem varies slightly with location, is distinct, and contributes to native biodiversity. The old-growth westside lowland conifer-hardwood forest on Matia Island could benefit associated old-growth species (e.g., Vancouver ground cone, bald eagle, and pileated woodpecker) and other native species, such as bats, pileated, hairy, and downy woodpeckers.

One emphasis of this objective is to sustain active bald eagle territories. Eleven breeding territories have been identified on Refuge islands by WDFW (Stofel pers. comm.). All activities on islands within eagle territories will be carried out in accordance with USFWS National Bald Eagle Management Guidelines (USFWS 2007). For more information on important nesting and roosting habitat for this species, see the rationale for Objective 4.1. Other species that will benefit from the strategies listed in this objective include western toads and garter snakes.

Although Matia Island supports a very small fragment of the lowland old growth, it serves as an example of a system that is decreasing elsewhere as young and mature stands continue to be intensively logged or converted to urban and residential uses. Invasive species are a serious threat to this system. In 2001, English ivy was observed on Matia Island; it had killed a few trees on the forest edge and was rapidly moving into the forest. Since 2001, 3.26 tons of English ivy has been removed from the island via mechanical treatment. English ivy has little wildlife value and the berries are toxic to most songbirds (No Ivy League, 2009 (http://www.portlandonline.com/shared/cfm/image.cfm?id=201790, http://www.calapooia.org/wp-content/uploads/2009/01/seeds_brochure1.pdf)). English holly, which will out-compete lower story plants, has been found, but not treated.

For more information about rats and rabbits, see the rationale for objective 1.1.

Goal 5: Restore, maintain, and protect the biological integrity of natural, small wetlands to increase species diversity and productivity.

Objective 5.1 Restore, Maintain, and Protect Brackish Water Wetlands

Where feasible, restore the biological integrity of brackish wetlands on Protection Island NWR (<5 acres historic; currently only a remnant) and Smith Island (<0.5 acres current) for the benefit of native wildlife species with the following attributes:

- No invasive aquatic species (e.g., green crab or spartina).

Strategies Applied to Achieve Objective	Refuge/Unit
a. Conduct hydrological studies on Protection and Smith Islands to identify historical and current hydrological processes and wetland functioning (e.g., salinity, soils, vegetation, and wildlife uses).	PI and Smith
b. If necessary and feasible, restore hydrological processes as a basis for freshwater/brackish wetland restoration on Smith.	Smith
c. If feasible, use standard restoration methodology to remove fill and recreate the wetland on PI. Historic size will not be possible due to creation of the marina.	PI
d. Control and eradicate invasive non-native plant and animal species. Treat infestations with IPM techniques using cultural, physical, biological, and/or chemical means.	PI and Smith

Rationale: The extent of these wetlands is limited. The wetland on Smith Island is less than 1 acre and the wetland on Protection Island was filled during marina construction prior to Refuge establishment. Both of the wetlands on these islands are similar in their location relative to the surrounding marine environment, formation, and water salinity (brackish). Protection Island's wetland at the base of Violet Spit was filled about 30 years ago to develop a marina; however, the area still retains shallow water during the winter and seepages can be observed in the shoreline of the marina. The Service is required

to maintain the marina as part of the agreement made with extended users when the Refuge was established, but the marina does not cover the entire historic wetland site. Wintering and migrating waterfowl continue to use the remnant wetland area during periods of high precipitation. The only other known fresh water on Protection Island occurs from small seeps on the north side bluffs.

The small brackish wetland on Smith Island is located at the base of the east spit. It is intact, but possibly human influenced. In 2007, Refuge staff learned that the Coast Guard built cisterns and, possibly, drainage channels from the uplands to the wetland. Further investigation is needed to establish the nature of this wetland and determine if restoration is warranted.

Up to 30,000 shorebirds (e.g., dunlin, western sandpipers) have been observed using this wetland area and adjacent shorelines during migration (Sanguinetti pers. comm.). The wetland on Smith Island is at risk of invasive green crab or spartina infestations because of its proximity to current control areas on Vancouver and Whidbey Island, respectively.

Objective 5.2 Restore, Maintain, and Protect the Freshwater Wetland

Where feasible, restore the biological integrity of the seasonal, freshwater wetland on Matia Island (~0.4 acres) for the benefit of native plant and wildlife species.

- No invasive species (e.g., bull frog, spurge laurel, or purple loosestrife).

Strategies Applied to Achieve Objective

a. Determine the hydrology of the freshwater wetland to identify historical and current hydrological processes and wetland functioning.

b. If necessary and feasible, restore hydrologic processes and use restoration techniques appropriate for wilderness areas.

c. Control and eradicate invasive non-native plant and animal species and treat infestations with IPM techniques using cultural, physical, biological, and/or chemical means.

Rationale: This small wetland is the only freshwater wetland found on the Refuge. Understanding the hydrology of this wetland would assist in managing for biological integrity and diversity on Matia. This wetland is within the upland of the island, surrounded by woodlands and is believed to be a forested wetland that seasonally recedes (Lane and Taylor 1997). The study may reveal that the wetland is on a natural successional path, meaning that it is naturally filling in and a change in vegetation is occurring which is acceptable to management. There is historic evidence of the island being inhabited, however the extent is unknown. Invasive plant species identified in the objective and others listed on the county list (San Juan County Noxious Weed Control Program 2009) are threats to the Refuge, and the wetlands in particular, and are monitored to prevent establishment.

GOAL 6: Refuge visitors increase their knowledge of the natural and cultural resources of the Salish Sea ecosystem; gain an understanding of the role of the National Wildlife Refuge System; and contribute to the stewardship of Protection Island and San Juan Islands NWRs.

Objective 6.1 Access to Matia and Turn Islands

Allow managed access to Matia and Turn Islands so that people of all ages may learn about and experience San Juan Islands NWR habitats.

- >90% of Refuge visitors know they are on a National Wildlife Refuge.
- >80% of Refuge visitors understand that "wildlife comes first" on wildlife refuges.

- >80% of Refuge visitors know there are other Refuge islands in the San Juan Archipelago and why they are closed.
- >80% of Refuge visitors understand access and other public use regulations, and know that their purpose is to protect human safety, wildlife, and habitats.
- 100% of visitors comply with fire regulations.
- Visitors obey access and other public use regulations on Turn and Matia Islands (# of violations observed or reported decreases by 50% over 5 years).

Strategies Applied to Achieve Objective

a. Maintain and enhance the existing 1.2 mile wilderness loop trail on Matia Island. Enhance the .9 mile loop trail on Turn Island to include interpretation. Eliminate social trails on Matia and Turn Islands.

b. In cooperation with State Parks maintain seasonal dock on Matia Island.

c. In cooperation with State Parks maintain 1 composting toilet on Matia Island and 2 composting toilets on Turn Island.

d. In cooperation with the State maintain or provide 2 mooring buoys for Matia Island in Rolfe cove and at least 3 mooring buoys at Turn Island in order to minimize anchoring damage on bottom habitat.

e. Matia: Allow shoreline access at Rolfe Cove only and maintain closure on remainder of shoreline. Turn: Allow shoreline access on west and southwest beaches, close southeast beach and remainder of shoreline to protect wildlife and habitat.

f. Require commercial groups to obtain a Refuge special use permit (SUP).

g. Increase Refuge law enforcement presence.

h. Reduce the risk of fire and the impacts of illegally collected firewood by allowing liquid fuel and gel camp stoves only.

i. Enforce existing Federal regulations regarding no pets on refuge lands.

j. Maintain and update regulatory signage in accordance with the comprehensive sign plan; see SJI sign plan Appendix D.

k. Include information on interpretive signs that show these islands are part of a larger Refuge within the San Juan Islands Archipelago. Indicate where the other islands are and explain why they are closed to the public.

l. Acquire leases (public access and conservation) of tidelands and bed-lands around Turn and Matia Islands from DNR to better control unauthorized access from inter-tidal areas.

Rationale: Protection Island NWR and the majority of the San Juan Islands NWR units (islands) are closed to the public to protect wildlife. Opening Refuges to visitation is a tradeoff. Visitors are likely to gain a greater understanding and appreciation of the Refuge resources if they have an opportunity to learn about and experience island habitats and associated wildlife. Controlling public access and minimizing disturbance is critical to providing high quality wildlife viewing experiences because wildlife will abandon even suitable habitat if disturbed. Increased law enforcement and working with partners is an effective way to manage public access and protect wildlife and their habitat while maintaining high quality visitor experiences.

Objective 6.2 Wildlife Viewing, Photography, and Interpretation on Matia and Turn Islands

Afford visitors the opportunity to learn about and experience island wildlife and their habitats while minimizing adverse impacts to Refuge resources.

- >80% of Refuge visitors know they are in rare old growth island habitat on Matia Island.
- >60% of Refuge visitors can name at least one species associated with old growth island habitat.
- >60% of Refuge visitors can name at least one species associated with island shoreline habitat.

- >90% of Refuge visitors know that humans and pets disturb wildlife and their habitat and can identify at least one negative impact.

Strategies Applied to Achieve Objective

a. Develop wildlife and plant lists.

b. Develop and install habitat and wildlife- specific interpretive panels on Matia (3 signs) and Turn (≤ 8 signs) Islands. Also see comprehensive sign plan Appendix D.

c. Volunteers stationed on Turn and Matia Islands provide information about wildlife and habitats to visitors.

d. Have a multi-function, seasonal live-aboard or on- island hosts/caretakers who will explain rules and regulations and provide other information to visitors on Turn and Matia Islands.

e. Create 2 new positions stationed in the San Juan Islands: a full time Refuge Manager responsible for planning, law enforcement, maintenance, education, public relations, and volunteer supervision, and a seasonal ranger position.

f. Continue working with current Refuge partners and develop new partnerships.

Rationale: Because Protection Island NWR and the majority of the San Juan Islands NWR units (islands) are closed to the public, Turn and Matia Islands offer a unique opportunity to experience island refuge habitats and their associated wildlife. Matia Island in particular offers the public an opportunity to visit a wilderness area with primeval island forest and increase their understanding and appreciation of the role and purpose of wilderness islands.

These islands offer unique opportunities within the San Juan Islands Refuge for on-site education through interpretive panels, trails, and personal contact with knowledgeable staff and volunteers. Working with partners is an effective way to continue providing high quality educational experiences.

Objective 6.3 Camping on Turn and Matia Islands

The San Juan Island NWR camping program on Turn and Matia Islands is safe, family-friendly, and facilitates wildlife observation, photography, and interpretation throughout the San Juan Island NWR.

- Disturbance to wildlife is minimized by campers using only designated campsites and staying off closed areas and shorelines (# of incidents of unauthorized camping and/or entry into closed areas).
- Refuge island camping is safe (# of unsafe incidents; # of undesirable behaviors) and family-friendly (# of families camping).
- Campers comply with Refuge regulations including no campers arriving by motorized boats, no pets, etc. (# of incidents of noncompliance).
- Campers know to keep their human-powered vessels up to 200 yards from closed Refuge islands and closed shorelines in order to not disturb wildlife (% of campers who know).
- Campers report observing Refuge wildlife from their human-powered boats and from Turn and Matia Islands (% of individuals or groups).

Strategies Applied to Achieve Objective

a. A reservation system maybe established for camping.

b. Permit camping only for visitors arriving by human-powered boats.

c. Camping permitted only in designated campsites with a limit of 8 people per campsite.

d. Provide 8 campsites on Turn Island and 6 campsites on Matia Island.

Rationale: Protection Island NWR and the majority of the San Juan Islands NWR units (islands) are closed to the public. Turn and Matia Islands, however, are open and offer a unique opportunity to experience refuge island habitats and their associated wildlife. Matia Island in particular offers the public an opportunity to visit a wilderness area with primeval island forest and increase their

understanding and appreciation of the role and purpose of wilderness islands. Day use of the islands will not be changed by these strategies. In addition, use of mooring buoys by sail- or motor-boats will continue.

Allowing camping to those arriving by human-powered craft affords such visitors the opportunity to experience these islands which they may otherwise not have sufficient time to do. Access to Matia and Turn Islands by human-powered craft affords visitors traveling in this manner the opportunity to rest and to allow wind and inclement weather to abate. Because human-powered craft is generally much smaller and slower than sail and motor craft, people traveling by such vessels require more time to reach their destinations and have additional safety considerations. Motor and sail vessels have greater capacity to seek alternative camping accommodations, including on-board facilities, and therefore do not have the same need to camp on refuge islands. Overnight access to visitors traveling by human-powered craft provides them with the opportunity to experience wildlife at times when animals are particularly active such as dawn and dusk, and to experience the sounds of wildlife at night.

Refuge and State Parks personnel will be monitoring camp site use, and should they find non-compliance in numbers of campers per site, camping in unauthorized locations, or camp site use resulting in unacceptable adverse effects to Refuge resources, additional camp site use modifications, including a camp site reservation system, may be necessary to initiate in order to continue to allow camping to occur on these islands.

See strategies and rationale for objective 6.2 for more information on wildlife viewing, interpretation and photography.

Objective 6.4 Education Through Stewardship Opportunities

Provide stewardship opportunities on both Refuges where participants can learn about seabirds and the Salish Sea Ecosystem.

- Complete at least one educational stewardship project per year.
- Participants can identify at least 3 adverse impacts of invasive species, marine debris, and/or human-caused wildlife disturbances.

Strategies Applied to Achieve Objective

a. Increase partnerships with schools and volunteer groups to assist with clean-up on 1/3 of the islands annually.

b. Remove invasive plants.

c. Observe and monitor wildlife.

d. Maintain trails, signs, buildings, and facilities.

Rationale: Public understanding and awareness is an important and effective way to protect wildlife and habitat. Providing stewardship opportunities promotes a greater understanding and appreciation of refuge resources by instilling a sense of involvement and the ability to positively affect the outcome. Participants in turn will advance that knowledge and appreciation within their communities. The result will be a generally better understanding of the needs of wildlife and how various refuge species use the islands, and how human disturbance impacts wildlife resources. This greater understanding will allow visitors to the area to act with greater sensitivity.

Objective 6.5 Environmental Education

Provide post-secondary environmental education opportunities on refuge lands

- At least 3 college-level students conduct environmental studies over a 5-year period.

• Student projects are designed to contribute measurably to both the student's and the Service's knowledge of Refuge resources.
Strategies Applied to Achieve Objective
a. Issue 3 or more permits every 5 years to regional colleges and universities to allow students to conduct environmental studies on PI and/or the SJIs.
Rationale: Enabling legislation for Protection Island NWR includes providing for wildlife-oriented public education. Offering students the opportunity to conduct environmental studies on Protection Island NWR and the San Juan Islands NWR will increase both the students' and the Service's knowledge and understanding of Refuge resources while meeting Refuge purposes. Environmental studies are of limited duration, complexity, and scale and are geared toward students gaining field experience and knowledge of the National Wildlife Refuge System and its management.

GOAL 7: Residents and visitors to the area increase their knowledge of the natural and cultural resources of the Salish Sea ecosystem, understand the Refuges' role in protecting those resources, and learn how they can reduce their impacts to those resources.

Objective 7.1 Wildlife Observation, Photography, and Interpretation
Promote water and land-based off-Refuge opportunities where visitors to the area can observe and photograph Refuge wildlife and habitats. • >50% of visitors to the area know that there is a National Wildlife Refuge in the San Juan Archipelago and know the conservation mission of the National Wildlife Refuge System. • >50% of visitors to the area know that Refuge islands provide key habitat for seabirds and marine mammals and know how to observe wildlife without causing disturbance. • >40% of visitors to the area know when and where the best wildlife viewing opportunities are and how to maximize those opportunities while minimizing disturbance.
Strategies Applied to Achieve Objective
a. Install interpretive panels associated with Protection Island (2 panels) and San Juan Islands (5 panels + 2 additional venues) in harbors and on ferries in accordance with the comprehensive sign plan; see Appendix D.
b. Install updated posters at 10 or more locations at marinas, county boat launches, and parks.
c. Provide two ecotourism interpreter training classes per year.
d. Install updated posters at San Juan Islands airports.
e. Develop and distribute info packets to ecotourism organizations.
f. Produce an educational video.
g. Show video on ferry boats.
h. Update and maintain Refuge-specific websites that can be linked to additional technology.
i. Place 10 articles per year in free tourist magazines, including Washington Guide.
j. Develop Refuge-specific brochures for each of the Refuges.
Rationale: Some wildlife-dependant recreation activities can be compatible with the primary Refuge goals to protect wildlife and their habitat. With proper information and education, the public should be able to observe and photograph Refuge wildlife without causing disturbances. Providing such information will result in greater awareness of the Refuges, the National Wildlife Refuge System, and their purposes, and will foster greater appreciation for their ecological values. When the public knows where to view wildlife and understands their needs, how various species use Refuge islands, and how human disturbance affects wildlife, they will be able to act with greater sensitivity to minimize impact on wildlife populations and habitat when visiting the San Juan Islands NWR and the waters around Protection Island NWR.

Objective 7.2 Community Awareness
Promote Refuge understanding and awareness within the community. • >60% of government and tribal officials and local citizens know of the Protection and San Juan Islands NWRs and that they provide key habitat for a variety of wildlife including seabirds and marine mammals. • >60% of government and tribal officials and local citizens understand the conservation mission of the National Wildlife Refuge System.
Strategies Applied to Achieve Objective
a. Create a traveling display and take it to festivals and other events.
b. Conduct five school and community EE programs per year that include information on why it is important to obey Refuge regulations.
c. Develop a relationship with the local press to produce ten articles and/or press releases per year about the Refuges.
d. Use the "adopt an island" concept to promote Refuge awareness.
e. Share administrative office space with another federal, state, or local agency or organization in the San Juan Islands.
f. Increase Project Leader and staff attendance at 8 or more agency and community and meetings per year in the San Juan Islands.
g. Recruit and train volunteers and partners to provide information about the refuges to San Juan Islands area visitors.
h. Have a multi-function, live-aboard or on- island hosts/caretakers who will be stationed seasonally in the San Juan Islands area and year -round on Protection Island to explain rules and regulations and provide other information.
i. Create two new positions stationed in the San Juan Islands: a full time Refuge Manager and a seasonal ranger. They would be responsible for planning, law enforcement, maintenance, education, public relations, and volunteer coordination.
Rationale: Community knowledge of the Refuges, their key habitats and wildlife, will assist with conservation efforts within the Salish Sea. The strategies for achieving this objective will be undertaken primarily off-Refuge where a great many opportunities exist for cooperative actions with a variety of organizations that also care about these resources. In order to achieve this objective, additional staff, as identified, stationed in the San Juans will be necessary.

Objective 7.3 Outreach to the Boating and Aviation Communities	
Help boaters and airplane pilots in the area become more knowledgeable about the Refuges and their resources. • >90% of area boaters know Protection Island is a NWR. • >90% of pilots know which islands are part of the NWR and maintain a 2,000-foot minimum ceiling above Refuge islands. • >80% of boaters know why it is important to maintain a 200-yard disturbance buffer around Protection Island NWR. • >60% of area boaters know which rocks, islands, and islets are part of the San Juan Islands NWR. • >70% of area boaters know why it is important to maintain a 200-yard disturbance buffer (or as close to 200 yards as possible) around Refuge islands in the San Juan Islands NWR. • >70% of area boaters know that wildlife comes first in refuges.	
Strategies Applied to Achieve Objective	**Refuge/Unit**

a. Attend at least 3 group events per year to educate boating clubs, wildlife tour businesses, charters, and kayak groups, about "why a closer look hurts" wildlife.	PI & SJI
b. Increase boater contacts to teach "why a closer look hurts" wildlife. Each year make at least 200 contacts to boaters in the Protection Island area and at least 150 in the San Juan Islands area.	PI& SJ SJI
c. Promote Refuges in outdoor recreation and boating TV shows.	PI & SJI
d. Write at least one article per year for a popular boating magazine that includes information on Refuge regulations.	PI & SJI
e. Work with entities that develop and update integrated navigational software, boater guides, and fishing regulations to include Refuge information in their products.	PI & SJI
f. Work with NOAA to identify Refuge islands on charts and show 200 yard buffers.	PI & SJI
g. Work with volunteers and partners (U.S. Coast Guard, Washington State Parks and Rec. Comm., WDFW, Sheriffs' Office, Sound Watch, commercial cruise boats, etc.) to adequately patrol Refuge islands and to report incidences of non-compliance.	PI & SJI
h. Distribute brochures and display posters in sporting goods and marine stores.	PI & SJI
i. Increase marina visits to 10-20 per year.	PI & SJI
j. Increase number of days per year spent maintaining signs (2-3 people for 5-7 days).	SJI
k. Implement a comprehensive sign plan which includes installation and maintenance of signs identifying closed islands where feasible.	SJI
l. Implement a comprehensive sign plan which includes installation and maintenance of large format signs that ask boaters to stay 200 yards away on up to 10 of the most sensitive islands.	SJI
m. Increase Refuge law enforcement presence to 70 days per year	PI & SJI
n. Work with partners to educate general transportation, military, and tourist aircraft operators regarding the impact of low-flying aircraft on wildlife.	PI & SJI
o. Work with the FAA to assure that Refuge islands are designated on aeronautical charts.	PI & SJI
Rationale: Because PI and SJI Refuges consist solely of islands and are primarily located in or adjacent to navigable waterways, commercial and recreational boaters have the potential to significantly impact Refuge resources. Over flights below 2,000 feet can also disturb wildlife (Hatch and Weseloh, 1999). Therefore it is important to target these particular audiences. Promoting an awareness of the Refuges' locations and sensitivity to disturbance within the boating and aviation communities will result in greater protection of Refuge wildlife.	

Objective 7.4 Education and Interpretation of Cultural and Paleontological Resources

In partnership with the interested Tribe(s) and other preservation partners, develop an education and interpretation program for Refuge cultural and paleontological resources on both refuges with the following attributes:

- At least one Refuge interpretive product or program created that focuses primarily on interpretation of cultural and paleontological resources.
- All appropriate Refuge educational products include interpretation of cultural and

paleontological resources.
Strategies Applied to Achieve Objective
a. Prepare interpretive media (e.g., pamphlets, signs, exhibits) that relate the cultural resources and Native American perspective as well as the Euroamerican settlement and use history for visitors.
b. Prepare environmental/cultural education materials for use in local schools covering the following cultural resource messages: paleontological resources, the discipline of archaeology, the perspective of Native Americans, the history of the area, and conservation of natural and cultural resources. These materials could include an artifact replica kit with hands-on activities and curriculum prepared in consultation with the local school district, historical societies, and the Tribe(s).
c. Consult with the Tribe(s) to identify the type of cultural resources information appropriate for public interpretation.
d. Develop an outreach program and materials so that the cultural resource message becomes part of cultural events in the area, including the State's Archaeology Month, National Wildlife Refuge Week, and appropriate local festivals.
e. Develop partnerships with Tribes, educational institutions, and other partners for the interpretation of cultural and paleontological resources at the Refuge.
f. Develop Museum Property inventory. Create storage and use plans for museum property.
Rationale: Interpretation of non-renewable cultural and paleontological resources is critical to instilling a stewardship ethic among the public and others who encounter or manage them. The purposes of the cultural resource education and interpretive program are fourfold: (1) translate the results of cultural and paleontological research into media that can be understood and appreciated by a variety of publics, (2) engender an appreciation for the Native American culture and perspective on cultural resources, (3) relate the connection between cultural resources and natural resources and the role of humans in the environment (which is one of the goals of the National Wildlife Refuge System), and (4) instill an ethic for the conservation of our cultural heritage and paleontological resources, including archaeological sites and historic structures. Museum property obtained from the Refuges currently exists at the Refuge headquarters and at the Burke Museum, Seattle, Washington. Their usefulness as educational and interpretive tools will be enhanced by developing a complete inventory, and a storage and use plan for current and potential future museum property.

GOAL 8: Promote the wilderness character and experience of the San Juan Islands Wilderness Area.

Objective 8.1 Signs on Wilderness Islands	
Preserve the wilderness character of islands designated as wilderness. • The "minimum tool" concept is used in selecting locations and sizes of signs. • 10 or less islands have large format signs. • Signs (and associated education) are effective in identifying Refuge islands and preventing trespass.	
Strategies Applied to Achieve Objective	**Refuge/ Unit**
a. Implement a comprehensive sign plan which will include number, sizes, locations, and text of signs in accordance with the comprehensive sign plan; see Appendix D.	PI & SJI

b. Standardize the text and limit the number of islands with large "200- yard buffer" signs to 10 or less.	SJI
c. Limit wilderness designation signs in the San Juan Islands wildereness to Matia Island only.	SJI
d. Maintain wilderness sign at Matia trailhead.	Matia
e. On closed islands (excluding reefs), install Refuge boundary signs (with standard Service text) paired with a new sign that reads: "Island Closed, No Entry". Signs sizes would be as follows: 15" x 20" signs – most islands; 11" x 14" signs – some islands; 22" x 28" signs – few select islands	SJI
f. Remove old sign posts, unneeded signs, and other human evidence.	SJI
Rationale: Section 4(b)(2) of The Wilderness Act of 1964 dictates that wilderness areas shall be administered so as to preserve their wilderness character. That includes minimizing non-natural features. There is a need to identify closed areas to protect wildlife. The Service will use the minimal tool concept and appropriate sight distances when determining the need for signs and their sizes. The standard Service sign text, "Area Beyond This Sign Closed," will be replaced by more applicable "Island Closed, No Entry."	

Objective 8.2 Wilderness Experience

Preserve the visitors' wilderness experience with the following characteristics:

- Natural sights and sounds predominate.
- Maximum number of visitors at one time on Matia Island is <100.

Strategies Applied to Achieve Objective	Refuge/Unit
a. Maintain a narrow and natural-appearing wilderness trail using only tools authorized for wilderness areas (e.g., no chainsaws).	Matia
b. Promote 2,000 foot aircraft ceiling over wilderness islands.	SJI
c. Better enforcement of boat landings limited to Rolfe Cove dock and beach on Matia Island only.	Matia
d. Acquire leases and/or withdrawal of tidelands and bed-lands from DNR to better control unauthorized access from inter-tidal areas.	SJI
e. Conduct garbage and marine debris clean-ups.	SJI
f. Limit the size of commercial day-use groups to no more than 20 people; monitor impacts and reduce numbers if necessary.	Matia
g. Number of authorized campsites on Matia Island to 6 sites.	Matia
h. Maximum of 8 people per campsite.	Matia
Rationale: The Wilderness Act of 1964 notes that the wilderness area should be managed to preserve the wilderness character of the area and maintain the purpose for which it was established. Limiting the number of visitors on Matia Island will help to maintain the wilderness characteristics. Protecting wilderness values enhances visitors' experiences, promotes the purpose for which the Refuge was established, and meets the intent of the Wilderness Act.	

Objective 8.3 Wilderness Education

Integrate wilderness education into Refuge public use program with the following messages:

- Visitors to Matia know that they are on a wilderness Refuge island.
- Visitors to the San Juan Archipelago know that the Refuge has islands that are designated wilderness.
- Visitors understand that the Wilderness Act preserves federal lands "…where the earth and its community of life are untrammeled by man…"

Strategies Applied to Achieve Objective	Refuge/Unit
a. Develop interpretive panels on Matia that illustrate the wilderness theme within an island ecology.	Matia
b. Develop interpretive panels for off-Refuge education about wilderness values of Refuge islands.	SJI
c. Promote volunteer opportunities for stewardship projects that highlight the wilderness character of the Refuge islands.	SJI
d. Develop an outreach component of the public use program for schools to connect the wildlife resources of the Refuge and the wilderness concept.	SJI

Rationale: The San Juan Island Wilderness was one of the first designated island wildernesses which are unique in the National Wilderness Preservation System.

The Wilderness Act of 1964 dictates that wilderness areas shall be devoted to public purposes including "…scientific, educational, conservation, and historical use." Protecting wilderness values enhances visitors' experiences, which promotes the purpose of the Wilderness Act and satisfies the mission of the National Wildlife Refuge System. The Fish and Wildlife Service manual 610 FW2 states that Interpretation provides opportunities for people to forge intellectual and emotional connections to the meanings inherent in wilderness resources.

Goal 9: Encourage and support collection of scientific information that assists in managing Refuge resources and contributes to a greater understanding of the natural and cultural resources of the Salish Sea ecosystem.

Objective 9.1 Management of the Scientific Research Program

Enhance the scientific research program while continuing to minimize disturbance to Refuge wildlife and habitats.

- 80% of research projects on the Refuge inform management.
- Reduced footprint of research facilities by 30%.
- Enhanced coordination between Refuge staff and research partners.

Strategies Applied to Achieve Objective	Refuge/Unit
a. Permit approximately 8 research projects over the life of the CCP which have a high level of applicability to Refuge management or significantly contribute to Refuge information needs.	PI & SJI
b. Establish a research committee to develop proposals to meet priority information needs identified by management.	PI & SJI
c. Reduce footprint of research facilities and associated human activity to minimize disturbance to wildlife by developing a centralized and updated research facility.	PI
d. Develop handbook of Refuge guidelines and distribute to all authorized people on islands to prevent disturbance or trampling.	PI
e. Require annual reporting/data on all studies on Refuge lands.	PI & SJI

f. Hire 1 additional full-time biologist to conduct research, monitoring, and restoration.	PI & SJI
g. Provide adequate equipment and boat support for the biological program (e.g., boat moored in Sequim and seasonally in SJI's).	PI & SJI

Rationale: The Protection Island National Wildlife Refuge Act states that scientific research is a Refuge purpose. Refuge islands provide a relatively undisturbed environment for studies; however, due to the physical environment, access is limited.

Refuge plans and actions based on research and monitoring provide an informed approach to biological programs. A research committee would help identify priority studies that contribute to information needs of management and research on Refuge lands. The majority of research projects will be designed to answer specific Refuge management questions. This committee will consist of staff from the Refuge, agencies, academia, research organizations, or Tribes. Research proposals would be reviewed and approved by Refuge staff. For the Service to evaluate the effectiveness of management and/or research projects, all raw data from studies conducted on the Refuge must be submitted to the Refuge for internal use. No unpublished data will be shared with outside parties without consultation with researchers.

There currently are two buildings used mainly for research needs that are situated on separate sections of the island and are in need of updates. Co-locating researchers in an updated structure would facilitate cooperation and maintenance and would help to reduce the human footprint on the island.

Objective 9.2 Conduct or Facilitate Research Projects

For the term of the CCP, implement or facilitate high quality, standardized feasibility studies and research projects that provide the best science for habitat and wildlife management on and off refuges. Scientific findings gained through these projects will assist the Service and others in assessing the impacts of climate change. In addition, these data would allow managers to identify or refine habitat and wildlife management actions and expand knowledge regarding life-history needs of species and species groups. Research will also reduce uncertainty regarding wildlife and habitat responses to Refuge management actions in order to achieve desired outcomes reflected in resource management objectives and to facilitate adaptive management. These research projects have the following attributes:

- Adhere to scientifically defensible protocols for data collection, where available and applicable, in order to develop the best science for resource management.
- Data collection techniques should have minimal animal mortality or disturbance and minimal habitat destruction.
- Collect the minimum number of samples (e.g., water, plants, macroinvertebrates, vertebrates) and repetitions (survey visits) to meet statistical analysis requirements for identification and/or experimentation in order to minimize long-term or cumulative impacts.
- Utilize proper cleaning of investigator equipment and clothing as well as quarantine methods, where necessary, to minimize the potential spread or introduction of invasive species.
- Publish results in peer-reviewed articles in scientific journals and publications and/or symposiums.

Strategies Applied to Achieve Objective	Refuge/Unit
a. Conduct a pre- and post-deer removal assessment of impacts to seabird nesting habitats and other Refuge resources.	PI
b. Conduct island-wide rhinoceros auklet breeding success survey before and after habitat restoration.	PI

c. Conduct studies to determine optimal plants for restoration of bluff habitat within test plots established on the edges of the colony in the grasslands. Monitor results using standardized techniques.	PI
d. Establish representative sites to determine vegetation types to the Willamette Valley grasslands/savannah using standardized techniques, such as transects, and monitor every 5 -7 years after that.	PI & SJI
e. Conduct studies to monitor glaucous-winged gull breeding success and predation in and around restoration areas pre- and post-restoration.	PI
f. Determine hydrology of all Refuge wetlands.	PI & SJI
g. Use established and current protocols to collect information on demographic parameters that may be limited due to threats for the following seabirds: rhinoceros auklet, black oystercatcher, pigeon guillemot (PIGU), glaucous-winged gull (GWGU), tufted puffin, double-crested or pelagic cormorants.	PI &SJI
h. Coordinate with NOAA Fisheries and WDFW to increase collection of abundance and distribution data for harbor and elephant seals, which could include tagging breeding elephant seals on Smith, Minor, and Protection Islands.	PI & SJI
i. Conduct a study on erosion rates of bluffs and deposition on spit habitats on Protection, Smith, and Minor islands.	PI, Smith, Minor

Rationale: Most research on the Refuge will be used to address Refuge-specific wildlife conservation questions. Other research has broader applicability, such as grassland restoration methodology on islands and documenting and predicting impacts associated with climate change. As our knowledge of threats to key ecological attributes increases, management actions become more efficient and effective.

Seabird conservation and management within the Refuges is based upon statistically viable scientific research combined with long-term monitoring. Seabirds are relatively easy to study within the breeding colony and can be used to strategically monitor and detect changes in ocean conditions that affect changes in marine food webs. Long-term, regional, or local research using seabirds as indicators of ocean conditions can be used to document change in the larger marine environment as well as track change in populations at the regional or local scale. With increasing threats from disturbance, predation, and habitat destruction or degradation in the Salish Sea, the Refuge's facilitation of research on demographic parameters of focal resources is important in making informed management decisions with the best scientific data available.

The last three strategies listed above will provide valuable data to help meet the Service's commitments to address climate change (USFWS 2009a). One of the greatest challenges currently facing the National Wildlife Refuge System and wildlife populations in the 21st century is climate change. In addition, it is clear that changes in the environment have the potential to have negative social and economic impacts. Research focused on qualifying the impacts of climate change on species and habitats is complex and difficult, and will require cooperation from numerous public and private organizations within the region.

Objective 9.3 Conduct Surveys

Throughout the life of the CCP, conduct high priority inventory and monitoring (survey) activities that evaluate resource management and public-use activities to facilitate adaptive management. These surveys may be necessary to assess the status of wildlife and habitats at the local and regional scale. Therefore, they should be designed to contribute to the enhancement, protection, use, preservation, and management of wildlife populations and their habitats on- and off-Refuge lands. Specifically, they can be used to evaluate achievement of resource management objectives identified under Goals 1-5 in this CCP. In addition, the resulting data may allow the Service and partners to track changes associated with climate change. These surveys have the following attributes:

- Adhere to scientifically defensible protocols for data collection, where available and applicable, in order to develop the best science for resource management.
- Collect the minimum number of samples (e.g., water, plants, macroinvertebrates, vertebrates) and repetitions (survey visits) to meet statistical analysis requirements for identification and/or experimentation in order to minimize long-term or cumulative impacts.
- Data collection techniques should have minimal animal mortality or disturbance and minimal habitat destruction.
- Utilize proper cleaning of investigator equipment and clothing as well as quarantine methods, where necessary, to minimize the potential spreads or introduction of invasive species.

Strategies Applied to Achieve Objective	**Refuge/Unit**
a. Continue San Juan Summer Surveys annually (June).	SJI
b. In late May-early June, conduct boat-based surveys for breeding black oystercatchers on Refuge islands.	PI & SJI
c. Conduct surveys for presence of non-native rats, rabbits, red foxes, feral cats and dogs, and use appropriate tools to maintain zero population levels using visual area searches, track plates, and bait stations where necessary.	PI & SJI
d. Conduct a survey of native mammalian predators (e.g., raccoon, mink, and river otter), determine impacts and if necessary, develop management actions under a separate step-down management plan.	PI & SJI
e. Conduct boat-based winter wildlife surveys from December through March.	PI & SJI
f. Collect distribution and abundance data of burrow nesting seabirds (rhinoceros auklet, tufted puffin and pigeon guillemot) throughout the Salish Sea ecosystem at periodic intervals.	PI & SJI
g. Conduct periodic, ecosystem-wide monitoring (presence/absence) for surface nesting seabirds and shorebirds (glaucous-winged gull, pelagic and double-crested cormorants, black oystercatcher).	PI & SJI
h. Integrate data into a regional database for trend analysis.	PI & SJI
i. Conduct periodic surveys for Taylor's checkerspot butterflies on Protection Island NWR and island marble and valley silverspot butterflies on the San Juan Islands NWR.	PI & SJI
j. Continue to conduct Christmas Bird Counts (CBC) and initiate breeding bird surveys (BBS) for passerines.	PI
k. Coordinate with partners to conduct surveys for bald eagles according to the Bald Eagle Delisting Monitoring Plan.	PI & SJI
l. Conduct periodic surveys to ensure success of restoration projects.	PI & SJI
m. Conduct a study to determine the best restoration techniques within test plots and monitor prior to full scale restoration.	PI
n. Conduct studies to determine which native plant species will provide the best erosion control throughout the year.	PI
o. Conduct annual surveys for marine debris on or around all Refuge islands – annually on PI and 14 islands in SJI per year.	PI & SJI
Rationale: Under the National Wildlife Refuge System Improvement Act of 1997 (16 USC 668), refuges are required to "monitor the status and trends of fish, wildlife, and plants in each refuge." The strategies listed above represent ongoing or new monitoring efforts of value, to the Refuge or the region, necessary to meet that mandate. These efforts have historically provided a strong foundation from which to assess the status of priority species and guide management actions. One goal of monitoring is to evaluate, regulate, guide, or investigate the success of the Complex's wildlife and land management actions. To meet this goal, the Service must conduct periodic, long-term monitoring of high priority habitats and wildlife. The complexity, costs, and scope required to effectively assess the conservation	

status of a species often exceeds the boundaries of individual refuges, therefore cooperative programs may be necessary to effectively implement these efforts. Working cooperatively assures that data are collected at an adequate scale to assess status and trends of focal resources. Survey emphasis will be placed on species, groups of species, or communities that are cited in the refuge's enabling legislation, establishing documentation or contained in international, national, regional, state, or ecosystem conservation plans or acts and those of importance due to federal or state listing as endangered, threatened, or species of concern (Service Policies 620 FW1, 701 FW2).

In order to meet the Service's commitments to respond to the threats posed by climate change, field stations are charged with identifying species and habitat priorities that must be addressed, implementing strategies, and monitoring results (USFWS 2009a). In order to identify priority species and habitats across the NWRS and follow through with monitoring results, the Service is developing a Strategic Plan for Inventories and Monitoring on NWRs which will guide survey activities on refuges (USFWS 2010). Ecosystem-wide surveys and integrating data into a larger database (strategies f-h) will help meet that need by providing a bigger picture from which to assess species and habitat trends.

The Service has conducted seabird surveys within Pacific Coast refuges for over 30 years. These large-scale studies (colony counts) have proven invaluable in providing managers with the data necessary to 1) mitigate effects of oil spill events, 2) close gill net fisheries in California, and 3) predict effects of climate change on fisheries stocks (e.g., Cassin's Auklets as covariates in forecasting salmon returns). Monitoring of non-listed seabirds and threats to those species is prioritized and guided by the Service's Pacific Regional Seabird Conservation Plan (USFWS 2005). A high priority of this plan was to "Design and implement a comprehensive seabird inventory and monitoring program that is science based and statistically rigorous" and to recognize the importance of refuges to the productivity and survival of seabirds. As a result, a large-scale monitoring plan is under development to guide Service inventory and monitoring efforts along the Pacific Coast, several islands within these Refuges have been identified as important sample sites for long-term, coordinated demographic monitoring.

Objective 9.4 Complete Scientific Assessments

Throughout the life of the CCP, conduct scientific assessments to provide baseline information to expand knowledge regarding the status of Refuge resources and better inform management decisions. These scientific assessments will contribute to the development of Refuge resource objectives and they will also be used to facilitate habitat restoration through selection of appropriated habitat management strategies based upon site-specific conditions. In addition, they may provide the first step in tracking changes associated with climate change.

- Utilize accepted standards, where available, for completion of assessments.
- Scale (1/4 of refuge islands annually) and accuracy of assessments would be appropriate for development and implementation of Refuge habitat and wildlife management actions.

Strategies Applied to Achieve Objective	Refuge/Unit
a. Continue initial inventory of plant species started by TNC and UW in 2005. Map locations of rare plants or communities and create overlay. Share information with Washington Natural Heritage Program and appropriate county extension office weed coordinator.	PI & SJI
b. Coordinate with partners to conduct an inventory of reptiles and amphibians in forested and wetland habitats to determine presence of rare species, such as sharp-tailed or bull snake. Begin survey on Matia Island and, if found, document habitat conditions used by these species.	SJI
c. Integrate data into a regional database for trend analysis.	PI & SJI

d. Survey all formerly occupied Refuge islands (PI and Smith) and islands supporting or formerly supporting Aids to Navigation for presence of contaminants.	PI & SJI
e. Assess levels of contamination and determine and initiate management action if deemed necessary.	PI & SJI

Rationale: Completion of scientific assessments is necessary to meet the mandate of the National Wildlife Refuge System Improvement Act of 1997 to "…ensure that the biological integrity, diversity and environmental health of the system are maintained…" (PL 105-57). Focused inventory efforts can serve as a base to develop a statistically valid framework for "…monitoring the status and trends of fish, wildlife and plants in each refuge…" (PL 105-57, Service Policy 701 FW 2).

Irregular seabird and marine mammal inventories have been conducted in the past. However, little to no baseline data is available for other wildlife or plant species found on refuges. Identifying and mapping refuge resources is necessary to protect, maintain, and restore biological diversity. Many of the habitat types on the refuges are regionally declining, for example less than 10% of the historic native grassland/savanna habitat remains in the Puget Sound (WDFW 2005).

Collection of baseline data is also necessary to begin the assessment of climate change impacts, particularly for flora and fauna not previously emphasized by the refuges, yet vulnerable to climate change such as reptiles and amphibians (USFWS 2009a). In order to identify priority species and habitats across the NWRS and follow through with monitoring results, the Service is developing a Strategic Plan for Inventories and Monitoring on NWRs which will guide survey activities on refuges (USFWS 2010).

Objective 9.5 Cultural Resources Inventory

Prioritize and conduct systematic baseline cultural resource surveys using the following guidelines:

- At least 1/3 of un-surveyed Refuge lands systematically surveyed in 5 years.
- At least 2/3 of un-surveyed Refuge lands systematically surveyed in 10 years.
- All Refuge lands systematically surveyed in 15 years.
- Relocate and resurvey known prehistoric sites at least once every 5 years.

Strategies Applied to Achieve Objective	Refuge/Unit
a. Conduct project-specific surveys of NWR lands.	PI & SJI
b. Conduct systematic survey of NWR lands that have a high potential for the existence of archaeological materials, based on previous research (e.g., Puffin Island, Ripple Island), as well as lands that have high public use or potential threats to cultural resources (e.g., Protection Island, Turn Island, Matia Island, Smith Island, Minor Island).	PI & SJI
c. Relocate the six known prehistoric sites and update documentation, conduct evaluations for eligibility to the National Register of Historic Places (NRHP), and identify threats and impacts to eligible sites.	SJI
d. Reevaluate the listing of the Smith Island Light Station (which is listed on the NRHP but has since collapsed into the ocean) and associated buildings, and consult with the Coast Guard and State Historic Preservation Office regarding building removal.	SJI
e. Develop a GIS layer for cultural resources that can be used with other GIS layers for the Refuges, yet contains appropriate security features to protect sensitive information.	PI & SJI

f. Develop partnerships with Tribes, educational institutions, and other preservation partners for cultural resources inventory, evaluation, and project monitoring, consistent with the regulations of the National Historic Preservation Act.	PI & SJI
g. Update the list of priority survey sites and research projects identified above at least once every 5 years.	PI & SJI
Rationale: Various federal historic preservation laws and regulations require the Service to implement the kind of program described under this objective. Proactive survey, inventory, and research projects can help ensure that we have the information needed to understand and protect cultural resource values and meet the requirements of the National Historic Preservation Act (NHPA). Locations and timing of cultural resource surveys will be scheduled to minimize impacts to wildlife and habitats. By surveying at least 1/3 of un-surveyed and accessible Refuge acres every 5 years until all of the Refuges have been adequately surveyed, it is reasonable to assume that the majority of observable cultural resources on the Refuges have been located, surveyed, and evaluated. Relocating and resurveying known cultural resource sites at least once every 5 years will enable assessment of any changes to the sites and identify mitigation needs.	

Objective 9.6 Paleontological Resources Inventory
Paleontological Resources Inventory • Completed paleontological resources survey on Protection Island
Strategies Applied to Achieve Objective
a. Conduct systematic survey of Protection Island for the existence of paleontological resources based on what is known.
b. Develop a GIS layer for paleontological resources that can be used with other GIS layers for the Refuges, yet contains appropriate security features to protect sensitive information.
Rationale: The Paleontological Resources Preservation Act of 2009 (PRPA) requires Federal agencies to manage and protect paleontological resources on Federal land using scientific principles and expertise. Paleontological resources have been identified as eroding out of the margins of Protection Island, however, a systematic survey has not been completed. Proactive survey, inventory, and research projects can help ensure that we have the information needed to understand, protect, and manage the paleontological resource values and meet the requirements of the PRPA. Locations and timing of paleontological resource surveys will be scheduled to minimize impacts to wildlife and habitats.

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Chapter 3. Physical Environment

3.1 Climate and Climate Change

3.1.1 General Climate Conditions

The climate in the Protection Island and San Juan Islands National Wildlife Refuges (NWRs) is a mild, mid-latitude, west coast marine type. The westerly winds from the ocean play a significant role in moderating the climate in these refuges. Summers are generally cool and dry while winters are mild but moist and cloudy with most of the precipitation falling between November and January (USDA 1962, WRCC 2010a). Extremes in temperature are rare at any season. Annual precipitation in the region is low due to the rain shadow cast by the Olympic Mountains and the extension of the Coastal Range on Vancouver Island (Figure 3-1). Consequently, when surrounding areas are experiencing moderate rainfall, Protection Island and much of the San Juan Archipelago often receive drizzle or light rain. Snowfall is rare or light. These islands receive slightly more sunshine and have less cloudiness than nearby Salish Sea locations. During the latter half of the summer and in the early fall, fog banks from over the ocean and the Strait of Juan de Fuca settle over these low elevation islands, causing considerable fog and morning cloudiness (WRCC 2010a).

Climate Change Trends

There is a growing body of scientific evidence demonstrating that the world climate is changing and that changes in atmospheric composition due to human activity are the drivers for global warming (Bierbaum et al. 2007, IPCC 2007). Average annual global air temperatures on the earth's surface have increased by 1.3°F since the mid 19th century. Furthermore, the increasing trend in global temperatures over the last 50 years is approximately twice the trend of the previous 50 years. Globally, for 11 of 12 years from 1995 to 2006 surface temperatures were the warmest on record since 1850 (IPCC 2007). The global climate system, in turn, controls regional and local-scale climate conditions in the Pacific Northwest. Detailed in the following sections, projected impacts to the region encompassing the refuges include changes in seasonal temperatures, precipitation, extreme weather events, oceanic conditions, and sea level rise.

3.1.2 Air Temperatures

It is rare for the San Juan Islands or Protection Island to experience temperatures below freezing. It is only in the extreme occurrences that temperatures have been recorded below 32°F; on average, they are above freezing. No days are on record with temperatures at or below 0°F (WRCC 2010b, WRCC 2010c).

Temperature data have been consistently collected since July 1891 at the Olga 2 SE station (number 456096), located on the southern shores of Orcas Island. Although Orcas Island is not within the San Juan Islands NWR, the proximity of the station provides valuable regional data. Table 3-1 provides a summary of the 118-year period of record.

There is no climate/weather station established on Protection Island; however, data have been consistently collected and recorded since October 1891 in Port Townsend, Washington (number 456678), approximately 8 miles east of Protection Island. Table 3-1 provides a summary of the 118-year period of record.

Data have also been collected for a brief time period at buoy stations. Table 3-1 summarizes data from

both the Western Regional Climate Center and the National Data Buoy Center for Smith Island, located in the southern extreme of the San Juan Islands NWR.

Table 3-1. Air temperature summaries near the Protection Island and San Juan Islands NWRs (NOAA 2007a, WRCC 2010b, WRCC 2010c).

Temperatures (°F)	Orcas Island [a] July 1891 – Dec. 2009	Smith Island Jan. 1984 – Dec. 2001	Port Townsend [b] Oct. 1891 – Dec 2009
Average Monthly Temperature – Low	35	42	37
Average Monthly Temperature – High	70	56	72
Monthly Mean Winter Temperature – High	45.0	56.7	45.4
Monthly Mean Winter Temperature – Low	34.3	12.7	35.2
Monthly Mean Summer Temperature – High	62.3	80.1	64.8
Monthly Mean Summer Temperature – Low	56.2	44.4	57.6
Daily Minimum Extreme – Low	-8	N/A	5
Daily Minimum Extreme – High	40	N/A	40
Daily Maximum Extreme – Low	66	N/A	61
Daily Maximum Extreme – High	92	N/A	96

a. Orcas Island air temperature data is representative of northern San Juan Islands air temperature.
b. Port Townsend air temperature data is representative Protection Island air temperature.

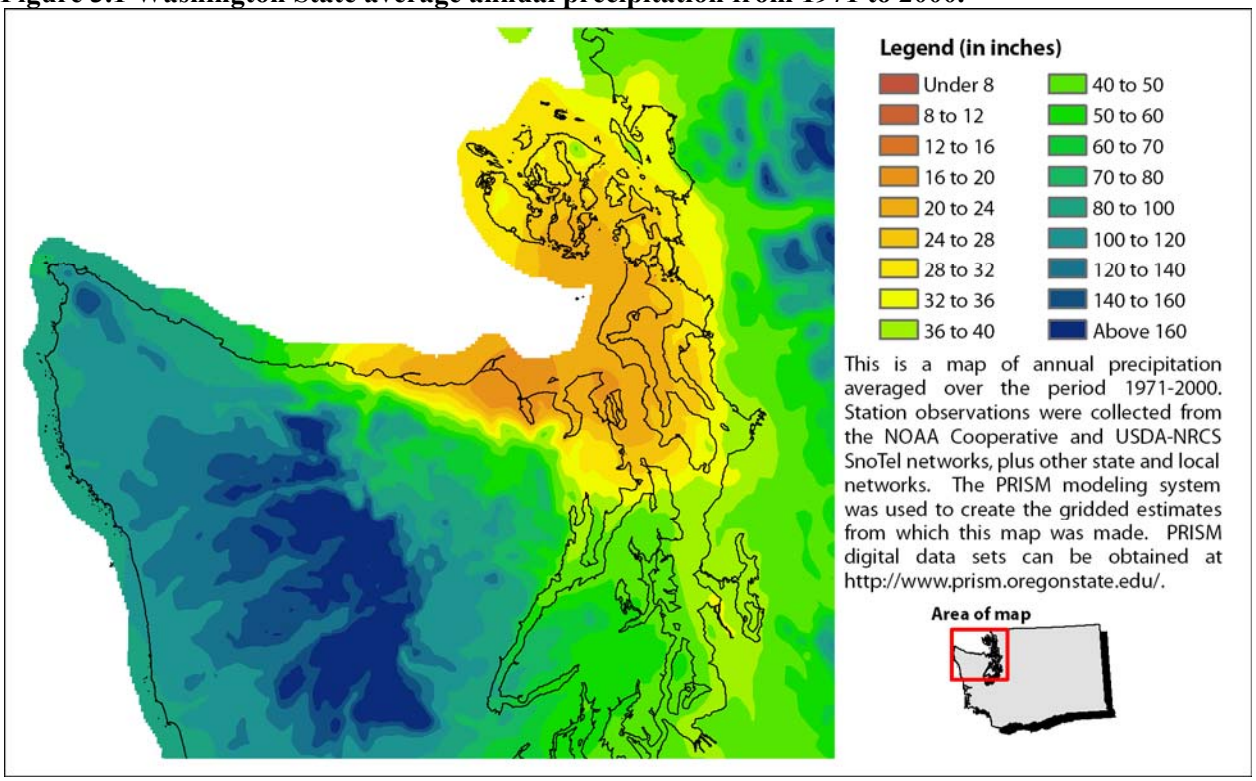
Future Trends

Leung and Qian (2003) modeled the changes in seasonal and extreme temperatures in the Salish Sea for the 105-year period from 1995 to 2100. The study area included the drainages around the Strait of Georgia, southern Vancouver Island, the British Columbia lower mainland, Puget Sound, the northern Olympic Peninsula, and west of the Cascade Range in Washington State. Modeling results, based on a 110-year high-resolution monthly climate time series, indicate that throughout the Salish Sea, the warming trend associated with global climate change is approximately 2.7 to 4.5°F (1.5-2.5°C) (Leung and Qian 2003). Mote et al. (2003) observed that the Pacific Northwest region experienced warming of approximately 1.5°F (0.8°C) during the 20th century. Using data derived from eight climate models, further warming of 0.9-4.5°F (0.5-2.5°C) was projected by the 2020s and 2.7-5.8°F (1.5-3.2°C) by the 2040s. The warming trends modeled by Leung and Qian are similar to the average estimated temperature increases modeled by Mote et al.

3.1.3 Precipitation

Protection Island and much of the San Juan Islands are located in the "rain shadow" of the Olympic Mountains. The rain shadow is an area that extends east from Port Angeles towards Everett and north into the San Juan Islands (Bach 2004). The annual average precipitation map of Washington (Figure 3.1) depicts this area.

Figure 3.1 Washington State average annual precipitation from 1971 to 2000.



The discussion below includes data from the Orcas Island (Olga 2 SE) and the Port Townsend climate stations. The Orcas Island station is located just north of the rain shadow and the Port Townsend station is located within the rain shadow. Precipitation data have not been recorded at the National Data Buoy Center stations; however, precipitation data were historically collected for a brief period (nine years) from the Richardson 3 SE Lopez station (station 457010), located on the southern shore of Lopez Island. The monthly and annual precipitation averages (May 1949 through July 1958) from Lopez Island are similar to the Port Townsend data (WRCC 2007). Precipitation data for Orcas Island and Port Townsend is summarized in Table 3.2.

The majority of precipitation in the northern San Juan Islands occurs during late fall and early winter, in the months of November and December. Nearly 30 percent of the annual precipitation occurs during these two months; January, the third wettest month of the year, brings another 13 percent. On average, only two days per year experience more than 0.50 inch of precipitation and only one day greater than 1.00 inch (WRCC 2010c).

Most precipitation in the southern San Juan Islands and Protection Island falls in November, December, and January. Roughly 38 percent of the annual precipitation occurs during these three months. On average, only one day each year experiences 0.50 inch or more of precipitation and less than one day in a year experiences 1.0 inch or more (WRCC 2010b).

Table 3-2. Precipitation summaries near the Protection Island and San Juan Islands NWRs (WRCC 2010b, WRCC 2010c).

. Precipitation (inches)	Orcas Island [a] July 1891 – Dec. 2009	Port Townsend [b] Oct. 1891 – Dec 2009
Average Annual Precipitation	28.93	18.74
Average Annual Snowfall	6.7	5.4
Average Monthly Snowfall Range (winter)	0.5 to 2.5	0.5 to 1.7
Highest Annual Snowfall	53.0 (1916)	26.7 (1950)
Highest Monthly Snowfall	35.0 (February 1916)	32.6 (February 1950)
Wettest Year on Record	37.89 (1917)	27.47 (1948)
Driest Year on Record	15.09 (1929)	12.97 (1952)
Wettest Season on Record	21.78 (winter 1918)	11.53 (1916)
Driest Season on Record	0.62 (summer 1938)	0.86 (1945)

a. Orcas Island precipitation data is representative of northern San Juan Islands precipitation.
b. Port Townsend precipitation data is representative of Protection Island precipitation.

Future Trends

On a global scale, warmer temperatures are predicted to lead to a more vigorous hydrologic cycle, translating to more severe droughts and/or floods (IPCC 1996). Observations of Pacific Northwest precipitation trends through the 20th century indicate a region-wide increase since 1920 (CIG 2004). The median value of the increase throughout the region was 22 percent, with the highest increase in Northeast Washington and British Columbia. Mote et al. (2003 as cited in CIG 2004) projected a further region-wide increase in precipitation except in the summer (please refer to the Air Temperature section for further discussion). Average projected increases for the 2020s were 8 percent during the October to March period and 4 percent for the April to September period. The same average projections for the 2040s were 9 percent and 2 percent, respectively. However, the regional climate model applied by Leung and Qian (2003) to the Salish Sea, a subarea of the Pacific Northwest, predicts an inconsequential change in precipitation for the immediate region of the two refuges. It is important to note that the one conclusion shared by researchers is that there is greater uncertainty in precipitation projections than that of temperature predictions and models (Leung and Qian 2003, CIG 2004, Bach 2004, Salathé et al. 2009). As an illustration, a comparison of recent Pacific Northwest climate model simulations indicated a weighted annual mean change in precipitation of nearly zero through 2100; however, the individual models produced changes ranging from −10 percent to +20 percent by 2080. In addition, there is no correlation between temperature change and precipitation change in the Pacific Northwest although there is a correlation with global models. Researchers have consistently found that regional climate model simulations yield an increase in the measures of extreme precipitation (Salathé et al. 2009).

3.1.4 Wind

During the spring and summer, the semi-permanent low-pressure cell over the North Pacific Ocean becomes weak and moves north beyond the Aleutian Islands. Meanwhile, a high-pressure area spreads over the North Pacific Ocean. Air circulates in a clockwise direction around the high-pressure cell bringing prevailing westerly and northwesterly winds. This seasonal flow is comparatively dry, cool, and stable (WRCC 2010a).

In the fall and winter, the high-pressure cell weakens and moves southward while the Aleutian low-pressure cell intensifies and migrates southward as well. It reaches its maximum intensity in midwinter.

Air movement around the low-pressure cell is in a counter-clockwise direction, bringing southwesterly and westerly prevailing winds to the region of the northeast Olympic Mountains and the San Juan Islands. The air mass over the ocean is moist and near the temperature of the water. As it moves inland, it cools and condenses, bringing the beginning of the wet season in October (WRCC 2010a).

The Friday Harbor (FRDW1), New Dungeness (Hein Bank [46088]), and Port Townsend (PTWW1) data buoys have not reported usable wind data for the brief periods of record available. Likewise, the climate summary data for Orcas Island (Olga 2 SE) and Port Townsend weather stations do not include wind data. Therefore, wind data from the Port Angeles and Friday Harbor airports have been used to draw generalizations about wind activity in/on Protection Island and the San Juan Islands, respectively. Wind data collected from the Smith Island station between 1984 and 2001 provides valuable information specific to the Strait of Juan de Fuca and is discussed below, as well. Table 3-3 provides a summary of data from all three locations.

Prevailing winds at Friday Harbor Airport are typically from the southeast; however, a definite shift takes place in April with winds changing to southwesterly through July (WRCC 2010d). Average monthly wind speeds are lowest in September and highest in December (WRCC 2010e). Prevailing winds at Port Angeles Airport are generally from the west; however, winds come from the southwest during the winter months (WRCC 2010d). Average monthly speeds are higher in the summer than in the fall and winter (WRCC 2010e).

The historical data from the Smith Island data buoy cover wind speed data for seventeen years (1984 - 2001). Average monthly speeds were lowest in September and highest in December, and wind gusts up to 62.4 knots (71.8 MPH) were recorded in March 1997 (NOAA 2007a).

Table 3-3. Wind data summaries for three locations within the Protection Island and San Juan Islands NWRs (NOAA 2007a, WRCC 2010d, WRCC 2010e).

	Friday Harbor	Port Angeles	Smith Island
Prevailing Wind Direction	SE/SW	W/SW	Not Reported
Average Annual Wind Speed	5.8 mph	5.2 mph	9.8 knots
Average Monthly Wind Speed Range	3.6 – 7.9 mph	4.2 – 6.6 mph	6.7 – 12.4 knots
Maximum Monthly Average Wind Speed	Not Reported	Not Reported	51.1 knots (Nov. 1991)

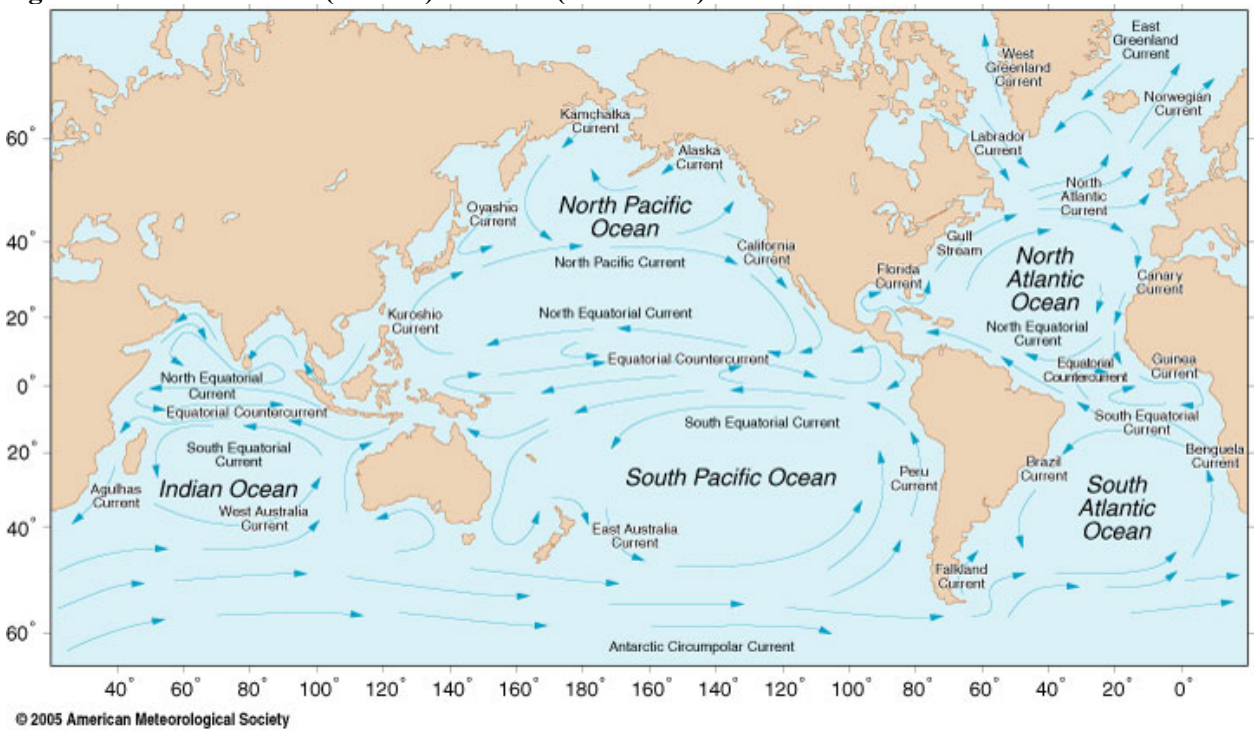
Washington does not experience hurricanes, and tornadoes in western Washington are very infrequent, especially in these island environments. The state experiences an average of two tornadoes per year. Likewise, thunderstorms are generally not severe and do not pose a significant threat.

3.2 Oceanography and Climate Change

3.2.1 Ocean Currents and Upwelling

Ocean currents, horizontal movement of seawater at the ocean's surface, are a result of frictional stress at the interface between the ocean and the winds circulating above its surface. Large ocean currents are constrained by the continental landmasses bordering the ocean basins, which cause the currents to develop nearly closed circular patterns; these currents flow at relatively high rates. The two major currents influencing the waters off the U.S. west coast are the North Pacific Current (also known as the North Pacific Drift) and the Alaska Current (Figure 3-2) (Pidwirny 2006, AMS 2005).

Figure 3-2. Global ocean (surface) currents (AMS 2005).



In addition to global surface currents, slower-moving global sub-surface currents are present; they are driven by differences in seawater density. In the North Pacific, a sub-surface current flows north from Antarctica, bringing deep, cold, nutrient-rich waters to the surface in areas of upwelling, before making a clockwise rotation in the Pacific Ocean and moving back to the east (Figure 3-3). During typical summers, cold, nutrient-rich waters also intrude upon the coasts of Washington and British Columbia in areas of upwelling. Upwelling is an important process that brings cold, nutrient-rich water into coastal systems and supports biological processes from microscopic plankton to whales, fishes, and seabirds (Banas et al. 1999, Pidwirny 2006).

Although global ocean currents affect the San Juan Islands and Protection Island, local physical oceanography has a great influence on the currents and upwellings in and around the two refuges. Both refuges are within the Georgia-Fuca system, a complex waterway comprising the Strait of Georgia, the San Juan Channel, and the Strait of Juan de Fuca. The Georgia-Fuca system is the estuarine link between freshwater runoff from the continent and saltwater from the Pacific Ocean (Banas et al. 1999).

Estuarine circulation is driven by the pressure gradient created at the freshwater sources. The major freshwater inflows occur at the mouth of the Fraser River in the Strait of Georgia and the mouth of the Skagit River in north Puget Sound. Lighter freshwater flows into the Georgia-Fuca system and out over the denser ocean saltwater. This pressure gradient (created by freshwater over saltwater), results in a net flow of water out of the estuary and into the ocean (Banas et al. 1999).

In addition to transporting nutrients to surface waters, upwelled waters along the coast of Washington and British Columbia flow into the Strait of Juan de Fuca affecting density stratification and water properties of the Georgia-Fuca system. Atmospheric changes can also affect circulation. Prevailing winds and their associated pressure systems can cause water to collect at the entrance of the Strait of Juan de Fuca, resulting in a reversal in estuarine circulation (Thomson 1994, as cited in Banas et al. 1999).

Figure 3-3. Global sub-surface currents (Pidwimy 2006).

The complex topography of the Georgia-Fuca system not only includes numerous islands, but many banks, constrictions, and sills, resulting in exceedingly complicated and swift tidal currents (up to 2 meters [6.5 feet] per second) (Banas et al. 1999). These swift tidal currents pose challenges associated with safe island access.

Future Trends

It is unknown how global climate change will influence the ocean currents and coastal upwelling affecting Protection Island and the San Juan Islands. However, current climate model simulations indicate little change in coastal upwelling in the Pacific Northwest (Mote et al. 2008b, Mote and Salathé 2009).

3.2.2 El Niño Events

A seasonal change in the circulation of the Pacific Ocean often brings an event known as El Niño to a wide region including the Pacific Northwest. A periodic weakening of the trade winds in the central and western Pacific, often occurring in December, allows warm water to invade the eastern Pacific. This seasonal change in the wind and ocean circulation can have global impacts to weather events. During an El Niño event, the winters of the Pacific Northwest tend to be warmer than usual. An El Niño event may be followed by La Niña, which results in cooler than normal ocean temperature in the eastern Pacific. La Niña also can have significant impacts on global weather. Collectively, the El Niño and La Niña cycle is known as the El Niño–Southern Oscillation (ENSO) (Pidwirny 2006). The shift between the two conditions of the ENSO cycle takes about four years (Conlan and Service 2000).

El Niño events are not caused by global warming; however, a relationship between global warning and El Niño may exist. NOAA (2010a) addresses the relationship as follows:

> Clear evidence exists from a variety of sources (including archaeological studies) that El Niños have been present for thousands, and some indicators suggest maybe millions, of years. However, it has been hypothesized that warmer global sea surface temperatures can enhance the El Niño phenomenon, and it is also true that El Niños have been more frequent and intense in

recent decades. Whether El Niño occurrence changes with climate change is a major research question.

Future Trends

Based on the evidence of the history of El Niño events, it is likely that they will continue to occur far into the future. However, the potential influence of climate change on El Niño events is unknown because more information is needed by the experts.

3.2.3 Tides and Sea Level Rise

Historic records of tides and water levels from three data stations in the San Juan Islands and one in Port Townsend are summarized in Table 3-4. Data for each station includes mean ranges, diurnal ranges, and the minimum and maximum water levels on record. The mean range is the difference in height between the mean high water and the mean low water. The diurnal range is the difference between the mean higher high water (MHHW) and the mean lower low water (MLLW) of each tidal day.

Table 3-4. Historic tidal data summary for San Juan Islands and Port Townsend (NOAA 2010b).

Station Information	Friday Harbor, San Juan Channel Sta. ID 9449880	Richardson, Lopez Island Sta. ID 9449982	Armitage Island Sta. ID 9449932	Port Townsend Sta. ID 9444900
Mean Range (ft)	4.82	4.55	4.9	5.34
Diurnal Range (ft)	7.76	7.17	7.84	8.52
Minimum Water Level (ft below MLLW)	-4.15 on 01/07/1947	-3.85 on 12/24/1999	-3.65 on 12/25/1999	-4.22 on 12/12/1985
Maximum Water Level (ft above MHHW)	3.39 on 12/16/1982	2.41 on 12/16/1997	2.61 on 12/16/1997	3.21 on 12/10/1993

While regular tide-related wave action can redistribute sediments along a shoreline, storm surges can have more pronounced erosion impacts. A storm surge consists of water that is pushed toward the shore by the force of the winds swirling around a storm (NOAA 2007b). The advancing surge combines with the normal tides to create a storm tide, which can increase the mean water level 15 feet or more (NOAA 2007b). In addition, wind waves are superimposed on a storm tide creating a cumulative impact on the tide level; the impacts are generally greatest when they occur during the normal high tide. Water weighs approximately 1,700 pounds per cubic yard; extended pounding by frequent waves can result in severely eroded beaches and coastal resources (NOAA 2007b).

Sea level rise on the Washington coast and inland marine waters of the state is the result of four major forces: global mean sea level rise driven by the thermal expansion of the ocean, global mean sea level rise driven by the melting of land-based ice, local dynamical sea level rise driven by changes in wind which push coastal waters toward or away from shore, and localized vertical land movements driven primarily by tectonic forces (Mote et al. 2008a). Mean sea level is defined as the average sea level over a 19 year period, about which other fluctuations (tides, storm surges, etc.) occur (Smerling et al. 2005). Global mean sea level rise has ranged from 0.05 to 0.09 inch per year from 1961 to 2003 (IPCC 2007). This global impact is primarily the result of general thermal expansion of the oceans (as warming occurs, the water volume expands) and ice field and glacier melt off (Warrick and Oerlemans 1990 as cited in Canning 2001). In addition, vertical land movements are occurring as the North American plate and the

off-shore Juan de Fuca plate collide. Uplift occurs along the Washington coast while subsidence occurs off-shore. Vertical land movements in the Strait of Juan de Fuca range from approximately 0.1 inch per year at Neah Bay to zero at Friday Harbor (Canning 2001).

Based on monthly mean sea level data from 1934 to 2006, the mean sea level trend at Friday Harbor is approximately +0.37 feet per century (NOAA 2010b). Data for Port Townsend was recorded from 1972 to 2006 and indicates a mean sea level trend of +0.65 feet per century (NOAA 2010b). The 95 percent confidence interval is ±1.08 feet per century and ±3.77 feet per century for the data trends, respectively.

Future Trends
Estimates for the rise in sea level at Puget Sound by 2050 range from 0.25 feet under the "very low" scenario to 0.5 feet under the "medium" scenario and 1.83 feet under the "very high" scenario. There is a low probability for both the "very low" and "very high" scenarios (Mote et al. 2008a).

3.2.4 Sea Temperatures

Based on historical data reported through the National Data Buoy Center (NOAA 2006), sea surface temperatures in the Refuge regions range from approximately 46°F in the winter months to approximately 54°F in the summer months (NOAA 2006, Emmett et al. 2000, Stephenson and Stephenson 1961). Sea surface temperatures are collected at stations located in Friday Harbor and Port Townsend. Buoys moored within the Strait of Juan de Fuca also report data with similar seawater temperature ranges.

Future Trends
Summer sea surface temperatures in the Pacific Northwest are projected to increase. Regional climate models for the Pacific Northwest project warming in summer sea surface temperature for the 2040s on the order of 2.2°F (1.2°C). This change is somewhat less than the warming projected in the 2040s for Pacific Northwest land areas but is significant relative to the small inter-annual variability of the ocean (Mote and Salathé 2009).

3.2.5 Oceanic Chemical Concentrations

The Strait of Juan de Fuca is open to the Pacific Ocean at its western end with a submarine canyon crossing the continental shelf just off the strait's opening. This deep canyon assists in cold bottom-water entering the strait. The wide opening to the ocean allows a considerable amount of wave action within the Strait of Juan de Fuca, and tidal currents are strong. Conversely, the Strait of Georgia is more protected from immediate interaction with the Pacific Ocean. Wave action is of primarily local origin, tidal currents are important, and salinity is affected by local rivers, the largest of which is the Fraser River. In general, the waters of the Georgia-Fuca system are unusually rich in nutrient salts, in part due to upwelling at the mouth of the Strait of Juan de Fuca (Stephenson and Stephenson 1961).

Waters of the Georgia-Fuca system contain relatively low salinity, with monthly salinity averaging around 31 parts per thousand (ppt) at Race Rocks in the Strait of Juan de Fuca near Victoria, Canada (Stephenson and Stephenson 1961). By comparison, salinity in much of the earth's oceans is approximately 34 to 36 ppt. The Fraser River and Puget Sound collectively bring more freshwater inflows to the Pacific Ocean than any other individual drainage from British Columbia through California (Emmett et al. 2000). This freshwater influx is responsible for the salinity of the waters surrounding both refuges, which is relatively low compared to that of many coastal island complexes.

Carbon dioxide flux is another important component of the chemical makeup of the water surrounding the refuges. While a large amount of the carbon dioxide concentration within surface seawater is due to

exchange at the interface between the atmosphere and ocean, another strong contribution of carbon dioxide to the ocean comes from biological production (Johnson et al. 1979). Thompson and Miller (1928) observed carbon dioxide levels from opposing tidal currents within the Georgia-Fuca system. The tidewater flowing out of the Strait of Georgia contained 64.48 milligrams carbon dioxide per liter (mg CO_2/l). Conversely, the tidal water flowing in from the Strait of Juan de Fuca contained 78.79 mg CO_2/l (Thompson and Miller 1928).

Future Trends

Although salinity trends related to climate cannot be calculated for the waters around the Refuge due to insufficient baseline data, there is some regional salinity data that can be used with projected stream data to estimate a general trend for salinity in the future. Salinity data collected from Puget Sound in the 1990s indicates a correlation between lower stream flows and higher sea surface salinity, and vice versa. Also, correlations between winter precipitation and slightly decreased salinity have been noted at Race Rocks in the Strait of Juan de Fuca (Snover et al. 2005). Changes in runoff of water into streams of Washington State have been projected to occur as a result of global warming, with estimated annual increases of 2 to 3 percent by the 2040s, and 4 to 6 percent by the 2080s; seasonal changes are expected with increases during the cool seasons and smaller decreases during the warm seasons (Littell et al. 2009). Based on the noted salinity trends and projected runoff changes, salinity in the Georgia-Fuca system could further decrease as a result of the continued warming trend associated with global climate change.

Ocean acidity is expected to rise as a result of continued increases in atmospheric carbon dioxide, as the additional carbon dioxide is taken up in the ocean, lowering pH. Plankton, fish, and other marine organisms that tolerate lower pH may benefit; however, others will not. Important plankton that form calcite shells will be negatively affected, and lower pH has been found to decrease calcification rates in mussels, clams, and oysters (Feely et al. 2008 as cited in Huppert et al. 2009, Snover et al. 2005). These changes are likely to result in cascading effects to other species at higher trophic levels, such as fish, birds, and marine mammals. The range and magnitude of biological effects are currently uncertain, but are thought to be substantial (NOAA 2008 as cited in Huppert et al. 2009).

As Kleypas et al. (2006) observed, little attention has been focused on the role of the carbon cycle of shallow-water (versus open) ocean within the context of global climate change. In general, increasing partial pressure of atmospheric carbon dioxide drives more carbon dioxide into seawater. However, an important caveat exists: as seawater temperature rises due to global climate change (warming), its capacity to hold carbon dioxide decreases (Kleypas et al. 2006). Sarmiento and Le Quere (1996) conducted modeling research that indicates the primary reason for the reduced uptake of carbon dioxide in the oceans will be weakened or collapsed density-driven ocean circulation.

3.3 Topography and Bathymetry

Protection Island is crescent-shaped with sand spits at the west and the east ends. The western spit is Kanem Point and the eastern is Violet Point. Each of the spits has less than 40 feet of elevation. A bluff and cliff complex circumscribes the main body of the island excluding the two spits. The bluff along the southern shore is approximately 100 feet high while the cliffs of the northern shore are approximately 150 feet high. The gently undulating hills of the central plateau of the island range from 120 to 204 feet of elevation (USGS 1960-1986). Protection Island is surrounded by Dallas Bank. The bank slopes gently away from the northern shores of the island and falls away sharply from the shores to the south. Dallas Bank rises from approximately 100 feet below sea level to roughly 10 feet below sea level and is generally a triangle-shaped feature (NOAA 2010c).

Some of the islands within the San Juan Archipelago have such little relief that they are completely submerged at high tide. A review of the 7.5-minute Mount Constitution quadrangle map (USGS 1979) indicates that the highest elevation on the largest of the islands within the San Juan Islands NWR complex, Matia Island, is approximately 162 feet above mean sea level. The majority of the islands within the NWR complex, however, have less than 20 feet of elevation while many of the remaining islands have no more than 40 feet of elevation (USGS 1960-1986).

Deep ice-scoured channels and sounds are the remnant glacial features of the last ice age that define the bathymetry surrounding the islands of the San Juan Archipelago. The bathymetry is a complex combination of shallows and deep U-shaped channels that form the primary navigational routes between the islands (Banas et al. 1999). In addition to the straits of Juan de Fuca and Georgia, the major channels within the archipelago include the San Juan Channel, Haro Strait, and Rosario Strait (NOAA 2010c, 2010d).

3.4 Recent Geological History and Geomorphology

The San Juan Islands represent the highest peaks of a submerged mountain range that formerly connected Vancouver Island with the Washington State and British Columbia mainland (USDA 1962). The valleys and ravines of the now-submerged range form the channels and harbors surrounding the San Juan Islands (McLellan 1927). The mountain range forming the San Juan Islands and channels was likely formed during the process of subduction along the boundary of the continental North American Plate and the oceanic Juan de Fuca and Pacific plates (Russell 1975). As the continental plate and the ocean plates collided, the ocean plates moved under the continental plate, and the sedimentary deposits on the sea floor folded against the continental plate (Schultz 1990). The relic left behind by this collision process is the San Juan Archipelago, which has been shaped and modified millions of years later by glaciers (Russell 1975).

Both refuge areas have been highly defined by the glacial activity of past ice ages. Some areas of the islands, and in some cases entire island outcrops, have been scoured to their bedrock bases. Others became depositional areas for the scoured materials (USDA 1962, 1975). As temperatures warmed and the ice retreated, seawater began to enter the Georgia-Fuca system and Puget Sound, eventually submerging much of the glaciated landscape (Grimstad and Carson 1981). The channels and straits of the Georgia-Fuca system exhibit the telltale steep-walled, U-shaped valleys of a glaciated area. The scoured and smoothed island tops are the uppermost visible evidence of the glacial activity. Steep, wave-cut bluffs along the straits further define the margins between the submerged and terrestrial landscapes (PSAT 2005).

The most recent ice age took place during the Pleistocene epoch (1.8 million to 10,000 years ago) within the Quaternary period (USGS 2006a). The Puget Lobe of the Cordilleran Ice Sheet carved much of the landscape and seascape within and surrounding the San Juan Islands and Protection Island. Due to temperature fluctuations, the Puget Lobe went through a series of four advances/retreats (Grimstad and Carson 1981). The final retreat occurred approximately 10,000 years ago (USGS 2006b). The glacial activity left behind a landscape of relatively gentle, rolling, elongated, northerly tending hills with steep valley sides (USDA 1962, 1975). Fluvial processes further cut some of the valley sides (Grimstad and Carson 1981). Table 3-5 summarizes the processes of each formation and some islands associated with each.

Table 3-5. Summary of geological formations and representative island associations.

Formation	Age (million years ago)	Lithology	Process	Island Name (number)
Turtleback Complex	490–443	intrusive rocks	Crystallized molten magma formed beneath an overlying structure. In the San Juan Islands, glacier activity has scoured the overlying structures away and left the intrusive bedrock exposed.	Fortress Island (3), Skull Island (4), Crab Island (5), Castle Island (8), 3 unnamed islands (9), Secar Rock (17), Barron Island (30), Willow Island (55), Pointer Island (57), 3 unnamed rocks (59), Bird Rock (68), unnamed island (69) Low Island (70), Nob Island (71)
Orcas	290–248	metasedimentary rocks, cherty	Deposits laid down as marine sediments in fairly deep water a considerable distance from the shore. Rocks are highly metamorphosed and contorted as a result of folding and intrusions.	Low Island (28), Battleship Island (31), Tift Rocks (50)
Constitution	248–65	marine sedimentary rocks	Erosion and deposition of sediments derived from uplifted land areas.	Turn Rock (52), Shag Rock (53), Turn Island (79)
Nanaimo	144–65	nearshore sedimentary rocks	Deposition laid down upon eroded surfaces near sea level.	Ripple Island (35), Little Cactus Island (37), Gull Rock (38), Flattop Island (39), White Rocks (40), Skipjack Island (42), unnamed island (43), Bare Island (84)
Spieden	144–65	nearshore sedimentary rocks	Deposition laid down upon eroded surfaces upland of sea level.	Sentinel Island (32)
Lummi	144–65	marine sedimentary rocks	A general withdrawal of the sea and an accompanying uplift exposed marine sedimentary rocks.	2 unnamed islands (2), Boulder Island (6), Aleck Rocks (10), Swirl Island (11), 4 unnamed islands (13), Hall Island (15), unnamed island (16), 3 unnamed islets (19), 13 unnamed islets (20), Mummy Rocks (21), islets and rocks (22), Shark Reef (23), Harbor Rock (24), Flower Island (54), unnamed rock (61), S. Peapod Rocks (62), Peapod Rocks (63), N. Peapod Rock (64), Colville Island (82), Buck Island (83)
Chuckanut	65–1.8	continental sedimentary deposits or rocks	With a gradual submergence, water began entering both from the north and the area now occupied by the Strait of Juan de Fuca. As submergence continued, water encroached farther and farther eastward. Sediments were laid down upon eroded surfaces followed by regional uplifting above sea level and gentle folding.	2 unnamed islands (2), Boulder Island (6), Round Rock (18), Clements Reef (44), The Sisters (47), Little Sister Island (48), Black Rock (58), 3 unnamed islands (59), Matia Island (77), Puffin Island (78), Four Bird Rock (80)
Glacial Deposits	1.8–present	glacial deposits	During glacial advance, ice cut deeply into older formations scouring material and re-depositing it adjacent (lateral) to and at the termini of the ice sheet and glaciers.	Matia Island (77), Turn Island (79)
Post-glacial Sediments	1.8–present	post-glacial deposits	During glacial retreat, a thick mantle of recessional glacial drift was left on many of the islands.	Protection Island, Smith Island (78)

Glacier activity scoured away the overlying structures and left behind exposed bedrock from the Turtleback Complex. Portions of the ice sheet at the ocean's edge actually floated, causing melting and glacial till outwash to occur. At the farthest floating edges of the ice sheet, the outwash was laid down as marine sediment in fairly deep water that was a considerable distance from the current shorelines. The Orcas Formation is the result of folding and intrusion that has highly metamorphosed and contorted these deep-water marine sediments. As the ice sheet retreated, uplift occurred. The Constitution Formation resulted from the erosion and deposition of sediments derived from the uplifted land. During the same period, nearshore sedimentary rocks were formed as erosion and deposition processes laid down sediments on eroded surfaces. The Nanaimo Formation consists of sediment deposited upon eroded surfaces near sea level while the Spieden Formation left depositional material further upland. A period of general sea withdrawal accompanied by further land uplift began. During this period, the Lummi Formation resulted in marine sedimentary rocks being uplifted and exposed (Russell 1975).

Eventually, a gradual submergence began as seawater began to enter from the north and through the area now occupied by the Strait of Juan de Fuca. As submergence continued, water encroached farther and farther eastward. Sediments were laid down upon eroded surfaces followed by another regional uplifting above sea level accompanied by gentle folding. This process resulted in the Chuckanut Formation. As the ice sheet continued to retreat, glacial deposits were left along the retreating edges to cover many of the exposed islands (Russell 1975).

Protection and Smith Islands were also formed during a period of glacier recession and consist primarily of postglacial sediments. The bluffs that are present in a circular pattern around the majority of Protection Island consist of a mix of undifferentiated glacial deposits (Grimstad and Carson 1981, Dragovich et al. 2005).

3.5 Soils

Soils mapped throughout the two refuges are described below. County soil surveys were not conducted for the two most northern features, Clements Reef and an unnamed island, or the two most southern islands in the refuge, Smith and Minor Islands.

The Soil Survey of San Juan County, Washington (USDA 1962), maps the majority of the islands within the NWR as Rock land, rolling (map unit Ry). These islands are characterized by rock outcrops made up primarily of sandstone, argillite, and basalt. Also scattered heavily throughout the refuge are islands mapped as Roche-Rock outcrop complex, 8 to 30 percent slopes (map unit RxD). This complex is characterized by the rock outcrops described above mixed closely with soils from the Roche series. Roche gravelly loam, 3 to 8 percent slopes is the predominant Roche series component of this complex. Islands of the refuge located in the southern expanses of San Juan County are predominantly mapped as Rock land, steep (map unit Rz). This soil type is similar to Rock land, rolling, but is steeper (USDA 1962).

Turn Island, adjacent to the western peninsula of San Juan Island, is mapped as Everett gravelly sandy loam, 3 to 8 percent slopes (map unit EgB). It contains a number of small patches of cobbly and stony areas. Everett soils are composed of sandy, gravelly, and cobbly materials derived from sandstone, granite, and basalt. Turn Rock, located close to Turn Island, is primarily mapped as Roche-Rock outcrop complex, 8 to 30 percent slopes. Unlike the other islands with this map unit type, Turn Rock is also mapped as having Coastal Beaches (map unit Cb) along its western shore. Coastal Beaches consist of sandy and gravelly sloping beaches in long narrow strips along island margins (USDA 1962).

The easternmost islands within the San Juan Islands NWR, Eliza Rock (Island #65) and Viti Rocks (Island #66), are located within Whatcom County. The Soil Survey of Whatcom County Area, Washington, maps both islands as Rock Outcrops (map unit 131). Typically, the outcrop is composed of sandstone, phyllite, dunite, or metasedimentary rocks. It is generally found on mountainsides and ridges and occurs as steep cliffs and irregular formations of unweathered rock. In the case of these features, they are found on the ridges of submerged mountains (USDA 1992).

The Soil Survey of Jefferson County Area, Washington (USDA 1975) indicates there are five soil map unit types on Protection Island. Kanem and Violet points are mapped as coastal beaches (Co) (see above description). The inland-most portion of Violet Point, at the base of the bluff is mapped as tidal marsh (Td) consisting of nearly level, extremely wet, salty, brackish areas within the overflow limits of high tides. Soil materials in tidal marsh areas are deep deposits of heterogeneous alluvium; no true soil formation has taken place. The bluff, or escarpment, surrounding the island is mapped as rough broken land (Ro) typically consisting of marine bluffs that are 80 feet high and 100 feet or more wide; the slopes are generally between 50 and 120 percent. The majority of the upper elevation of the island, approximately 155 acres, is mapped as Townsend fine sandy loam, 0 to 15 percent slopes (TIC). These soils are formed as strong prevailing winds blow fine sand from the beaches and bluffs and deposit it on the surface. Wrapping around the western and southern limits of the TIC area is a band of dune land (Du) covering approximately 118 acres and consisting of fine sand (USDA 1975).

3.6 Hydrology

The circulation of Salish Sea region, which includes the Straits of Georgia, Juan de Fuca, and Puget Sound, is driven by tidal currents, the surface outflow of freshwater from major river systems, and the deep inflow of saltwater from the ocean. Fresh water originates from the Olympic Mountains, Vancouver Island Range, and Cascade Range, both during winter rain events and from the spring melt. The strong freshwater influence of the Fraser River from the north, Bellingham, Padilla, and Skagit bays from the east, and South Puget Sound occasionally causes large drops in surface salinities.

Lakes, reservoirs, and ponds occur throughout the San Juan Islands and supply much of the domestic water used on the larger islands (e.g., San Juan and Orcas Islands). However, the size of the surface water impoundments on these islands are limited by topography, precipitation, and glacial sediment overlay. Watersheds on the islands are generally small and the streams that drain them are typically seasonal. The lack of rivers and snow pack means that groundwater supply and recharge comes wholly from local rainfall. However, seawater intrusion affects many glacial drift aquifers as well as some fractured bedrock aquifers.

Protection Island

Prior to development from 1968 to 1974, tidal salt and brackish marsh formerly existed on Violet Point. Daily and seasonal input of freshwater from the seeps coming down the slopes to the west of the spit likely affected the vegetation composition of the marsh. Thus, low marsh species probably quickly graded into high marsh species and then into tidal freshwater species. However, the marsh was filled in and graded during the construction of a marina and no longer exists.

San Juan Islands NWR

Matia Island is unique among the smaller of the San Juan Islands in that it includes a small freshwater emergent marsh. The amount of water and, consequently, duration of the wetland vary with precipitation.

Smith Island contains an interdunal wetland on its eastern spit. Some salt-tolerant wetland species occur along the perimeter of a small shallow pond that receives limited freshwater input from seeps coming down from the west in addition to direct precipitation. Water levels vary seasonally, typically receding and occasionally drying up in the summer. The spit protects the wetland from wave action but is likely to allow saltwater intrusion, especially heightened during storm or overwash events.

3.7 Fire

Protection Island and San Juan Islands NWRs are in the driest area in western Washington (please refer to the Precipitation section for further discussion). Consequently, prior to Euroamerican settlement, the predominant vegetation on lowlands west of the Cascades, from the Willamette Valley of Oregon north to the Georgia Basin of southwest British Columbia, was a mosaic of grasslands, oak and conifer savannas, and various types of wetlands (Chappell and Crawford 1997, Sinclair et al. 2006). These forests, savanna, grassland, and herbaceous bald ecosystems generally rely on fire to maintain their vegetative structure and species composition. In addition to lightning-caused fires, historical accounts have also established that Native Americans burned grasslands and oak savannas to create habitat for game animals and to promote the growth of weaving materials and food (Agee 1993, Chappell et al. 2001, Sinclair et al. 2006). The historic frequency with which a given area burned depended directly upon the number of natural and human-ignited fires. Other factors affecting fire frequency and fire intensity include plant community types, changes in topography (i.e., slope and aspect), varying fuel accumulations, and variation in seasonal precipitation. However, the advent of Euroamerican settlement interrupted Native American land management practices and altered the fire regime by eliminating prescribed fires.

Although there has been little research documenting the pre-settlement fire history of either Protection Island or the San Juan Islands Refuges, the influence of fire was likely higher on larger islands such as Protection and Smith Islands than on smaller islands, which probably had very little history of burning just due to their size. In recent history, between 1944 and the 1950s, at least two major fires burned most of the uplands on Protection Island, including buildings and forested land, and both Kanem and Violet points (Power 1976, Clark 1995). Alcorn and Alcorn (1966) recorded the occurrence of another major fire on Violet Point in 1962. Additionally, fire scars have been noted by Refuge staff on several trees on Matia Island.

At Protection Island, the general fire season runs from mid-April to mid-October. Depending on the specific weather of any particular year the seasons may be shorter or longer and, therefore, may start earlier or last longer. The general fire season recognized by the WDNR Olympic Region runs from June to September.

3.8 Air Quality

The San Juan Islands NWR lies within the Georgia Basin airshed and the Protection Island NWR is at the very northern edge of the Puget Sound airshed. The combined airshed is referred to as the Georgia Basin/Puget Sound airshed. In the Georgia Basin/Puget Sound airshed, air quality is primarily determined by weather patterns, which are influenced by the topography of the airshed. Air movements in the basin are responsible for dispersing airborne chemicals emitted from a variety of sources (Environment Canada 2004).

During the summer and winter, periods of stagnation cause airborne pollutants to buildup and remain in the airshed or to drift only slightly downwind of their origins. Episodes of poor air quality generally occur during these months. Interactions between airborne pollutants can cause secondary air pollutants to

form in the atmosphere, compounding poor air quality episodes. During the spring, winds off the Pacific Ocean carry pollutants from Eurasia and California to the airshed, adding a small but measurable amount to the ozone and particulate matter concentrations (Environment Canada 2004).

Even with these stagnant air events, ozone concentrations measured in rural coastal locations within the airshed are often between 40 and 50 parts per billion (ppb) (Environment Canada 2004), nearly half of the national ambient air quality standard set by the U.S. Environmental Protection Agency (USEPA). Likewise, the average particulate matter mass concentrations are below USEPA standards, although they vary considerably by season, week, and day. In general, the overall air quality within and surrounding the NWRs is good (Environment Canada 2004).

3.9 Water Quality

The Strait of Juan de Fuca is the primary conduit between the Salish Sea and the Pacific Ocean. Water properties within the Strait are influenced by both oceanic and riverine inputs (Newton et al. 2003). In general, stratification of fresh to salt water is more evident north of the San Juan Islands in the Strait of Georgia than south of the islands closer to Protection Island (Newton et al. 2002). Stratification reduces opportunities for vertical mixing within the water column, thereby isolating the various water quality indicators to the surface layer with little opportunity for dilution. However, the open waters to the south of the Strait of Georgia are well flushed by strong currents, deep channels, and tidal mixing, and thus, less stratified (Erickson et al. 1995). Common water quality indicators for the Salish Sea system are dissolved oxygen (DO), dissolved inorganic nutrients, and fecal coliform bacteria (Erickson et al. 1995).

Areas sampled near Protection Island NWR indicate moderate, infrequent stratification. Low DO concentrations in the waters near Protection Island are typical and reflect the influence of upwelled, naturally low-oxygen water from the Pacific Ocean that flows eastward beneath the less-saline surface layer flowing westward. Nutrient concentrations and fecal coliform bacteria counts in the waters surrounding the San Juan Islands NWR are low, indicating good water quality in the areas surrounding Protection Island NWR (Newton et al. 2002).

Overall, water quality in the San Juan Islands NWR area is good (Newton et al. 2002). Sampling conducted by Newton et al. (2002) indicates that strong and intermittently stratified, very low DO water flows from the Strait of Georgia, influencing waters of the San Juan Islands NWR. The low DO concentration in the Strait of Georgia is likely a result of the naturally low DO waters from the Strait of Juan de Fuca and waters from the Fraser River plume, which have a high organic load and further reduce DO. In general, nutrient concentrations in the waters of the San Juan Islands NWR are not limiting and thus, not an indicator of poor water quality. Fecal coliform bacteria counts are low.

3.10 Environmental Contaminants

3.10.1 Oil Spills

Oil spills are a major concern for refuge wildlife and habitats. Over 41 million gallons of oil are delivered over sensitive waterways every day in Washington (WDOE 2009). Washington State has the fifth highest refining capacity (by state) within the United States, with Puget Sound being the closest national port in the lower 48 states for vessels carrying crude oil out of Valdez, Alaska (Neel et al. 1997). In addition to receiving oil via tankers from Alaska, western Washington also receives oil from Canada via a pipeline. The Trans Mountain pipeline delivers crude oil from Edmonton, Alberta, to Sumas, British Columbia, at

the Washington State/Canada border (Kinder Morgan 2007). From Sumas, the crude oil is delivered to refineries in Ferndale and Anacortes, Washington. Oil leaves the refineries bound for other western states (i.e., Oregon and California) via pipelines, barges, and tankers (Neel et al. 1997).

The Strait of Juan de Fuca is one of the most critical maritime highways for both the United States and Canada. Tanker traffic alone through this area carries over 15 billion gallons of oil each year (WDOE 2009). There are six refineries in Washington for which vessel traffic is generated through the Strait of Juan de Fuca.

As one of North America's major gateways to Pacific Rim trade, Puget Sound and the Strait of Juan de Fuca are among the busiest waterways in the world; vessel traffic moves to and from busy ports in both Washington and Vancouver, British Columbia (Neel et al. 1997, Etkin and Neel 2001). The high volume of marine traffic puts Puget Sound and the Strait of Juan de Fuca at risk of substantial oil spills. In addition to oil tankers and barges, dry cargo, passenger (cruise ships and ferries), naval, and commercial fishing fleet vessels, and a high per capita recreational boat ownership, all add to the risk of spills within this transportation corridor (Etkin and Neel 2001).

Heavy fuel and crude oils, recognized as viscous "black" oils, have a tendency to smother animals such as birds and mammals, often killing them. These oils are highly persistent and create residues that are resistant to natural and biological degradation processes (Neel et al. 1997). Table 3-6 summarizes the known oil spills in the Salish Sea area since 1970.

Table 3-6. Summary of representative vessel oil spills and select other incidents in the Georgia Basin/Puget Sound since 1970 (Neel et al. 1997, Islands' Oil Spill Association, San Juan Co., 2007, WDOE 2007).

Incident Date	Incident Name	Total Quantity Spilled (gallons)	Product Type
04/26/1971	United Transportation Barge #U	230,000	Diesel fuel
01/01/1972	General M.C. Meiggs	2,300,000	Heavy fuel oil
06/04/1972	World Bond	21,000	Crude oil
12/21/1985	Arco Anchorage	239,000	Crude oil
01/31/1988	MCN #5 Barge	70,000	Heavy fuel oil
07/22/1991	Tenyo Maru	100,000*	Heavy fuel, oil, & diesel fuel
12/31/1994	Crowley Barge 101	26,900	Diesel fuel
01/10/2000	Point Wells, Lucky Buck	unknown**	Diesel fuel
11/05/2000	Columbia	300-500	Diesel fuel
01/29/2001	Prince William Sound, Port Angeles	200	Crude oil
06/13/2001	Overseas Boston, TOSCO, Ferndale	315-630	Crude oil
10/14/2004	Polar Texas – Conoco Phillips	1,000+	Crude oil
11/11/2004	Thrasyvoulos V cargo ship	unknown	Light fuel oil
1/28/2005	Dalco Passage Spill	unknown	unknown
3/17/2006	Elliot Bay Sheen	50	Lubricating oil
April 2006	Mutiny Bay bunker oil	80 tons***	Bunker C oil
08/30/2006	Sill near Edmonds, WA	unknown	Sheen

*The Tenyo Maru contained more than 400,000 gallons when it sank; at least 100,000 gallons were released during the initial incident.
**To date there has been an unknown quantity of diesel fuel leaked. At the time of the incident, the Lucky Buck had on board 125.000 gallons of diesel fuel, 700 gallons of hydraulic oil, and 70 gallons of lube oil.
***80 tons of oil and oil-contaminated sediment was removed from a 100-foot-long section of beach in the Whidbey Island inter-tidal zone.

Some of the spills data reported in the sources used to compile the table are incomplete. Therefore, the table is a representation of past incidents but should not be viewed as a complete list of incidents over time. The Islands' Oil Spill Association for San Juan County also logged several incidents of unrecoverable sheens and other smaller scale incidents that are too numerous to list in the summary table but can be viewed on the association's website: http://www.iosaonline.org/ResponseHistory/index.htm.

3.10.2 Polybrominated diphenyl ethers (PBDE)

Polybrominated diphenyl ethers (PBDEs) are a common flame retardant chemical. PBDEs are in a wide variety of products including furniture, electronics, and textiles. They leach out of these products into the air, household dust, and eventually into the organisms in contact with the materials. They belong to a group of chemicals that dissolve easily in animal fat and do not break down readily, causing them to build up or bioaccumulate in the food web, known as persistent bioaccumulative toxins (PBTs) (USEPA 2007). PBTs have been found in humans, salmon, seals, and orcas (Manning 2007).

These organic chemicals, which are soluble in lipids (fats), are known to accumulate in the insulating fat of fish and animals, including birds and marine mammals (Raloff 2001, USEPA 2007). Due to bioaccumulation, the accumulation of substance up the food chain by transfer of residues of the substance from smaller organisms that become food for larger organisms (USEPA 2007), the heaviest accumulations of PBDEs have been found in the largest and oldest animals studied (Raloff 2001). Studies of concentrations of PBDEs in fish also showed that concentrations rise with the size and age of the fish (Raloff 2001). Animal studies have shown that PBDEs alter brain development, affecting learning, behavior, and memory; developing fetuses and infants are most at risk (Manning 2007).

Studies conducted by the USEPA (2007) on harbor seals and Pacific herring, a large portion of the seal diet, were conducted in the Salish Sea. The study was conducted to compare the levels of PBTs between the seals in Puget Sound and the Strait of Georgia. The results indicated that not only were high levels of PBDEs present in both seal populations, but that the seals from Puget Sound were twice as contaminated as those in the Strait of Georgia. In studies of the seals' preferred diet, PBDE concentrations were almost five times higher in the Puget Sound seal diet than that of the Strait of Georgia. Likewise, Pacific herring sampled in Puget Sound had elevated PBDE levels that were nearly three times higher than those sampled from the southern Georgia Basin.

3.10.3 Pesticides

Many industrial and agricultural activities continue to affect lands and the wildlife that use them. Although many improvements have been realized since the use of the pesticide DDT has been curbed, incidence of eggshell thinning in waterbirds in western Washington is still detectible. Residues of DDT (in the form of DDE) and polychlorinated biphenyls (PCBs) have been found in many of the species that use the two refuges (Speich et al. 1992, Henny et al. 1989). The levels present, however, were below those known to impact reproductive success.

3.10.4 Other contaminants

Over the past 150 years, human activities around the Salish Sea have introduced a variety of persistent, bioaccumulative toxic chemicals into the environment at levels that can be harmful to both humans and wildlife. These toxic chemicals include heavy metals such as lead, mercury, and copper, as well as organic compounds such as polycyclic aromatic hydrocarbons (PAH), PCBs, dioxins, furans, and phthalates. These contaminants enter the aquatic environment through a variety of sources and human activities, including industrial and municipal discharges, groundwater seepage, atmospheric deposition,

and resuspension of sediments (PSAT 2003). While primarily concentrated in areas around urban or industrial developments, these contaminants affect a much larger area of the ecosystem. When organisms live in or eat within these areas of contamination, not only are they directly harmed, but they also accumulate contaminants in their tissues and transfer them throughout the food web. Additionally, rogue creosote logs are also a source of contamination for all refuge islands and removal is an ongoing management activity.

Protection Island NWR

Historical uses of Protection Island include agriculture, military, research, residential, and recreation (Clark 1995). After establishment of the Refuge, a solid waste disposal site was removed in 1996. In 2003, surveys and tests were conducted across the island to establish baseline contamination levels of selected chemicals. None of the selected chemicals were detected at any sites (USFWS 2003). Creosote pilings were used in the marina, and this source of contamination will require future replacement with non-polluting pilings.

San Juan Islands NWR

In the 1930s Smith Island was used as a naval bombing area by the United States military with aircraft from nearby Whidbey Island Air Station. Unarmed bombs and sonar buoys were dropped by naval aircraft as practice in hunting submarines (Skiff 2009). Therefore, munitions debris may still be found on the island.

The United States Coast Guard has maintained a presence on the island as a location for aids to navigation. A lighthouse station was staffed from 1858 to 1957 when it was abandoned due to erosion which threatened the structure. In 1998, the last of it disappeared into the sea and only miscellaneous structures remain (Butler et al. 2007). Underground and aboveground fuel storage areas as well as the potential for lead-based paint and asbestos associated with remaining structures were noted during a survey in 2006 (USCG 2006). Refuge staff have also observed containers with unknown contents near the powerhouse during visits to the island.

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