Protection Island and San Juan Islands National Wildlife Refuges

Draft Comprehensive Conservation Plan,
Draft Wilderness Stewardship Plan,
and Environmental Assessment

Jefferson, Island, San Juan, Skagit, Whatcom Counties, Washington

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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% 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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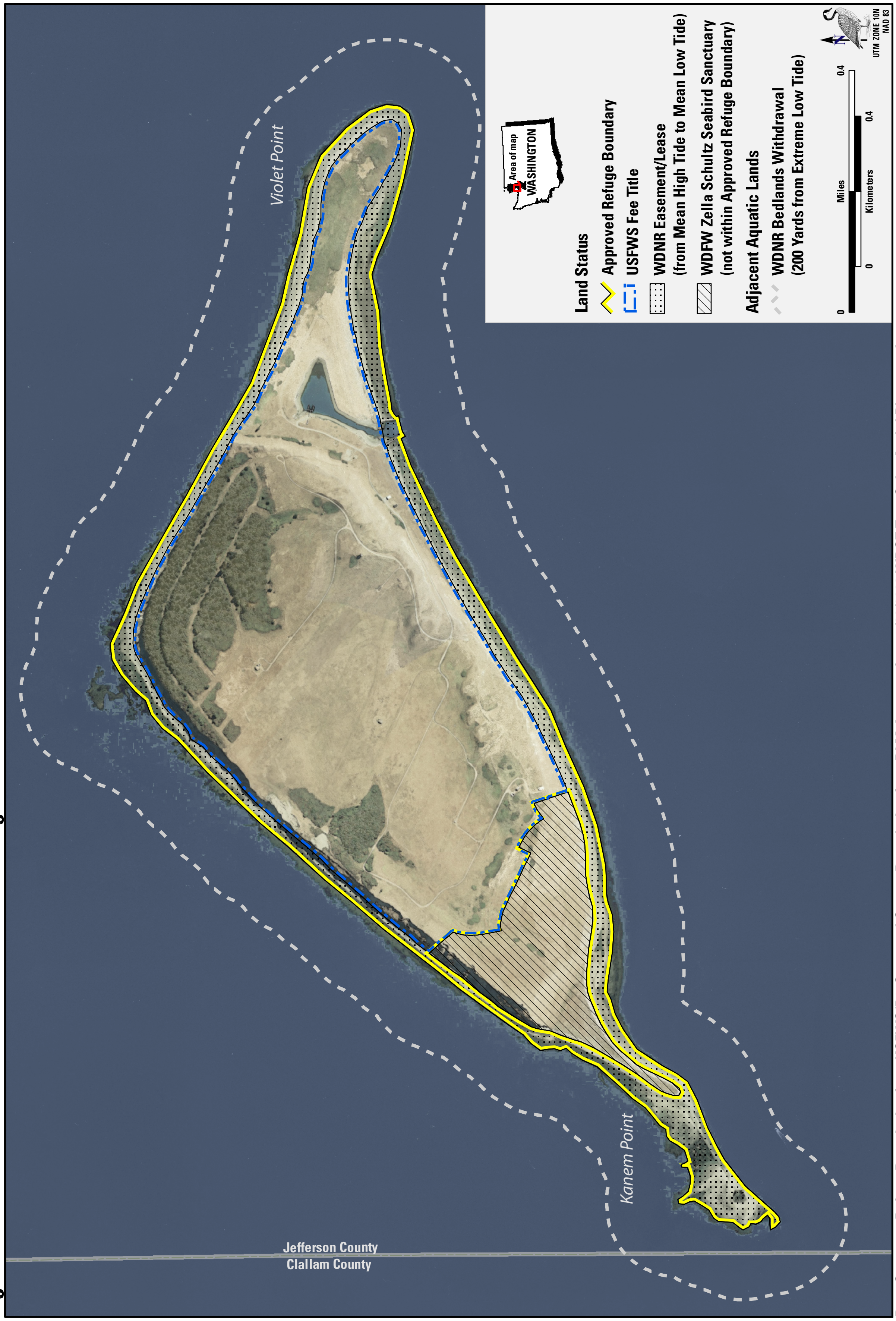
Figure 1.2 Protection Island National Wildlife Refuge



Data Sources: Refuge Boundaries from USFWS/R1; State and County Boundaries from BLM; Imagery from 7/30/2003 WDOT True Color Aerial Photography

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Figure 1.3 San Juan Islands National Wildlife Refuge

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 Proposed Action

The Service is proposing to adopt and implement a Comprehensive Conservation Plan for Protection Island and San Juan Islands NWRs and a Wilderness Stewardship Plan for the San Juan Wilderness. This document is the Refuges' Draft Comprehensive Conservation Plan, Wilderness Stewardship Plan, and Environmental Assessment (Draft CCP/WSP/EA, CCP, or plan). This Draft CCP/WSP/EA has been prepared pursuant to the National Wildlife Refuge System Administration Act of 1966 (Administration Act), the National Environmental policy Act of 1969 (NEPA), and the Wilderness Act of 1964.

The Administration Act requires CCPs to identify and describe:

- The purposes of the refuge;
- The fish, wildlife, and plant populations, their habitats, and the archaeological and cultural values found on the refuge;
- Significant problems that may adversely affect wildlife populations and habitats and ways to correct or mitigate those problems;
- Areas suitable for administrative sites or visitor facilities; and
- Opportunities for fish and wildlife dependent recreation.

The Service developed and evaluated three alternative management approaches which are described in Chapter 2 of this Draft CCP/WSP/EA. The proposed action is to implement Alternative B which has been identified as the Service's Preferred Alternative. Among the alternatives evaluated, this alternative appears to best achieve the purpose, vision, and goals for the Refuges. The preferred alternative may be modified between the draft and final documents depending upon comments received from the public or other agencies and organizations. The Service's Regional Director for the Pacific Region will decide which alternative will become the Refuges' Comprehensive Conservation Plan.

1.4 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. Once an alternative has been selected and the plan is finalized and approved, it will supersede 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).

1.5 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 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).
- The anticipated effects of each alternative (Chapter 6).
- 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).
- Memorandum of Understandings with other Agencies (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).
- Guide to acronyms used in the document and well as some definitions (Appendix L).

1.6 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.

1.6.1 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."*

1.6.2 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)

1.6.3 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.

1.6.4 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/.

1.7 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.

1.8 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 Draft CCP/WSP/EA where these plans were applicable.

Relationship of Other Planning Efforts to the Protection Island and San Juan Islands CCP/WSP/EA **Plans Reviewed**	**Goals, Objectives, & Strategies (Chapter 2)**	**Affected Environment (Chapters 3-5)**	**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)	✓	✓	

1.9 Issues Addressed in the Draft CCP/WSP/EA

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 are within the scope of the CCP/WSP/EA and are considered by the Service to be the major issues to address in this planning process:

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?*

1.10 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.

1.11 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.

1.12 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. The Service also distributed two 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, management alternatives and an internal review draft of the 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. Alternatives, Goals, Objectives, and Strategies

The National Environmental Policy Act (NEPA) requires Federal agencies to evaluate a full range of reasonable alternatives to a proposed action. This chapter describes the alternatives development process and three possible alternatives for management of Protection Island and San Juan Islands Refuges.

2.1 Alternatives Development

During development of the CCP alternatives presented in this chapter, 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 alternatives. 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 and will continue to be 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 alternatives. The planning team then developed preliminary management concepts and strategies which they presented to the public in a planning update and at two public meetings in September 2008. More details regarding public involvement can be found in Appendix K.2.

Based on all of the information gathered and feedback from others through the public involvement process, the Service developed three alternatives for the Comprehensive Conservation Plan for Protection Island and San Juan Islands NWRs. Alternative A: Current Management is how the Refuges are being managed now and can also be referred to as the "Status Quo" or "No Action" Alternative. Alternatives B and C are the "Action" alternatives that reflect changes from current management. Alternative B is the Service's preferred alternative.

2.2 Actions Considered but Not Developed

Early in the alternatives development process, the planning team considered including the following actions in one or more CCP alternatives. These actions were ultimately eliminated from further consideration in this CCP for the reasons provided.

Elimination of Camping from Matia Island

The Service initially considered eliminating camping on both Turn and Matia Islands because the Service's Appropriate Refuge Uses policy raised concerns regarding the appropriateness of camping on the San Juan Islands Refuge. After hearing the State's concerns, gathering additional information, and conducting a review of the situation, the Service has a better appreciation for how camping on Refuge islands facilitates multi-day, non-motorized boat trips to observe wildlife and enjoy nature in the San Juan Islands (also see Appendix I – Findings of Appropriateness). Therefore the Service is no longer proposing to eliminate all camping as part of Alternatives B and C. Elimination of camping, on Turn Island only, is still under consideration in Alternative C and there will be other changes to camping under both Alternatives B and C.

A Variety of Nearshore Management Tools

The planning team reviewed and considered promoting a large variety of nearshore management tools for their potential to provide greater protection for Refuge wildlife and habitats. The tools that were considered but are not currently proposed in the CCP include Washington Department of Fish and Wildlife (WDFW) designations, including sea urchin exclusion zones and shellfish beach closures; San Juan County initiatives, including voluntary bottomfish recovery areas and boat-free zones for orcas; United States Coast Guard's regulated navigation areas; and the International Maritime Organization's Areas to be Avoided. Where they occur around Refuge islands, many of these tools can and do help to reduce human disturbance to Refuge wildlife. However, these particular tools were intended primarily for purposes other than Refuge wildlife and therefore the Service has decided not to propose initiating new designations of these types around Refuge islands. The Service will continue to work with the Washington Department of Natural Resources (WDNR) and their aquatic lands designations which are appropriate for protecting Refuge wildlife. There are currently two aquatic reserve proposals that include areas around Protection Island Refuge and portions of San Juan Islands Refuge.

Opening More Refuge Islands to Public Access

During public scoping there were a few requests made for allowing public access to closed islands. The Service did consider these requests, but ultimately decided not to open any Refuge islands that are currently closed to the public. Refuge islands provide some of the last areas where seabirds and marine mammals can remain relatively undisturbed. Some of the best Refuge wildlife observation opportunities are available not on the islands themselves but by observing from a boat at a distance that does not disturb the wildlife. The Service does propose improving their visitor services program on the two Refuge islands that are currently open to the public. There will also be some opportunities for limited public access to closed Refuge islands in association with volunteering for Refuge stewardship projects and conducting or assisting with approved research or monitoring studies.

2.3 Similarities Among Alternatives

Alternatives contain some common features. These are presented below to reduce the length and redundancy of the individual alternative descriptions in other portions of this chapter.

2.3.1 Features Common to all Alternatives (A through C)

Implementation Subject to Funding Availability

Under each alternative, 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.

Integrated Pest Management (IPM)

In accordance with Department of the Interior and Service Policies (517 DM 1, 30 AM 12, and 7 RM 14,) an integrated pest management (IPM) approach would 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.

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 that 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 2009, 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, 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 DNR to maintain a 200-yard conservation lease and tideland withdrawal at Protection Island to reduce human disturbance. Also see Chapter 4 for more information regarding the threat of human-caused disturbance.

Participation in Regional Planning and Conservation Efforts
The Complex 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. Complex staff would cultivate working relationships with pertinent local, county, State, and Federal agencies to stay abreast of current and potential developments; and would utilize outreach, education, and information as needed to raise awareness of Refuge resources and their dependence on a healthy local environment.

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.

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).

Maintaining of Existing Facilities
Periodic maintenance of Refuge buildings and facilities will be necessary regardless of the alternative selected. Periodic maintenance and upgrading of facilities is necessary for safety and accessibility and to support management and visitor needs, and is incorporated in the Service Asset Management System.

State Coordination
The Complex 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.

Tribal Coordination
Communication with Native American Tribes who have an interest in the Refuges would continue under all alternatives. The Service seeks assistance from Tribes in Native American Graves Protection and Repatriation Act and National Historic Preservation Act and related issues. The Service is also interested in partnering with Tribes to provide cultural resources education and interpretation opportunities.

2.3.2 Features Common to Action Alternatives (B & C)

Protection Island Site Plan Development and Implementation
Many Refuge buildings on Protection Island 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. Both Alternatives B and C would include the development and implementation of a site plan for all Refuge administration and research facilities, buildings, roads, and trails on Protection Island to improve Refuge management capability, facilitate research activities, and reduce disturbance to important wildlife habitat areas.

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.

Fire Management
The overall objective for fire management on the Complex 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. Since Alternatives B and C describe habitat restoration projects and IPM techniques that may include the use of prescibed fire, the Fire Management Plan would be updated to reflect this.

Increase Staffing Levels
Alternatives B and C identify many actions above and beyond those under current management (Alternative A). The ability to accomplish those actions depends in part on increased staffing, which is also proposed in Alternative B and C. While increased staffing is never guaranteed, it is anticipated that over the 15-year life of the CCP there would be some increase in staffing levels. For additional information regarding proposed staffing levels, see Appendix G.

2.4 Summary of Alternatives

Alternative A: Current Management

Under Alternative A, the Refuges would continue with current management which focuses on stewardship, including removing unnecessary roads and human structures; allowing natural processes to occur with minimal human intervention; 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. Recreational activities would continue as they have in the past and be facilitated through a State Parks partnership.

Alternative B: Preferred Alternative

This alternative would continue many of the activities in Alternative A, but would also include 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, and a camping reservation system would be initiated. 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.

Alternative C

This Alternative is very similar to Alternative B, although there are differences. In Alternative C there would be fewer acres of native habitat restoration, as well as fewer research studies and surveys compared to Alternative B; camping would continue with fewer campsites on Matia Island, however, Turn Island would be limited to day-use only. Compared to Alternative B, fewer and mostly smaller signs would be used in Alternative C to identify closed Refuge islands and reduce human-caused wildlife disturbance.

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

<table>
<tr><th>Key Management Topics</th><th>Alternative A (Current Management)</th><th>Alternative B (CCP Team Preferred)</th><th>Alternative C</th></tr>
<tr><td colspan="4">HABITAT MANAGEMENT</td></tr>
<tr><td>Multiple Habitats</td><td>- Work with partners to minimize human disturbance to wildlife and habitats.
- WDNR tideland lease and bedland withdrawal around PI.
- Participate in oil spill prevention and preparedness planning and activities near PI.
- Opportunistic shoreline clean-up activities with volunteers and partners.
- Survey and use integrated pest management strategies on invasive species, except no prescribed burning.</td><td colspan="2">Same as Alt A., plus:
- 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 SJ.
- Participate in oil spill prevention and preparedness planning and activities in PI and SJ 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.
- Include prescribed burning as a potential restoration and integrated pest management tool.
- Work with WDFW to reduce deer impacts by removing deer from PI.
- 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.</td></tr>
<tr><td>Shoreline</td><td>- Occasional mowing of spits on PI.
- Periodic shoreline nourishment with gravel on PI.</td><td>- 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.
- 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.</td><td>Same as Alt. B, except:
Only up to 15 acres of spit restoration.</td></tr>
<tr><td>Sandy Bluffs</td><td>No specific habitat enhancement actions.</td><td colspan="2">- 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.</td></tr>
<tr><td>Savanna Grasslands and Herbaceous Balds</td><td>Removal of unnecessary roads and structures on PI.</td><td>- 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</td><td>Same as Alt. B, except:
- Manage/restore up to 40 acres of savanna grassland on PI and up to 10</td></tr>
</table>

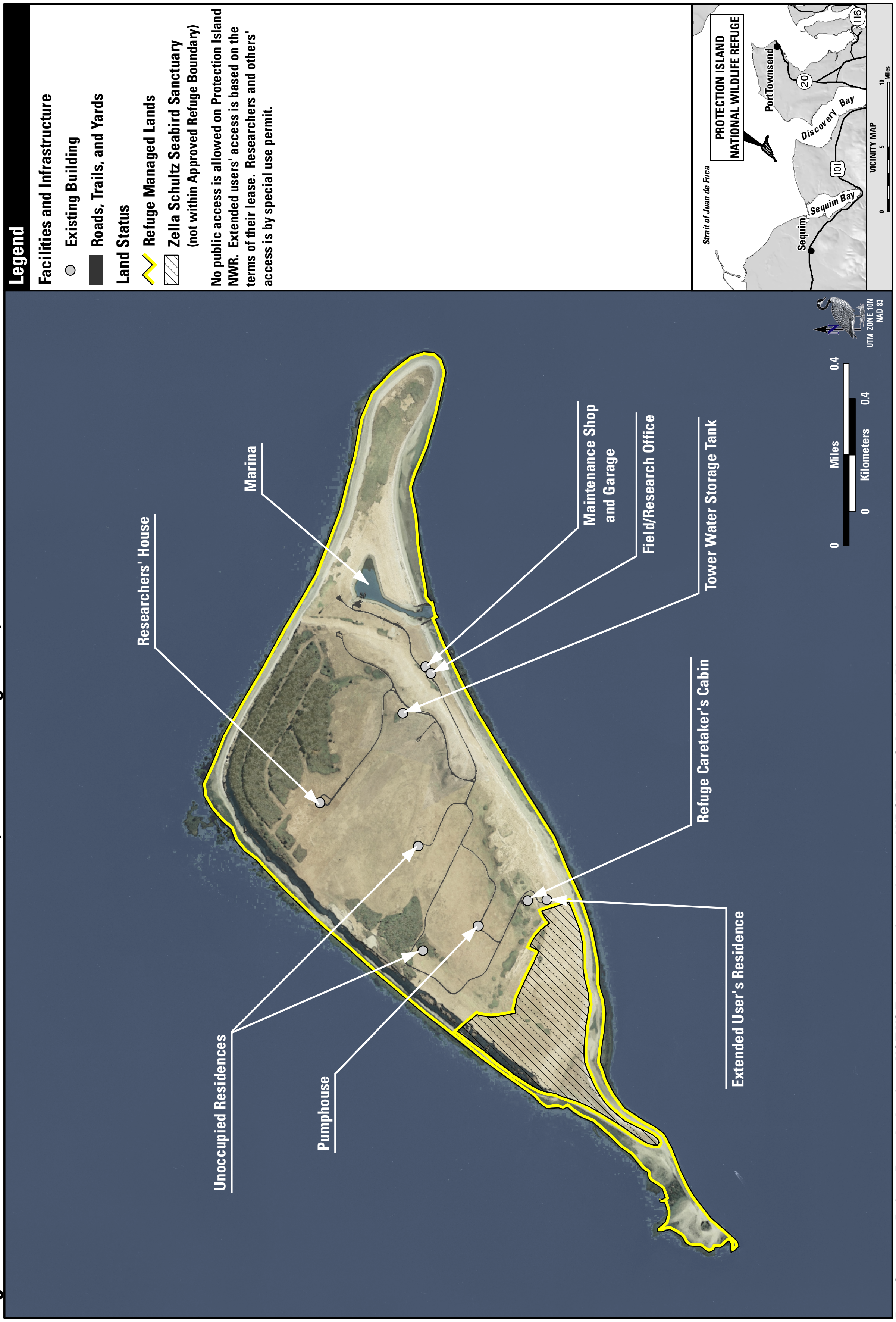
Key Management Topics	Alternative A (Current Management)	Alternative B (CCP Team Preferred)	Alternative C
		benefit a variety of wildlife. - Maintain herbaceous bald patches and where appropriate, associated rare plants on 28 islands within SJ.	acres on Smith and Turn Islands. - Maintain herbaceous bald patches on 14-28 islands within SJ.
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 SJ.	
Wetlands	No specific habitat enhancement actions.	- 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	- Good collaboration between the Service and long-term PI researchers. - Old buildings used by researchers in 2 separate locations on PI.	- 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	- Glaucous-winged gull behavior studies. - Studies on a variety of other topics.	Same as Alt. A, plus more emphasis on the following topics: - 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.	Same as Alt. B, minus: - Demography study of marine mammals. - Study of bluffs erosion and deposition
Surveys	- Long-term monitoring of rhinoceros auklets, pigeon guillemots, glaucous-winged gulls, and marine mammals. - Summer wildlife surveys.	Same as Alt. A, plus: - Refuge and ecosystem-wide monitoring of nesting seabirds and black oystercatchers. - Bald eagle surveys. - Periodic surveys for rare butterflies and	Same as Alt. B, minus: - Winter wildlife survey. - Bald eagle survey. - Breeding bird survey on PI.

Key Management Topics	Alternative A (Current Management)	Alternative B (CCP Team Preferred)	Alternative C
		rare plants. -Winter wildlife surveys. - Breeding bird survey on PI.	
Scientific Assessments	- Some assessments conducted and species lists developed.	- Systematically complete plant surveys on SJ. - 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.	Same as Alt. B, minus: - Reptile and amphibian assessment.
Cultural and Paleontological Resources	- Cultural resource surveys of mostly project-specific locations. - No paleontological studies conducted.	Same as Alt. A, plus 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	-Limited 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.		
SJ Refuge entry areas and open and closed areas.	Turn Island - All beaches are Refuge entry and boat landing areas. - All island areas except steep slopes are open.	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.		
SJ Public Use Times and Other Restrictions	- Turn and Matia Islands open year-round, 24 hours per day. - Turn - Pets allowed on leash. - Matia - Pets allowed on leash within 2-acre picnic/campground area only.	- 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.	Same as Alt. B, except Turn Island is only open to day-use; no camping allowed.

Key Management Topics	Alternative A (Current Management)	Alternative B (CCP Team Preferred)	Alternative C
		- No pets allowed.	
SJ - 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.		
SJ - Camping	Camping allowed only in designated campsites: Turn Is - 13 campsites. Matia Is. - 6 campsites. Visitors arriving by motorized and nonmotorized boats are permitted to camp on the Refuge.	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 initiated.	Same as Alt. B, except Turn Is - no camping. Matia Is. - 4 campsites.
SJ - Campfires	Liquid fuel or gel camp stoves allowed. Some unauthorized charcoal and wood campfires occurring.	Matia and Turn – Better enforcement of no fires. Liquid fuel or gel camp stoves allowed.	
SJ - Trails	Turn - 0.9 mile loop trail around perimeter. Matia - 1.2 mile loop trail.	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	Unstructured opportunities. No interpretive signs. Infrequent interpretive walks conducted.	- Design and install informational and interpretive signs at Turn and Matia Islands. - Interpretive trail at Turn Island. - Local experts and/or trained volunteers provide short "ranger" programs during some summer weekends.	
Environmental Education - Scientific Studies	Some students given opportunities to do scientific studies on PI and SJ.	At least 3 college students/5 years given opportunities to do scientific studies on PI and SJ.	
Environmental Education - Stewardship Projects	PI - 1 per year. SJ – less than 1 per year.	PI - 1+ projects per year SJ - 1+ projects per year	
SJ - Commercial Outfitters	Allowed for camping and day-use on Turn and Matia Islands. Special use permit required		Allowed for camping and day-use on Matia Is. and day-use only on Turn Is. 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.		Same as Alts. A and B, except: The Service/other partners would provide facilities and maintenance on Turn Is. after camping is phased out.
SJ - Law enforcement for public safety/resource protection on Turn and Matia.	WA State Parks enforces State Parks regulations on Turn Island and on 2 acres of Matia Island. The Service enforces regulations on all Refuge lands.	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.	Same as Alt. B, except phase out WA State Parks law enforcement on Turn Is. as camping is phased out.
OFF-REFUGE VISITOR SERVICES			
Wildlife Observation and	Some staff coordination with Port Townsend	Same as Alt. A, plus additional Refuge staff time, volunteers, and partners facilitate and	

Key Management Topics	Alternative A (Current Management)	Alternative B (CCP Team Preferred)	Alternative C
Photography	Marine Science Center (PI) and SoundWatch (SJ) to facilitate wildlife observation and minimize human-caused wildlife disturbance.	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 and no other interpretive activities. SJ - no interpretive panels or activities.	Same as Alt. A, plus: PI – 1 more panel (Port Townsend area) and 2 additional interpretive venues. SJ – Panels at 5 marina locations and 2 additional interpretive venues.	Same as Alt. B, except: SJ – Panels at 5 marina locations only.
Environmental Education Materials	SJ - Refuge poster at marinas.	Same as Alt. A, plus educational materials prepared for use by local teachers. Provide information at local community events, tourist agencies, ferries, etc.	
Boater Education to Reduce Human-Caused Wildlife Disturbance	PI - Direct boater education. SJ - Poster at marinas and some coordination with partners to provide boater education regarding human-caused disturbance to wildlife.	PI - Continue direct boater education. PI & SJ - 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	Standard text and 11” x 14” size Refuge boundary/closure signs used on most islands. Very large (4’x 6’) “stay away 200 yds” signs on approximately 15 islands.	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.	Improve text of boundary/closure signs, but use standard 11” x 14” size only. 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	- Boat landing limited to Rolfe Cove only, but not well enforced. - No number limits on commercial day-use groups.	- Enhance enforcement of limited landing and camping areas. - Limit the size of commercial day-use groups to not more than 20 people.	
Wilderness Education	Limited 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 - Alternative A (Current Management)



Data Sources: Refuge Boundaries from USFWS/R1; Imagery from 7/30/2003 WDOT True Color Aerial Photography

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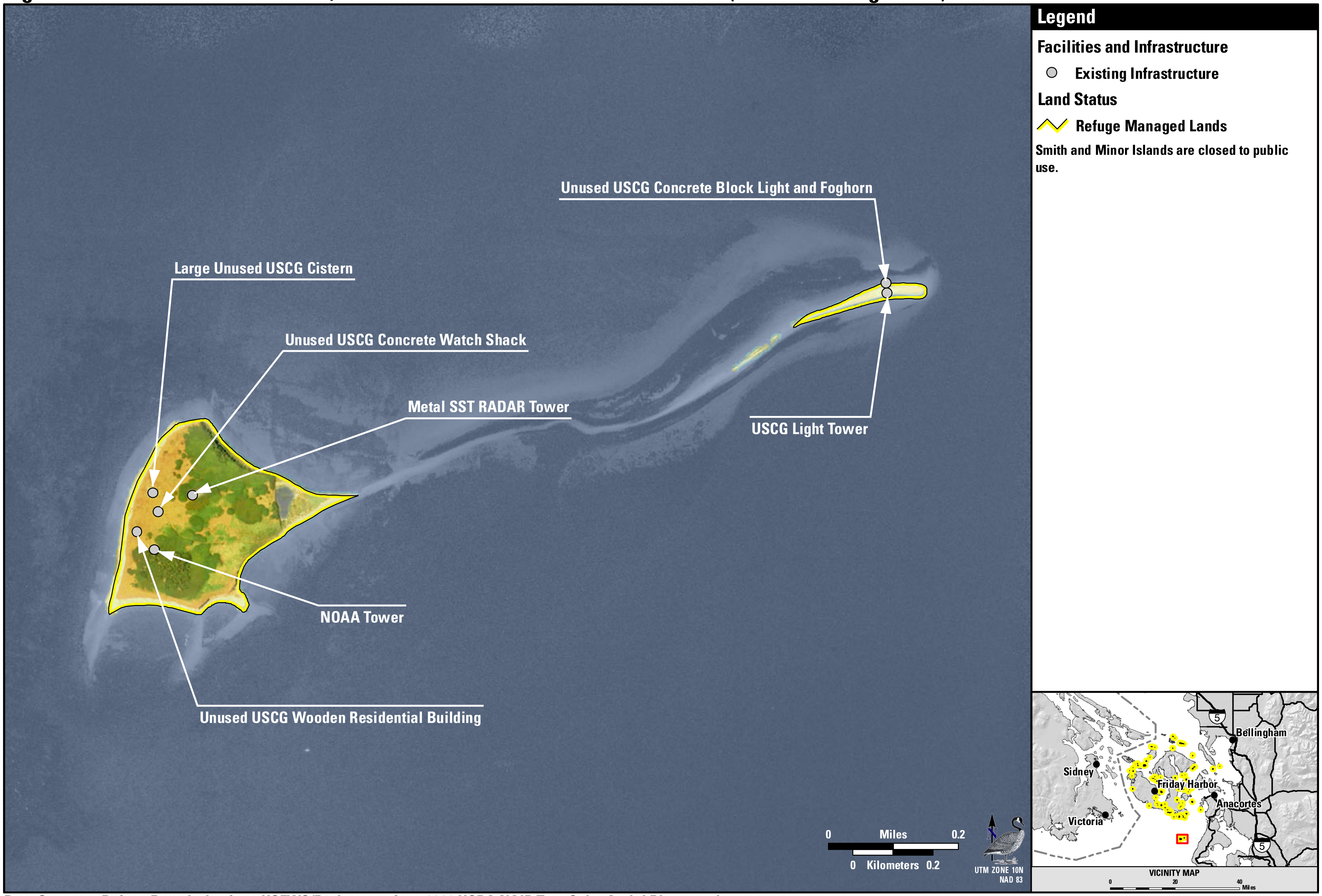
Figure 2.2 San Juan Islands NWR, Smith and Minor Islands - Alternative A (Current Management)



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

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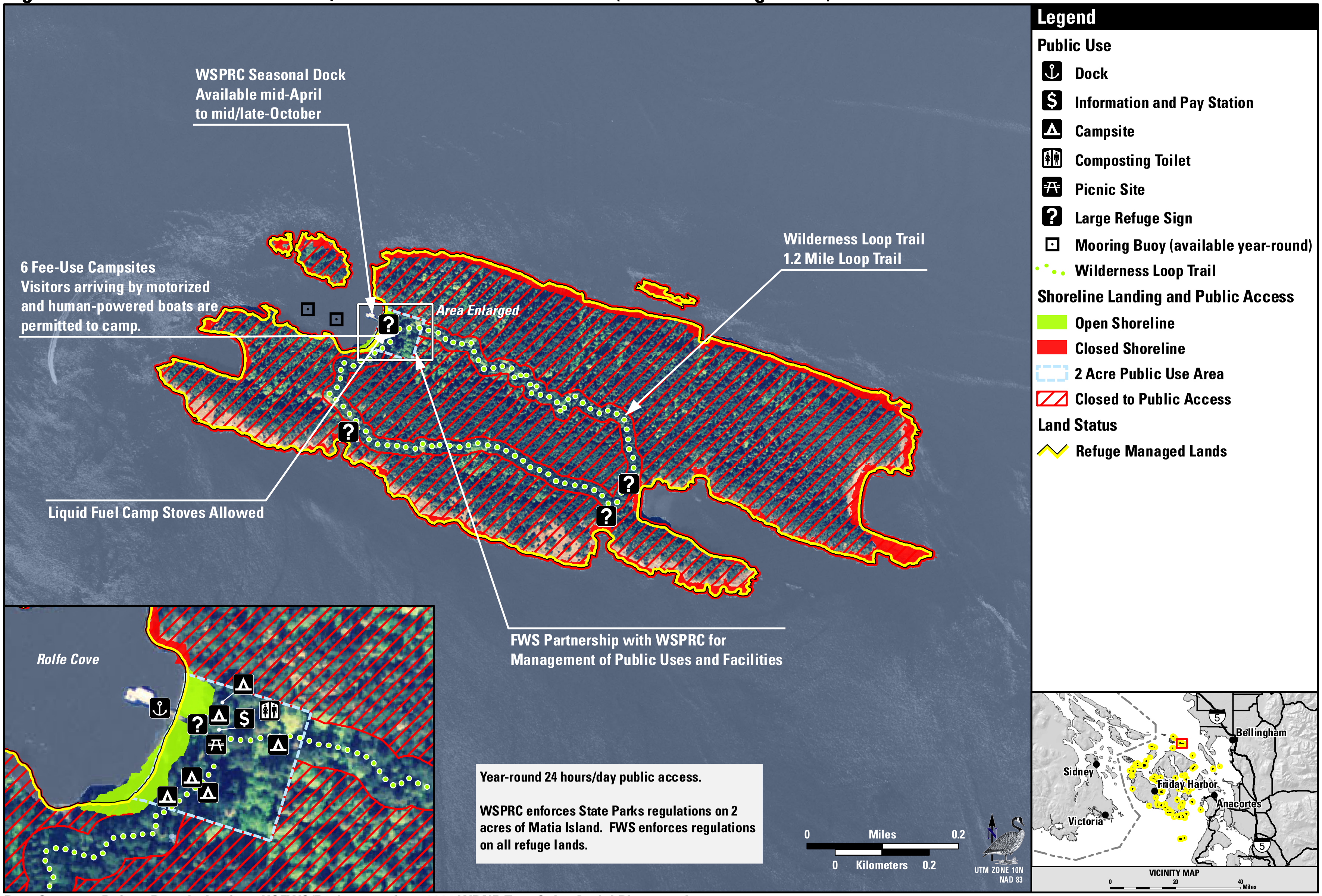
Figure 2.3 San Juan Islands NWR, Matia Island - Alternative A (Current Management)



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

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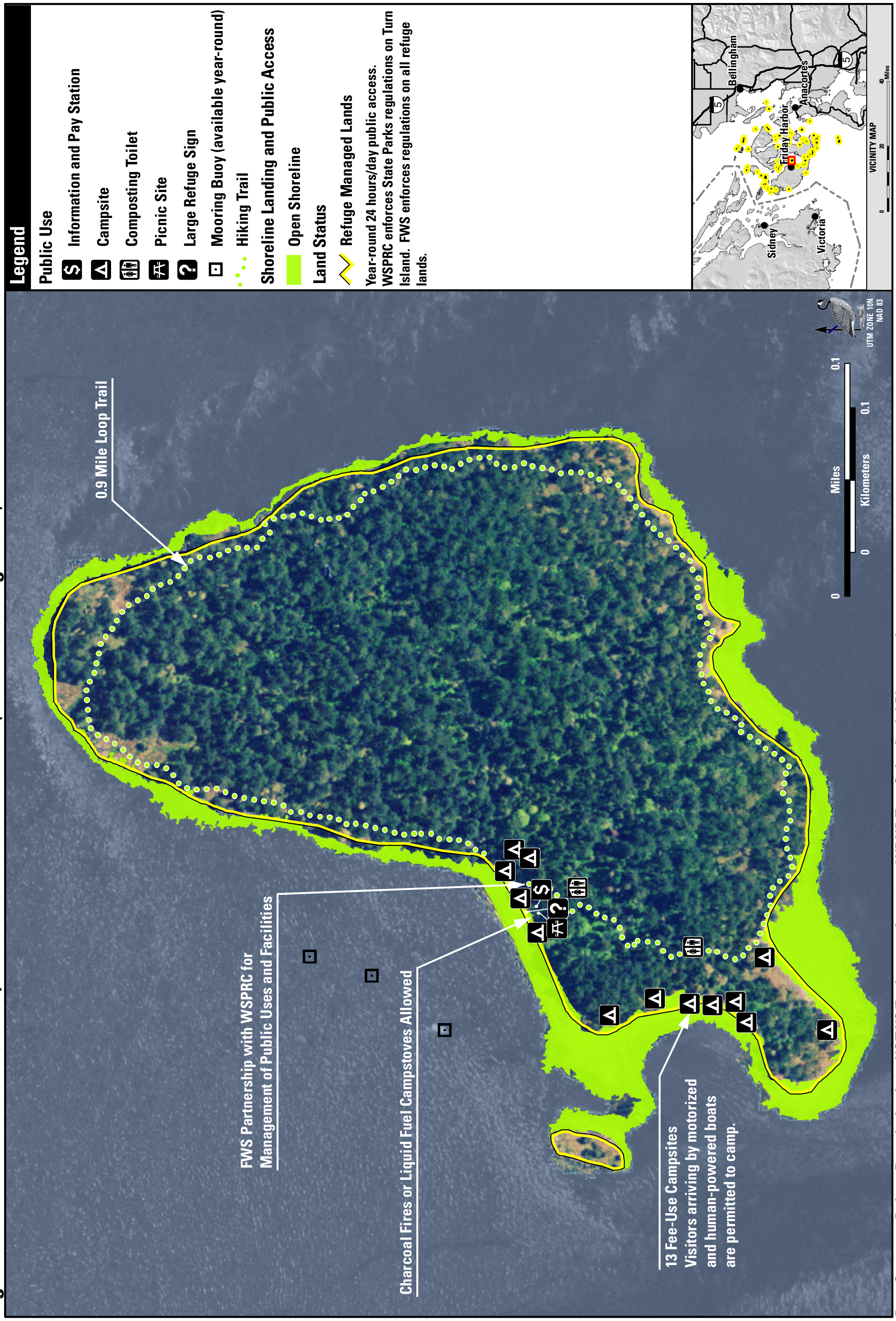
Figure 2.4 San Juan Islands NWR, Turn Island - Alternative A (Current Management)



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

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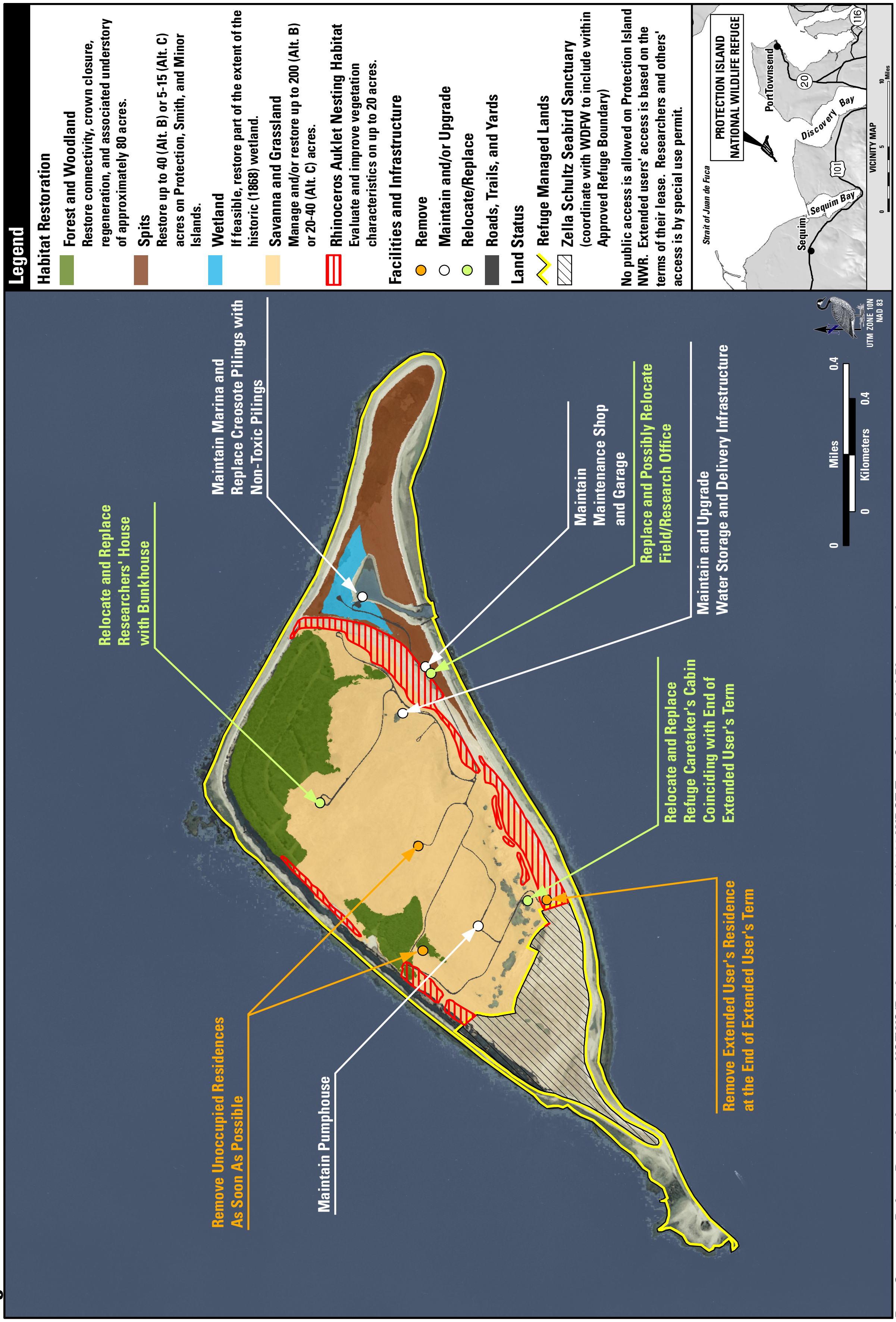
Figure 2.5 Protection Island NWR - Alternatives B and C



Data Sources: Refuge Boundaries from USFWS/R1; Imagery from 7/30/2003 WDOT True Color Aerial Photography

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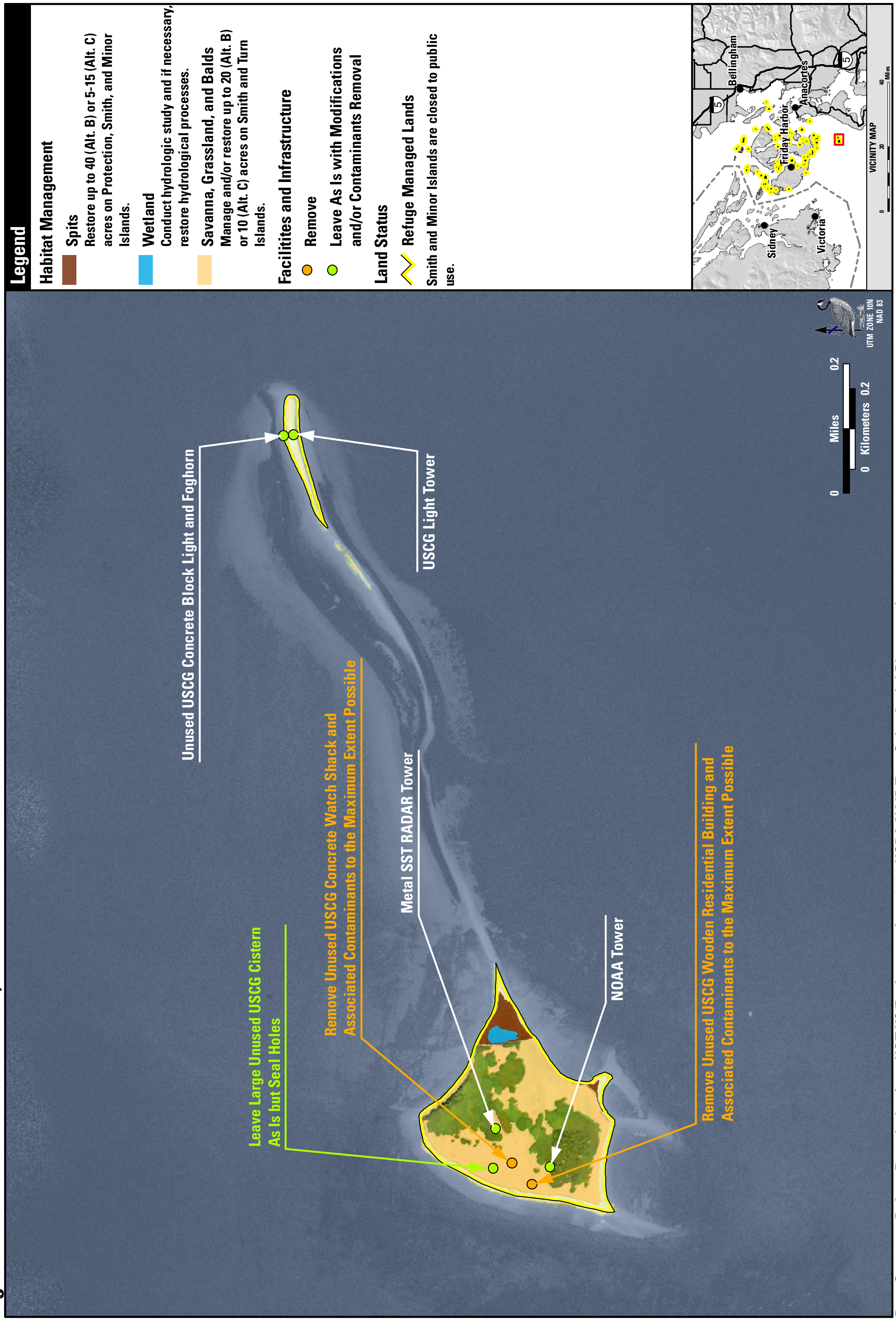
Figure 2.6 San Juan Islands NWR, Smith and Minor Islands - Alternatives B and C



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

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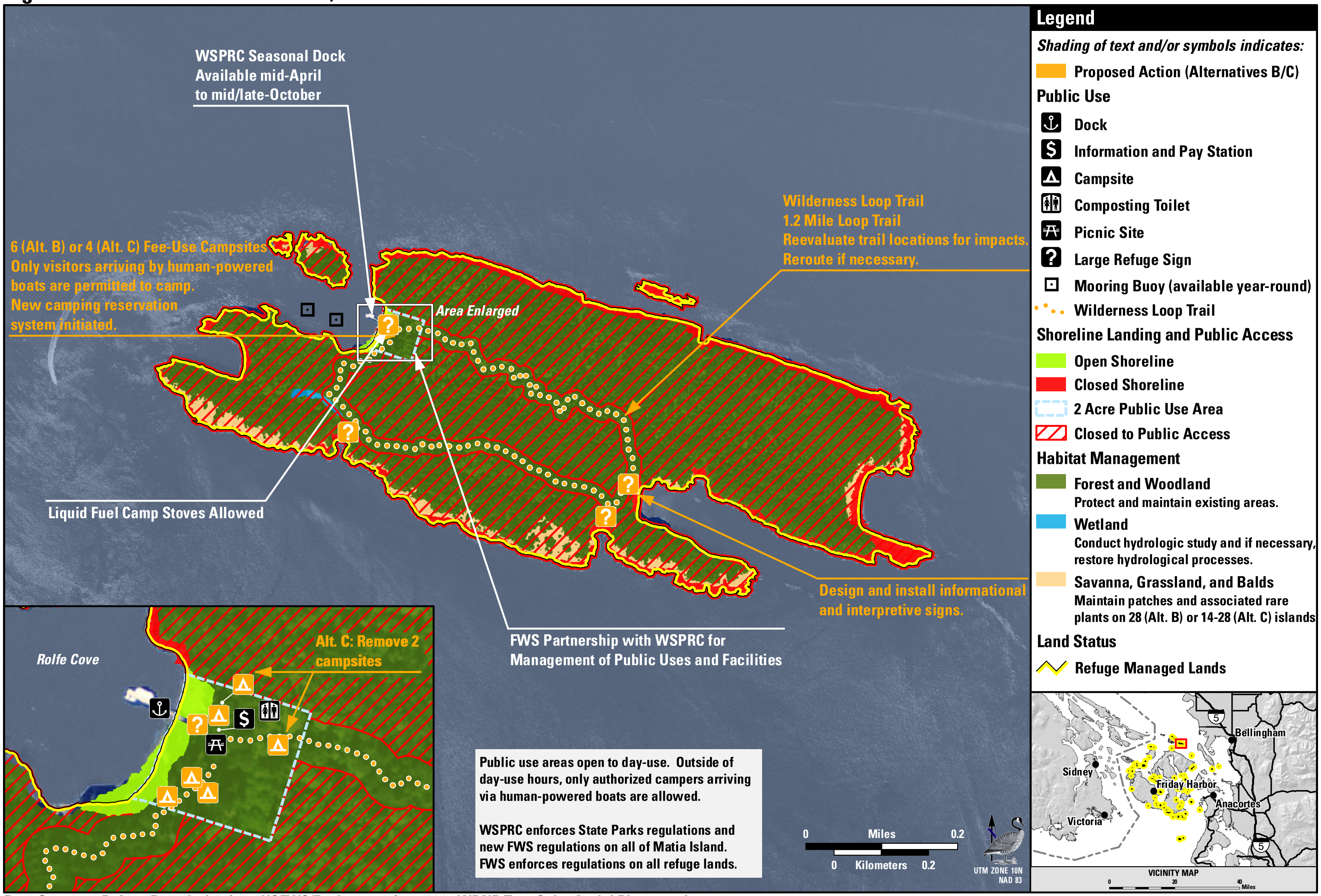
Figure 2.7 San Juan Islands NWR, Matia Island - Alternatives B and C



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

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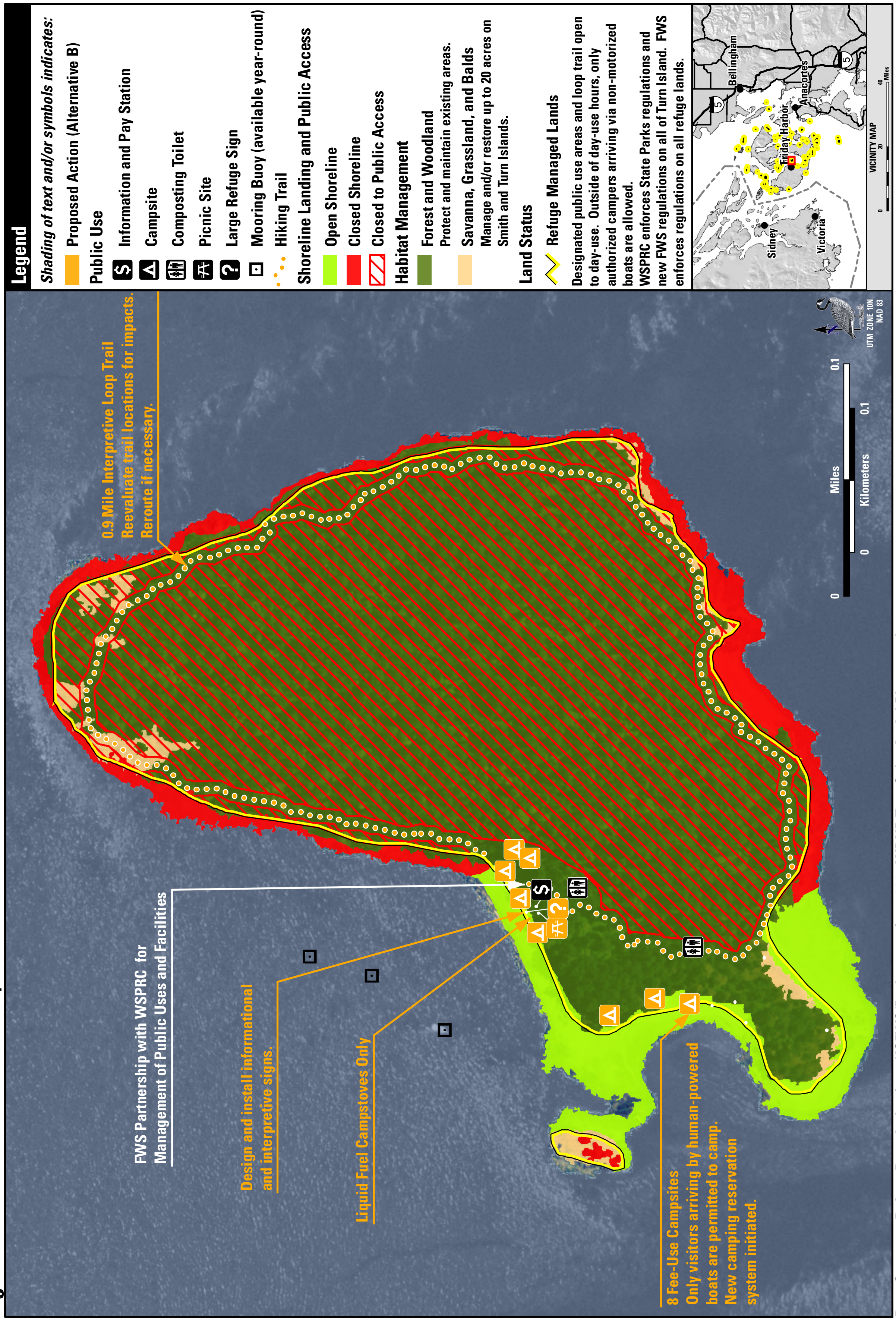
Figure 2.8 San Juan Islands NWR, Turn Island - Alternative B



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

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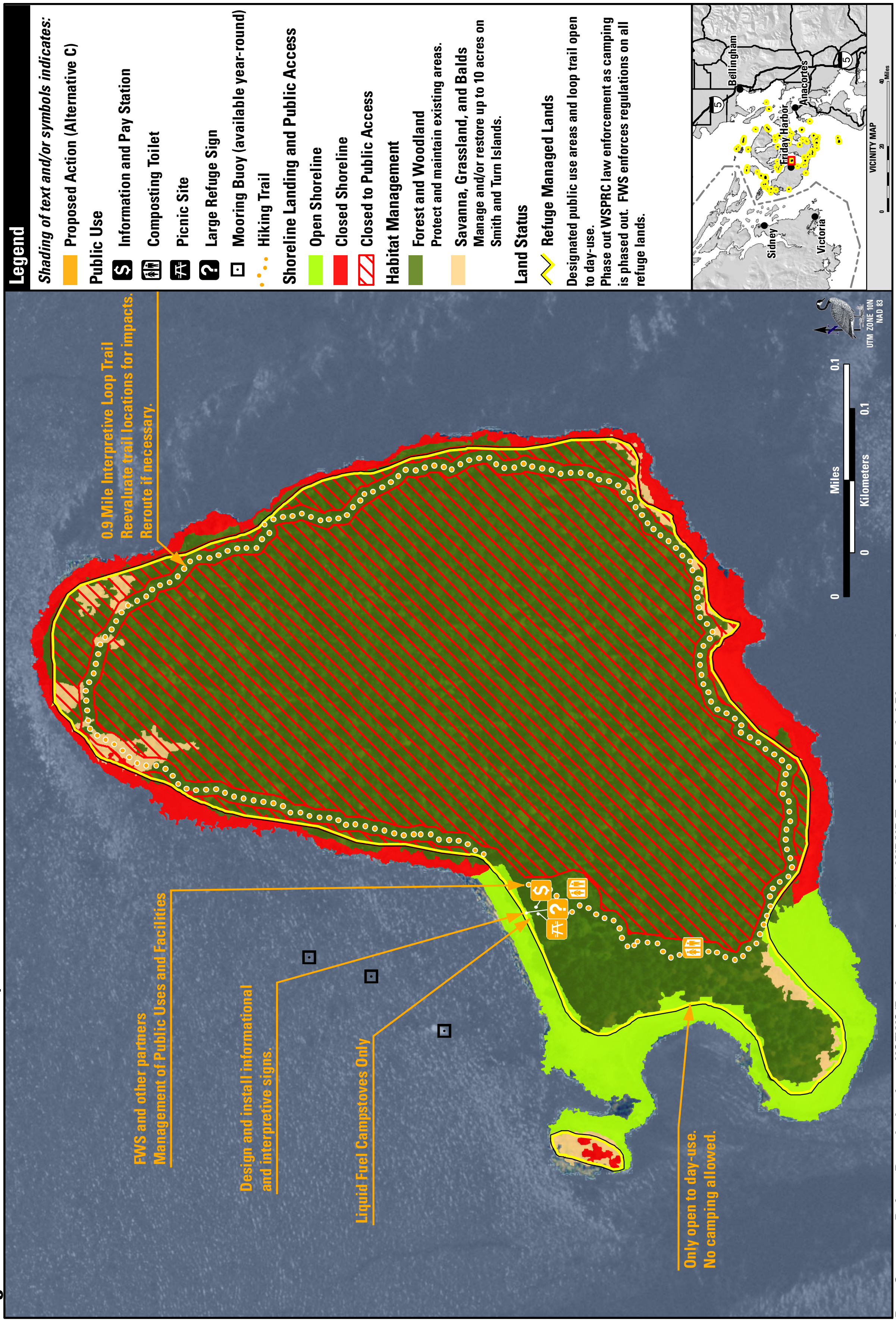
Figure 2.9 San Juan Islands NWR, Turn Island - Alternative C



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

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2.5 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 timeframe for accomplishing CCP objectives is the 15-year life of the CCP, unless otherwise specified in the objective.

In the development of this CCP, the Service has prepared an environmental assessment that evaluates three management alternatives. One set of goals applies to all alternatives. The objectives and strategies, however, vary by alternative.

Readers, please note the following:
The objective statement as written, including bulleted items, specifically applies to the Preferred Alternative, Alternative B. In some objectives, bolded text is used to show how the preferred alternative varies from the other alternatives. How it varies is displayed in the short row that comes after each objective statement where text substituting for the bolded text is provided for the other alternatives.

Below each objective statement are the strategies that could be employed in order to accomplish the objective. The ✓ marks alongside each strategy show which alternatives include that strategy. If a column for a particular alternative does not include a ✓ mark for a listed strategy, it means that strategy would not be used in that alternative.

The "Rationale" section provides additional information and the reasoning behind the objectives and strategies.

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 (e.g., Scotch broom or Spartina grass) 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).

Alternatives	**Refuge/Unit**	**Alt A**	**Alt B**	**Alt C**
The alternative is modified by replacing bold type above with the text in this row.	PI and Smith/Minor	0 acres	Up to 41 acres	5-15 acres
Strategies Applied to Achieve Objective	**Refuge/Unit**	**Alt A**	**Alt B**	**Alt C**
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. Work with WDFW to remove deer from PI. Appropriate methods to remove deer will be determined in a step-down planning process.	PI	---	✓	✓
e. Continue to survey for presence of non-native rats, rabbits, red foxes, feral cats and dogs, and use appropriate tools to maintain zero population levels.	PI and Smith/Minor	PI only	✓	✓
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	PI only	✓	✓
g. Monitor, and when found, remove marine debris and contaminated material.	PI and Smith/Minor	PI only	✓	✓

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 nonnative 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 (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 ship wreck 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 New Zealand, researchers found that changes caused by heavy fallow deer browsing may have permanently altered the ecosystem and suggested that maintaining very few or zero deer was the only successful method to assist regeneration of native species (Husheer and Frampton 2005). 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. At the same time, 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).

Alternatives	**Refuge/Unit**	**Alt A**	**Alt B**	**Alt C**
Objective as written above applies to alternatives (✓).	PI and Smith/Minor	---	✓	✓
Strategies Applied to Achieve Objective	**Refuge/Unit**	**Alt A**	**Alt B**	**Alt C**
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	PI only	✓	✓
d. Continue to prohibit collection of driftwood from shorelines and within marina of Protection Island.	PI	---	✓	✓
e. Continue to survey for presence of non-native rats, rabbits, red foxes, feral cats and dogs, and use appropriate tools to maintain zero population levels.	PI and Smith/Minor	PI only	✓	✓
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	PI only	✓	✓
g. Monitor, and when found, remove marine debris and contaminated material.	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 will both restore the upland spit where it now acts as an impediment to vegetation, 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 Island.
- 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.

Alternatives	**Refuge/Unit**	**Alt A**	**Alt B**	**Alt C**
Objective applies to alternative as written above (✓).	SJI		✓	✓
Strategies Applied to Achieve Objective	**Refuge/Unit**	**Alt A**	**Alt B**	**Alt C**
a. Coordinate with DNR to establish appropriate shoreline buffers (conservation leases and/or withdrawals) to minimize disturbance from boat landings and tideland development.	SJI	---	✓	✓
b. Grow and outplant populations of brittle prickly-pear cactus on 5 Refuge islands and monitor to ensure success of restoration.	SJI	---	✓	✓
c. Monitor, and when found, remove marine debris and contaminated material.	SJI	---	✓	✓
d. Continue to survey for presence of non-native rats, rabbits, red foxes, feral cats and dogs, and use appropriate tools to maintain zero population levels.	SJI	---	✓	✓
e. Conduct a survey of native mammalian predators (e.g., coyote, raccoon, mink, and river	SJI	---	✓	✓

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.	Matia Turn	✓ ---	✓ ✓	✓ ✓

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, 2003b). 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). Therefore, special emphasis will be placed on reducing human activities (i.e., camping) that may support predators (e.g., raccoons) on Matia and Turn Islands to induce black oystercatchers to nest in suitable habitat on those islands.

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 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).

Alternatives	Refuge/Unit	Alt A	Alt B	Alt C
The alternative is modified by replacing bold type above with the text in this row.		---	Up to 5 acres	Up to 5 acres
Strategies Applied to Achieve Objective	**Refuge/Unit**	**Alt A**	**Alt B**	**Alt C**
a. Develop a site plan for infrastructure on Protection Island 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.	PI	---	✓	✓
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.	PI	---	✓	✓
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.	PI	---	✓	✓
d. Expand use of solar energy to reduce transport of gas, oil, and propane.	PI	---	✓	✓
e. Determine the best restoration techniques within test plots and monitor prior to full-scale restoration.	PI	---	✓	✓
f. Conduct studies to determine which native plant species will provide the best erosion control throughout the year.	PI	---	✓	✓
g. Prevent wildfires by continuing to prohibit public access and open fires by all island users.	PI	✓	✓	✓
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.	PI	---	✓	✓
i. Work with WDFW to remove deer from PI. Appropriate methods to remove deer will be determined in a step-down planning process.	PI	---	✓	✓
j. Search equipment and supplies to prevent the establishment of non-native species.	PI	✓	✓	✓
k. Continue to survey for presence of non-native rats, rabbits, red foxes, feral cats and dogs, and use appropriate tools to maintain zero population levels.	PI	✓	✓	✓
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.	PI	✓	✓	✓

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 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 of 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 (1988) 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 also alter natural fire regimes, and wildfires remove standing vegetation which can lead to increased erosion (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 for the benefit of breeding rhinoceros auklets and tufted puffins with the following attributes:

- $\geq$ 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.
- $\geq$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).

Alternatives	**Refuge/Unit**	**Alt A**	**Alt B**	**Alt C**
The alternative is modified by replacing bolded type above with the text in this row.	PI	---	Up to 20 acres	Up to 20 acres
Strategies Applied to Achieve Objective	**Refuge/Unit**	**Alt A**	**Alt B**	
a. Establish vegetation restoration test plots for non-native plant removal and develop techniques for establishing native vegetation.	PI	---	✓	✓
b. Conduct studies to determine which native plant species will provide the best erosion control throughout the year.	PI	---	✓	✓
c. Prevent wildfires by continuing to prohibit public access and open fires by island users.	PI	✓	✓	✓
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.	PI	---	✓	✓
e. Work with WDFW to remove deer from PI. Appropriate methods to remove deer will be determined in a step-down planning process.	PI	---	✓	✓
f. Search equipment and supplies to prevent the establishment of non-native species.	PI	---	✓	✓
g. Continue to survey for presence of non-native rats, rabbits, red foxes, feral cats and dogs, and use appropriate tools to maintain zero population levels.	PI	---	✓	✓
h. Conduct a survey of native mammalian predators (e.g., coyote, raccoon, mink, and river	PI	---	✓	✓

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 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).

Alternatives	Refuge/Unit	Alt A	Alt B	Alt C
The alternative is modified by replacing bolded type above with the text in this row.	PI	0 acres	Up to 200 acres	20-40 acres

Strategies Applied to Achieve Objective	Refuge/Unit	Alt A	Alt B	Alt C
a. Determine extent and composition of historical (pre-farming) savanna, grassland, and herbaceous bald habitat.	PI	---	✓	✓
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.	PI	---	✓	✓
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.	PI	---	✓	✓
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.	PI	---	✓	✓
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.	PI	---	✓	✓
f. Develop partnerships to propagate difficult to obtain plant materials for re-introductions.	PI	---	✓	✓
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.**	PI	---	✓	✓
h. Work with WDFW to remove deer from PI. Appropriate methods to remove deer will be determined in a step-down planning process.	PI	---	✓	✓
i. Continue to survey for presence of non-native rats, rabbits, red foxes, feral cats and dogs, and use appropriate tools to maintain zero population levels.	PI	✓	✓	✓
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.	PI	✓	✓	✓

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).

Alternatives	**Refuge/Unit**	**Alt A**	**Alt B**	**Alt C**
The alternative is modified by replacing bolded type above with the text in this row.	SJI	0 islands	28 islands	14-28 islands
Strategies Applied to Achieve Objective	**Refuge/Unit**	**Alt A**	**Alt B**	**Alt C**
a. Where appropriate, use prescribed fire strategies to promote native grasses and forbs by removing invasive and non-native plants and reducing canopy cover.	SJI	---	✓	✓

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).	SJI	---	✓	✓
c. Use non-motorized hand tools for removal of woody species to promote native grasses and forbs by reducing canopy cover.	SJI	---	✓	✓
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.	SJI	---	✓	✓
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.**	SJI	---	✓	✓
f. Continue to survey for presence of non-native rats, rabbits, red foxes, feral cats and dogs, and use appropriate tools to maintain zero population levels.	SJI	---	✓	✓
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.	SJI	---	✓	✓
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).

Alternatives	**Refuge/Unit**	**Alt A**	**Alt B**	**Alt C**
The alternative is modified by replacing bolded type above with the text in this row.	SJI	0 acres	Up to 20 acres	10 acres
Strategies Applied to Achieve Objective	**Refuge/Unit**	**Alt A**	**Alt B**	**Alt C**
a. Introduce rare plant species (e.g., golden paintbrush and California buttercup).	SJI	---	✓	✓
b. Restore or enhance (where appropriate) populations of host plants for rare butterflies (e.g., mustard, verbena, plantain, and hairy Indian paintbrush).	SJI	---	✓	✓
c. Use prescribed fire strategies to promote native plants by removing invasive and non-native plants and reducing shrub and tree cover.	SJI	---	✓	✓
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).	SJI	---	✓	✓
e. Use mechanical removal of woody species to promote native grasses and forbs by reducing canopy cover.	SJI	---	✓	✓
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.	SJI	---	✓	✓
g. Continue to survey for presence of non-native rats, rabbits, red foxes, feral cats and dogs, and use appropriate tools to maintain zero population levels.	SJI	---	✓	✓
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.	SJI	---	✓	✓
i. Reroute trail system on Turn Island to minimize trampling through sensitive camas community (see Objective 7.1).	Turn	---	✓	✓

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 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).

Alternatives	**Refuge/Unit**	**Alt A**	**Alt B**	**Alt C**
The alternative is modified by replacing bolded type above with the text in this row.	PI	49 acres	Up to 80 acres	Up to 80 acres
Strategies Applied to Achieve Objective	**Refuge/Unit**	**Alt A**	**Alt B**	**Alt C**
a. Control or eradicate invasive and non-native plants with IPM techniques using cultural, mechanical, physical, biological and/or chemical means.	PI	✓	✓	✓
b. Conduct vegetative and wildlife surveys to establish baseline diversity and monitor change over time.	PI	---	✓	✓
c. Implement total wildfire suppression tactics on all wildfires on the island.	PI	✓	✓	✓
d. Focus opportunistic restoration activities on the shrub layer within the “gap area” between the forest patches on the north side of the island.	PI	---	✓	✓
e. Work with WDFW to remove deer from PI. Appropriate methods to remove deer will be determined in a step-down planning process.	PI	---	✓	✓

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

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, 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).

Alternatives	**Refuge/Unit**	**Alt A**	**Alt B**	**Alt C**
Objective applies to alternative as written above (✓).	SJI		✓	✓
Strategies Applied to Achieve Objective	**Refuge/Unit**	**Alt A**	**Alt B**	**Alt C**
a. Use IPM strategies to control invasive and non-native plants.	SJI	---	✓	✓
b. Re-vegetate removed campsites with trees or shrubs.	Matia and Turn	---	✓	✓
c. Implement total wildfire suppression tactics on all forested islands.	SJ 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, feral cats and dogs, 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 amphibians, such as 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 (<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).

Alternatives	Refuge/Unit	Alt A	Alt B	Alt C
Objective as written above applies to alternatives (✓).			✓	✓
Strategies Applied to Achieve Objective	**Refuge/Unit**	**Alt A**	**Alt B**	**Alt C**
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 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)

Alternatives	**Refuge/Unit**	**Alt A**	**Alt B**	**Alt C**
Objective applies to alternative as written above (✓).	Matia		✓	✓
Strategies Applied to Achieve Objective	**Refuge/Unit**	**Alt A**	**Alt B**	**Alt C**
a. Determine the hydrology of the freshwater wetland to identify historical and current hydrological processes and wetland functioning.	Matia	---	✓	✓
b. If necessary and feasible, restore hydrologic processes and use restoration techniques appropriate for wilderness areas.	Matia	---	✓	✓
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.	Matia	---	✓	✓

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 weed list 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	**Refuge/Unit**	**Alt A**	**Alt B**	**Alt C**
a. Maintain and enhance existing trails while reducing or eliminating illegal social trails. Matia: maintain and enhance the existing 1.2 mile wilderness loop trail and eliminate illegal social trails. Turn: re-develop the .9 mile loop trail to include interpretive component.	Matia	---	✓	✓
	Turn	---	✓	✓
b. Maintain seasonal dock.	Matia	State	State	State
c. Maintain composting toilets.	Matia	1, State	1, State	1, State
	Turn	2, State	2, State	1, FWS
d. Maintain or provide mooring buoys in order to minimize anchoring damage on bottom habitat.	Matia	2 buoys in Rolfe cove, State	2 buoys in Rolfe cove, State	2 buoys in Rolfe cove, State
	Turn	3 buoys, State	3+ buoys, State	3+ buoys, FWS
e. 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.	Matia	Rolfe cove only	Rolfe cove only	Rolfe cove only
	Turn	Unregulated	✓	✓
f. Require commercial groups to obtain a Refuge special use permit (SUP).	Matia	State permit	Refuge SUP, State permit	Refuge SUP, State permit
	Turn	State permit	Refuge SUP, State permit	Refuge SUP
g. Increase Refuge law enforcement presence	Turn & Matia	minimal	✓	✓
h. Reduce the risk of fire and the impacts of illegally collected firewood. Allow liquid fuel and gel camp stoves only.	Matia & Turn	No fires, not well enforced	No fires allowed	No fires allowed
i. Pets.	Matia& Turn	Matia: State allows pets on leash in 2 acre rec. area. Turn: State allows pets on leash. Federal: no pets, regulations not enforced	Enforce existing Federal regulations, no pets	Enforce existing Federal regulations, no pets

j. Maintain and update regulatory signage in accordance with the comprehensive sign plan; see SJI sign plan Appendix D.	**Matia & Turn**	---	✓	✓
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.** See appendix D.	Matia	---	1 signs	1 sign
	Turn	---	3 signs	2 signs
l. Acquire leases (public access and conservation) of tidelands and bed-lands from DNR to better control unauthorized access from inter-tidal areas.	Turn & Matia	---	✓	✓
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	Refuge/Unit	Alt A	Alt B	Alt C
a. Develop wildlife and plant lists.	Matia & Turn	---	✓	✓
b. Develop and install habitat and wildlife-specific interpretive panels in accordance with the comprehensive sign plan; see Appendix D.	Matia	---	3 signs	1 sign
	Turn	---	$\leq$ 8 signs	3 signs
c. Volunteers provide information to visitors.	Matia & Turn	---	✓	✓
d. Have a multi-function, live-aboard or on-island hosts/caretakers who will explain rules and regulations and provide other information to visitors	Matia& Turn	---	Seasonal	Seasonal
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.	SJI	0 staff	Refuge Manager & seasonal Ranger	Refuge Manager & seasonal Ranger
f. Continue working with Refuge partners	Matia	Partner with WA State	Partner with WA State	Partner with WA State

		Parks and others	Parks and others	Parks and others
	Turn	Partner with WA State Parks and others	Partner with WA State Parks and others	Partner with others

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 SJI 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).

Alternatives		**Alt A**	**Alt B**	**Alt C**
The alternative is modified by replacing bold type above with the text in this row.		Turn and Matia	Turn and Matia	Matia Island only
Strategies Applied to Achieve Objective	**Refuge/Unit**	**Alt A**	**Alt B**	**Alt C**
a. Establish a reservation system for camping.		--	✓	✓
b. Permit camping only for visitors arriving by human-powered boats.		--	✓	✓
c. Camping permitted only in designated # of campsites with a limit of 8 people per campsite.	Turn	13	8	0
	Matia	6	6	4
d. Eliminate camping and night use of Turn 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.

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	Refuge/Unit	Alt A	Alt B	Alt C
a. Increase partnerships with schools and volunteer groups to assist with clean-up on 1/3 of the islands annually.	PI & SJI	PI, Matia	✓	✓
b. Remove invasive plants.	PI & SJI	✓	✓	✓
c. Observe and monitor wildlife.	PI & SJI	PI	✓	✓
d. Maintain trails, signs, buildings, and facilities.	PI & SJI	SJI	✓	✓

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

- 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	Refuge	Alt A	Alt B	Alt C
a. Issue 3 or more permits every 5 years to regional colleges and universities to allow students to conduct environmental studies on PI and the SJIs	PI & SJI	PI	✓	✓

Rationale: Enabling legislation for PI includes providing for wildlife-oriented public education. Offering students the opportunity to conduct environmental studies on Protection Island and the San

Juan Islands 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	Refuge/Unit	Alt A	Alt B	Alt C
a. Install interpretive panels in harbors and on ferries in accordance with the comprehensive sign plan; see Appendix D.	PI	1 panel	2 panels	2 panels
	SJI	0	5 panels, 2+ additional venues	5 panels
b. Install updated posters at marinas.	PI & SJI	✓	10 marinas	5 marinas
c. Provide ecotourism interpreter training.	PI & SJI	---	2 classes/yr	1 class/yr
d. Install updated posters at island airports.	SJI	---	✓	✓
e. Develop and distribute info packets to ecotourism organizations.	PI & SJI	---	✓	✓
f. Produce an educational video.	PI & SJI	---	✓	---
g. Show video on ferry boats.	PI & SJI	---	✓	---
h. Update and maintain refuge-specific websites that can be linked to additional technology.	PI & SJI	✓	✓	✓
i. Place articles in free tourist magazines, including Washington Guide.	PI & SJI	✓	10 articles	5 articles
j. Develop Refuge-specific brochures.	PI & SJI	---	✓	✓

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 and the waters around Protection Island.

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	Refuge/Unit	Alt A	Alt B	Alt C
a. Create a traveling display and take it to festivals and other events.	PI & SJI	---	✓	---
b. Conduct school and community EE programs that include information on why it is important to obey Refuge regulations.	PI & SJI	---	5 events	3 events
c. Develop a relationship with the local press to promote news articles and get Refuge information posted.	PI & SJI	✓	10 articles and/or postings	5 articles and/or postings
d. Use the "adopt an island" concept to promote Refuge awareness.	PI & SJI	PI only	✓	✓
e. Share office with another agency in the San Juan Islands (NPS at Friday Harbor; BLM on Lopez Island).	SJI	---	✓	✓
f. Increase Project Leader/staff attendance at community and other agency meetings.	SJI	4-6 meetings	8-10 meetings	8-10 meetings
g. Volunteers provide information to area visitors.	SJI	---	✓	✓
h. Have a multi-function, live-aboard or on- island hosts/caretakers who will explain rules and regulations and provide other information.	SJI	---	Seasonal	Seasonal
	PI	Year round	Year round	Year round
i. Staffing commitment: Create a Refuge Manager position responsible for planning, law enforcement, maintenance, education, public relations, and volunteer supervision. Create a seasonal staff position. Station both in the San Juan Islands.	SJI	Current Staff, approxim-ately 20 days per year	Permanent FTE Manager & seasonal FTE Ranger, 35-40 staff days/yr	Permanent FTE Manager & seasonal FTE Ranger, 30-35 staff days/yr

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	Alt A	Alt B	Alt C
a**.** Educate boating clubs, wildlife tour businesses, charters, and kayak groups, about “why a closer look hurts” wildlife.	PI & SJI	---	3 group events	1 group event
b. Increase boater contacts to teach “why a closer look hurts” wildlife.	PI	100 contacts	200 contacts	150 contacts
	SJI	20 contacts	150 contacts	100 contacts
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	minimal	✓	✓
h**.** Distribute brochures and display posters in sporting goods and marine stores.	PI & SJI	---	✓	✓
i. Increase marina visits and boater contacts.	PI & SJI	10-20 visits	150-200 visits	100-150 visits
j**.** Increase number of days per year spent maintaining signs (2-3 people).	SJI	minimal	5-7 days	3-5 days
k. Implement a comprehensive sign plan which includes installation and maintenance of signs identifying closed islands where feasible.	SJI	No sign plan	✓	✓
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	15+ signs. No sign plan	≤10 signs	≤10 signs
m**.** Increase Refuge law enforcement presence.	PI & SJI	minimal	70 Days	70 Days
n. Work with partners to educate general transportation, military, and tourist aircraft	PI & SJI	minimal	✓	✓

operators regarding the impact of low-flying aircraft on wildlife.				
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 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	**Refuge/Unit**	**Alt A**	**Alt B**	**Alt C**
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.	PI & SJI	---	✓	✓
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).	PI & SJI	---	✓	✓
c**.** Consult with the Tribe(s) to identify the type of cultural resources information appropriate for public interpretation.	PI & SJI	---	✓	✓
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.	PI & SJI	---	✓	✓
e**.** Develop partnerships with Tribes, educational institutions, and other partners for the interpretation of cultural and paleontological resources at the Refuge.	PI & SJI	---	✓	✓
f**.** Develop Museum Property inventory. Create storage and use plans for museum property.	PI & SJI	---	✓	✓

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	Alt A	Alt B	Alt C
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 reduce the number of islands with large 200 yard "buffer" signs.	SJI	15 islands, variable text	≤10 islands, standard text	≤10 islands, standard text
c. Reduce the number of wilderness designation signs.	SJI	Many Refuge units	Matia Island only	Matia Island only
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".	SJI	---	15" x 20" signs – most islands; 11" x 14" signs – some islands. 22" x 28" signs – few select islands	11" x 14" signs – most islands.
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**.

Objective Management Indicator	**Refuge/Unit**	**Alt A**	**Alt B**	**Alt C**
Objective as written above applies to alternatives (✓) or the alternative is modified by replacing bolded type above with the text in this row.		**>100 visitors**	**<100 visitors**	**<75 visitors**
Strategies Applied to Achieve Objective	**Refuge/Unit**	**Alt A**	**Alt B**	**Alt C**
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	not well enforced	✓	✓
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.	Matia	---	✓	✓
g. Number of authorized campsites on Matia Island.	Matia	6 sites	6 sites	4 sites
h. Maximum number of people per campsite.	Matia	8 people	8 people	8 people

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	Alt A	Alt B	Alt C
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	Alt A	Alt B	Alt C
a. Projects with high level of applicability to Refuge management or scientific knowledge needs	PI & SJI	3 projects for both	8 projects through the term of the CCP	6 projects through the term of the CCP
b. Establish a research committee to develop proposals to meet priority information needs identified by management.	PI & SJI	---	✓	✓
c. Reduce footprint of research facilities of higher human activity to minimize disturbance to wildlife by developing a centralized research facility.	PI	Old research housing in two locations	Updated research facility in one location	Updated research facility in one location
d. Develop handbook of Refuge	PI	---	✓	✓

guidelines and distribute to all authorized people on islands to prevent disturbance or trampling.				
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 biological program (e.g., boat moored in Sequim and seasonally in SJI's).	PI & SJI	Boat moored in Sequim	✓	✓

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 raw 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.
- Often result in peer review articles in scientific journals and publications and/or symposiums.

Strategies Applied to Achieve Objective	Refuge/Unit	Alt A	Alt B	Alt C
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	PIGU and GWGU	✓	✓
	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	harbor seal	✓	---
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 possible.

The last three strategies listed above will provide valuable data to the 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 would 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	Alt A	Alt B	Alt C
a. Continue San Juan Summer Surveys annually (June).	SJI	✓	✓	✓
b. In late May-early June, conduct boat-based surveys for breeding black oystercatchers on 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 (glaucous-winged gull, pelagic and double-crested cormorants, black oystercatcher).	PI and SJI	---	✓	✓
h. Integrate data into a regional database for trend analysis.	PI & SJI	---	✓	✓
i. Conduct periodic surveys for Taylor's checkerspot butterflies on PI and island marble and valley	PI and SJI	---	✓	✓

silverspot butterflies in the San Juan Islands NWR.				
j. Continue to conduct Christmas Bird Counts (CBC) and initiate breeding bird surveys (BBS) for passerines.	PI	CBC	✓	CBC
k. Coordinate with partners to conduct surveys for bald eagles according to the Bald Eagle Delisting Monitoring Plan.	PI and SJI	---	✓	---
l. Conduct periodic surveys to ensure success of restoration projects.	PI and SJI	PI	✓	✓
m. Conduct 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 and SJI	PI	✓	✓

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 scale and abilities 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 e-g) 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 (Naughton et al. 2007). 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 would 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.

Objective Management Indicators	Refuge/Unit	Alt A	Alt B	Alt C
The following is a prioritized list of scientific assessments to support resource management decisions on the Refuges.	PI & SJI			
Strategies Applied to Achieve Objective	**Refuge/Unit**	**Alt A**	**Alt B**	**Alt C**
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	FWS amphibian survey on Matia	✓	---
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.

Objective Management indicators	Refuge/Unit	Alt A	Alt B	Alt C
Strategies Applied to Achieve Objective	**Refuge/Unit**	**Alt A**	**Alt B**	**Alt C**
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				
Alternatives	**Refuge/Unit**	**Alt A**	**Alt B**	**Alt C**
Strategies Applied to Achieve Objective	**Refuge/Unit**	**Alt A**	**Alt B**	**Alt C**
a. Conduct systematic survey of Protection Island for the existence of paleontological resources based on what is known.	PI	---	✓	✓
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.	PI	---	✓	✓
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 degrees 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. From the years 1995 to 2006, global surface temperatures have been 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 degrees F; on average, they are above freezing. No days are on record with temperatures at or below 0 degrees 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 (degrees 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.

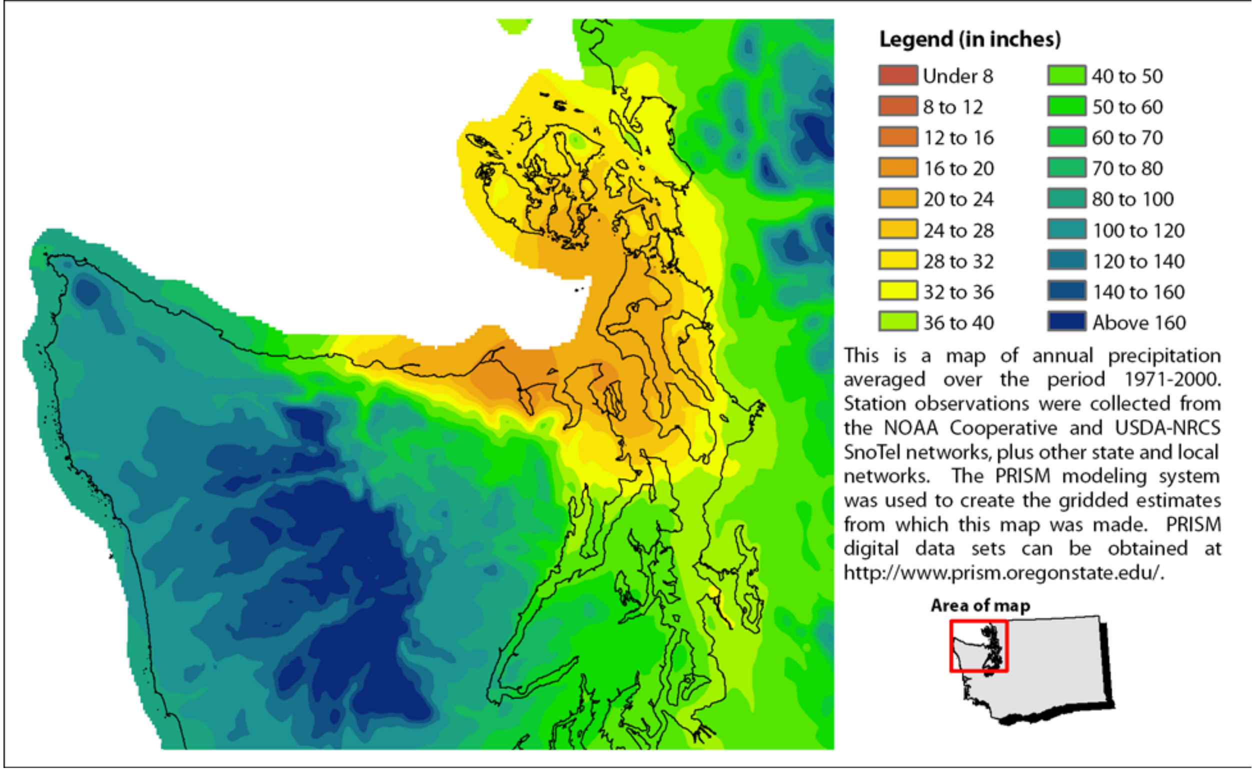
Future Trends

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 degrees F (1.5-2.5 degrees C) (Leung and Qian 2003). Mote et al. (2003) observed that the Pacific Northwest region experienced warming of approximately 1.5 degrees F (0.8 degrees C) during the 20th century. Using data derived from eight climate models, further warming of 0.9-4.5 degrees F (0.5-2.5 degrees C) was projected by the 2020s and 2.7-5.8 degrees F (1.5-3.2 degrees 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 toward 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 provide 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)

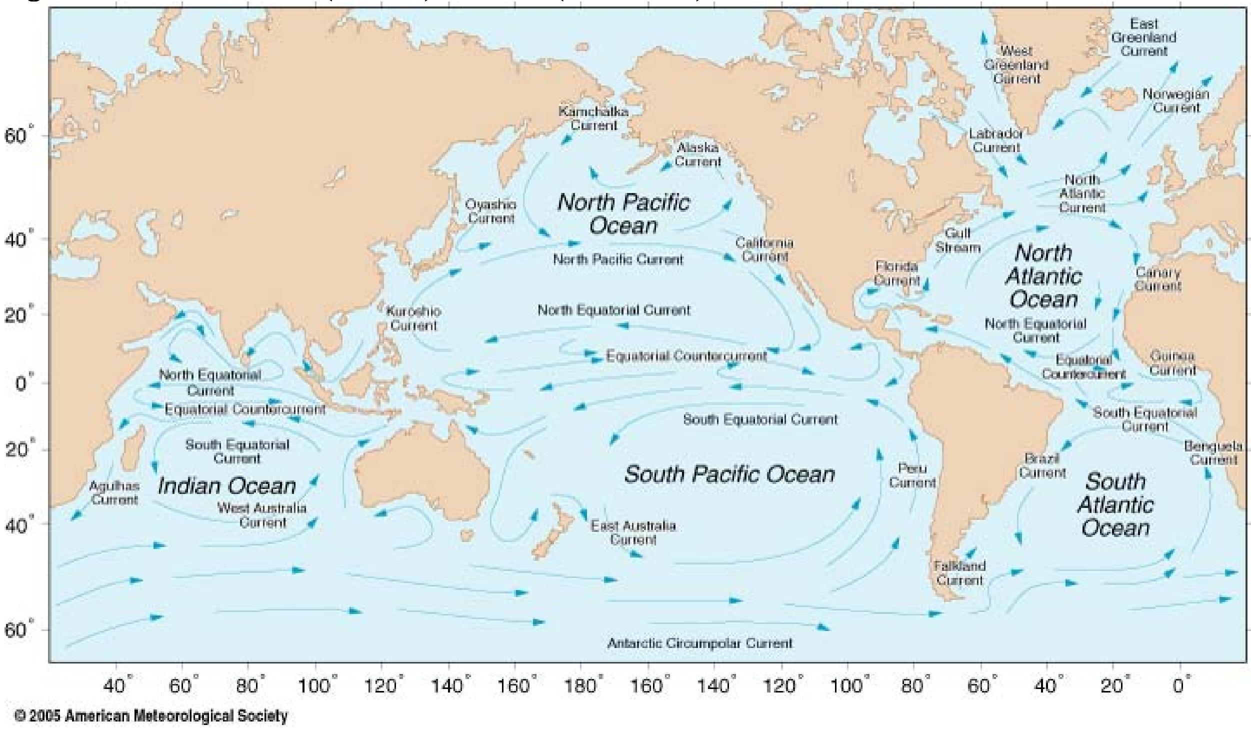
Washington does not experience hurricanes, and tornadoes in western Washington are very infrequent, especially in these island environments. The state experiences an average of two tornadoes per year. Likewise, thunderstorms are generally not severe and do not pose a significant threat.

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).



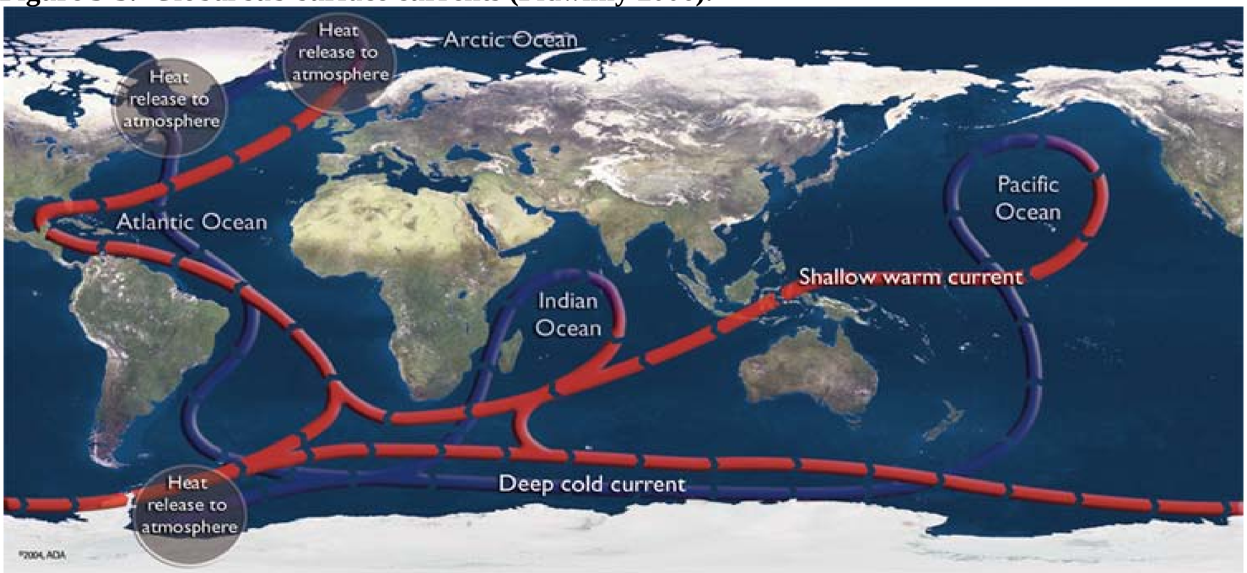
In addition to global surface currents, slower-moving global sub-surface currents are present; they are driven by differences in seawater density. In the North Pacific, a sub-surface current flows north from Antarctica, bringing deep, cold, nutrient-rich waters to the surface in areas of upwelling, before 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 fresh water over salt water), 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 (e.g., tides, storm surges) 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 degrees F in the winter months to approximately 54 degrees 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 degrees F (1.2 degrees 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 indicate 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 in elevation (USGS 1981a, 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, and 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 the 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 cause 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 NWR

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 the marina and no longer exists.

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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 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 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.

On 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 Washington DNR 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	Spill 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 toxics (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 have effects upon 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 into 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 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 threatening 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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Chapter 4. Refuge Biology and Habitats

This chapter addresses the biological environment of the Protection Island and San Juan Islands National Wildlife Refuges (NWRs); however, it is not an exhaustive overview of all species and habitats. The chapter begins with a discussion of biological integrity, as required under the National Wildlife Refuge Administration Act, as amended. The biological integrity (601 FW3) analysis section introduces the biological environment by describing the native wildlife and vegetation that occur on the two Refuges in comparison to the surrounding landscape. The bulk of the chapter is then focused on the presentation of pertinent background information for the priority habitats and species that the Refuge Complex personnel will actively manage to accomplish biological conservation and/or restoration. The priority habitats and species are collectively known as the 'priority resources of concern' designated under this CCP. Background information includes description, location, condition, trends, key ecological attributes, and threats associated with each priority resource of concern. The information presented herein was used by the CCP team to develop goals and objectives for each of the priority resources of concern.

4.1 Biological Integrity Analysis

The National Wildlife Refuge System Improvement Act of 1997 directs the Service to ensure that the biological integrity, diversity, and environmental health (BIDEH) of the Refuge System are maintained for the benefit of present and future generations of Americans. In simplistic terms, elements of BIDEH are represented by native fish, wildlife, plants, and their habitats as well as those ecological processes that support them. National Wildlife Refuge System Policy on BIDEH (601 FW 3) also provides guidance on the consideration and protection of the broad spectrum of fish, wildlife, and habitat resources found on refuges and associated ecosystems that represents BIDEH on each refuge. Through the consideration of BIDEH, the refuges will provide habitat for all appropriate native species. Refuge management priorities may change over time and since the CCP is designed to be a living, flexible document, changes will be made as needed and at appropriate times as identified by refuge personnel.

Protection Island NWR is located in the southeast corner of the Strait of Juan de Fuca approximately 2 miles from the mouth of Discovery Bay. Approximately 70% of the island's roughly 370 acres consists of an upland plateau surrounded by very high, steep-sloped sandy bluffs. Currently, about 80% of the plateau is covered by grassland and 20% by mixed coniferous forest. Sediment derived from the steep unvegetated bluffs along the north and south shorelines and transported by longshore currents to the ends of the crescent-shaped island results in two sand and gravel spits, Kanem Point on the southwest and Violet Point on the southeast.

The San Juan Islands NWR is located within the San Juan Archipelago, at the convergence of the Strait of Juan de Fuca and the Strait of Georgia. Geologically, the 83 small rocks, islands, and reefs comprising the refuge contain extensive exposures of sedimentary, metamorphic, and/or volcanic bedrock which are occasionally overlain with glacial and alluvial deposits, particularly on the larger islands. The combination of these soil characteristics, near-drought conditions during the summer months, and highly variable topography and aspect results in a diverse assemblage of plant communities and ecological systems that range from xeric to mesic (Franklin and Dyrness 1988).

The BIDEH of the ecosystems, including and surrounding the Refuges, have undergone dramatic alterations since pre-settlement times. The most discernible changes are related to: a) the conversion and development of large portions of coastal areas into agriculture, housing, commercial, and industrial lands; b) human-caused wildlife disturbance; c) the introduction of contaminants into the aquatic environment; d) fisheries bycatch and marine debris; e) the alteration of fire regimes; f) the loss of native species accompanied by a large influx of non-native and invasive plants and animals into the system; and g) climate change. This section discusses the connection between these main landscape level changes with the current vegetation and wildlife on the lands and waters occupied by the Refuges. This summary is not a complete analysis of all factors related to changes in native vegetation, fish and wildlife. For the purposes of this document, we define the Salish Sea as encompassing the Strait of Juan de Fuca, Puget Sound (Olympia north to Deception Pass and west to Hood Canal), San Juan Archipelago and the Strait of Georgia (See Figure 1.1). This area effectively defines the ecosystem that encompasses the refuges. We use this term wherever relevant; however, it is a relatively new term and spans international boundaries. Therefore, throughout this chapter, we may refer to the sections of the Salish Sea listed above when a study, survey, or other source reports only for that section.

4.1.1 Habitat Loss or Degradation

Habitat conversion for human uses within the Salish Sea, which includes Protection Island and the San Juan Islands, has been rapid since the mid-late 1800s and continues today, bringing profound and widespread alterations to the watersheds and shorelines of the region. Logging and the milling of logs were among the earliest and more defining aspects of early settlement. Lower floodplains and tidal wetland areas were diked and drained in order to become prime locations for agricultural settlement. Major river delta areas such as Seattle and Tacoma were converted into centers of industrial and urban development. Today, over 40% of the region has been converted to urban or agricultural uses while most of the remainder is in production forestry (Floberg et al. 2004).

Furthermore, as residential, commercial, and industrial development occurs in close proximity to water, spit features and other low-lying sediment depositional areas along the shoreline were modified by armoring (bulkheads consisting of rock, concrete and timber), large revetments (sloped face to protect a bank or shore structure, usually constructed of rock), causeways (fill corridors that extend across embayments), groins (cross-shore structures designed to trap sediment), overwater structures, fill, and dredging (Johannessen and MacLennan 2007). Approximately 34 percent, or 805 miles, of the shoreline inventoried by the Washington State ShoreZone Inventory has undergone such modifications (WDNR 2001). Shore modifications, almost without exception, impact the ecological functioning of nearshore coastal systems. The proliferation of these structures has been viewed as one of the greatest threats to the ecological functioning of coastal systems (PSAT 2003a, Thom et al. 1994).

4.1.2 Human-caused Wildlife Disturbance

Many of our partners have identified this threat in their plans and have identified similar strategies to ours to address this threat (USFWS 2005, WDFW 2005, Evens and Kennedy 2007, Mills et al 2005, NMFS 2008, Tessler et al 2007, USFWS 2007). The counties containing the Refuges (San Juan, Jefferson, Whatcom, Skagit, and Island) have experienced rapid (>50% increase) human population growth over a twenty year period from 1980 to 2000 (WSDOT 2009). Additionally, this area has become an increasingly popular tourist destination, particularly during the summer months. As a result, activities such as fishing, boating, recreational aviation, camping, and other economic and recreational activities have increased within the coastal areas. These activities often cause stress, reduced productivity, and increased predation of seabirds and pinnipeds associated with the Refuges (Rojek et al. 2007). Please refer to the Priority Resources of Concern sections for further discussion and detailed descriptions of habitat, associated wildlife, and disturbance factors.

4.1.3 Oil Spills and Other Contaminants

These two refuges are particularly vulnerable to the threat of oil spills. Shipping lanes for cargo ships and large oil transport vessels that carry crude oil to refineries are located throughout the Salish Sea with primary ports in Seattle, Tacoma, Olympia, Port Angeles, Everett, Bellingham, Anacortes, Washington, and Vancouver, B.C. Tanker traffic alone through this area carries over 15 billion gallons of oil each year (WDOE 2009). Such high vessel presence increases the risk of oil spills that can cause devastation to the marine ecosystem. Additionally, other sources of hydrocarbon pollution from diesel, gasoline, kerosene, lubricant and various industrial oils are just as toxic to wildlife but can occur at a much smaller scale and may not be properly tracked (USFWS 2005).

In addition to the threat of oil spills, 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), polychlorinated biphenyls (PCB), dioxins, furans, phthalates, and polybrominated diphenyl ethers (PBDE). These contaminants enter into 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 2003b). 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. In addition, ballast water and other waste dumping from ocean vessels also increase contaminant load in the Salish Sea (Puget Sound Water Quality Action Team 2000).

4.1.4 Fisheries Bycatch and Marine Debris

With the growth of fisheries within the Salish Sea, the incidences of interactions between fisheries and seabirds and pinnipeds have increased. Seabird mortalities due to gillnet fisheries have been documented in Washington (Thompson et al. 1998). Additionally, the proliferation of derelict (lost or abandoned) fishing gear or nets is becoming a problem in the Salish Sea. Derelict gear poses an entanglement hazard to invertebrates, fish, waterfowl, seabirds and marine mammals (Natural Resource Consultants 2004, Evens and Kennedy 2007, Natural Resource Consultants 2008, Northwest Straits Initiative 2008). During one study of 4 derelict nets in the Puget Sound, seabirds (88% of which were cormorants) were caught at a rate of 0.24 per day. At this rate, researchers calculated that each net could entangle approximately 7 seabirds per month. Compound that over the estimated 3,800 derelict nets distributed throughout the area and up to 26,600 seabirds per month could be lost to this threat (Natural Resource Consultants 2008). Seals have also been observed with wounds and scarring from entanglement with derelict gear and interactions with aquaculture (net pen) operations.

4.1.5 Alteration of Fire Regimes

The predominant pre-Euroamerican settlement 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). Oak woodlands and dry Douglas-fir forests were found in dry sites with shallow bedrock or deep, gravelly glacial outwash soils, and high growing season moisture stress (Chappell et al. 2001, Natureserve 2009). Historically, fire was a major component of these habitats.

In addition to occasional lighting strikes, fires were intentionally set by Native Americans to maintain food staples such as camas and bracken fern, prevent oak-dominated stands from converting to Douglas-fir forests, keep tree densities lower, and maintain grassy, as opposed to shrubby, understories. Although there is no definitive fire history information, evidence suggests that many, if not most, grasslands and savannas burned every few years. Fire frequency within forest and woodlands probably ranged from frequent (every few years) to moderately frequent (once every 50-100 years), and reflected low-severity and moderate-severity fire regimes (Chappell et al. 2001). The exclusion of fire from most of these habitats over the past 100-130 years has resulted in profound changes. In the absence of fire, trees show a tendency to encroach upon grasslands and savannas, eventually converting these areas to mixed conifer forests and woodlands. Fire suppression, along with factors such as invasive non-native species, grazing, and urban and agricultural conversion, has greatly reduced the amount of native grassland to just a small fraction of the pre-Euroamerican settlement extent. Estimates of remaining prairie vary from 10% of the pre-settlement extent in south Puget Sound (Crawford and Hall 1997), to less than 5% (including savannas) in southwest British Columbia (Garry Oak Ecosystem Recovery Team cited in Sinclair et al. 2006), to 1% in the Willamette Valley (Wilson et al. 1995).

4.1.6 Influx of Exotic, Invasive, and Other Species of Management Concern

One of the largest threats to the wildlife and habitat of the Refuges is invasive plants and pest animals. Invasive plant species displace native vegetation, altering the composition and structure of vegetation communities, affecting food webs, and modifying ecosystem processes (Olson 1999). Introduced native and non-native animal species are usually in direct competition with native wildlife species for food, shelter, and breeding areas and often cause existing native species populations to decline or become extirpated. Ultimately, both plant and animal invasive species can result in considerable impacts to native wildlife and the habitat upon which they depend.

Invasive marine algae, plants, and wildlife

The ballast water of ships is a vector for the transport of marine invasive species (Carlton and Geller 1993) which threatens the conservation and sustainable use of biological diversity (Bax et al. 2003). These are some of the newest and least understood threats to the refuges due to difficulties in monitoring and jurisdictional controls. Plants such as Japanese eelgrass, common cordgrass and the algae *Sargassum* seaweed have been recorded within the Salish Sea. Many of these species have infested large areas along the outer coast of Washington and removal has been costly. Other species of algae such as Japanese kelp and *Caulerpa* have not yet been found in the Salish Sea. To date, none of the species listed in Puget Sound Marine Invasive Species Monitoring Program - Target Species List (Eissinger 2009) are known to exist on or near any of the refuge islands. Marine invertebrates are also a threat to refuge resources that have not been well understood. The refuge staff has begun monitoring for European green crab and plans to expand monitoring efforts to include tunicates, particularly at the Protection Island marina. The Service is required to maintain the marina on Protection Island and any infestation of these tunicates will impact native marine wildlife which may then affect refuge trust resources. The effects of these threats are similar to that of oil spills, marine debris, and derelict fishing gear in that they occur mainly outside refuge jurisdictional boundaries, but still affect refuge resources.

Invasive, non-native terrestrial plants and animals

Non-native invasive plants on the Refuges include European beachgrass, Canada thistle, Himalyan blackberry, cheatgrass, Kentucky bluegrass, English ivy, field bindweed, and Scotch broom. This list is not all inclusive and includes only the most problematic species; many other exotic plants have been introduced.

Herbivores and predators of management concern

Native and non-native mammals that have the potential to negatively affect seabird populations and their habitat on the refuges include black-tailed deer; rabbits, rats and small rodents; raccoons; red fox; feral and domestic cats; trespassing dogs; river otter; mink, short and long-tailed weasels.

Black-tailed deer are native and abundant from the Cascade crest west toward the coast range (WDNR 2009, WDFW 2009). However, there are no historic records of black-tailed deer on Protection Island (Richardson 1961, USFWS 1985). Three adult deer were first observed on the island in 1991 (Hayward 2008). Due to a high reproductive rate and lack of natural predators on Protection Island, this number has increased to a high estimate of 100 deer in 2008/2009 (J. Hayward pers. comm.). The most current estimate as of February 2010 consists of approximately 70 deer (P. Davis pers. comm.). Black-tailed deer use all habitat types present on Protection Island including forest, grassland, bluff, and shoreline. Refuge staff have also observed black-tailed deer on refuge islands in the San Juan Archipelago. For information on the effects of deer under current management, see Chapter 6.

European rabbits are one of the fastest colonizing mammals in the world, primarily because of their high reproductive rate (Hall and Gill 2005). European rabbits do occur on the larger islands within the San Juan Archipelago; however, the only sign of rabbit presence on a refuge island has been rabbit pellets on Nob Island within the San Juan Islands NWR (Murphy pers. comm.). Rabbits can potentially compete with seabirds for nesting areas and change vegetation at colony sites, affecting the reproductive success of seabirds (Courchamp et al. 2003).

Predation, particularly by non-native predatory mammal species such as rats, have been documented to have devastating effects on nesting seabird populations throughout the world (Kadlec 1971, Jehl 1984, Atkinson 1985, USFWS 1993, Ashmole et al. 1994, Gaston 1994). Predator impacts on seabirds may include direct predation of eggs, young, and adults; reproductive failure due to disturbance during the nesting season; and detrimental alteration of habitat, including destruction of nesting burrows. These impacts can result in complete abandonment of nesting colonies.

4.1.7 Climate Change

A growing body of scientific evidence has emerged 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 air temperatures on the earth's surface have increased by 1.3 degrees 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. From 1995 to 2006, global surface temperatures have been the warmest on record since 1850 (IPCC 2007). The global climate system, in turn, controls regional and local-scale climate conditions within the Pacific Northwest. Projected impacts to the region encompassing the refuges include changes in seasonal temperatures, precipitation, extreme weather events, oceanic conditions, and sea level rise.

Climate change may have drastic effects on these refuges, but due to the complexity of the issue and unknown severity of change, the magnitude of the effects of climate change on the BIDEH of the refuges during the term of this CCP cannot be predicted. Climate change will further exacerbate all of the environmental stressors imposed by the threats listed in this and the following sections as they will likely be additive or synergistic. The anticipated effects of climate change on the Priority Resources of Concern are addressed in the following sections.

4.2 Priority Resources of Concern Selection and Analysis

4.2.1 Priority Resources of Concern Selection

In preparing this plan, the Service reviewed other local, regional, and national plans that pertain to the wildlife and habitats of Protection Island and San Juan Islands NWRs (see Appendix C). The Service also sought input from Washington State conservation agencies, non-governmental organizations, and the general public. The refuges' purposes, as stated in the enabling legislation for each refuge (see Chapter 1) were carefully reviewed as was the refuges' contribution to maintenance of BIDEH (Appendix C) within the ecoregion. As a result of this information gathering and review process, a comprehensive list of potential resources of concern was developed. From this list, those species and habitats that are most representative of refuge purposes and habitats, BIDEH, as well as other Service and ecosystem priorities, were chosen as priority resources of concern (habitat types) and focal resources (plant and animal species). Habitats selected as priority resources of concern include shoreline, bluff, grassland/savanna/herbaceous bald, forest and woodlands, and wetlands (see Table 4.1). The International Terrestrial Ecological System Classification under development by NatureServe and its natural heritage program members was used to describe and map refuge vegetation types (see Figures 4.1, 4.2, and Appendix C) which fall under the more general refuge habitat types.

Priority resources of concern and focal resources consist of habitats and species whose conservation and enhancement will guide refuge management into the future. Potential management actions will be evaluated on their effectiveness in achieving refuge goals and objectives for the priority resources of concern. However, many native species that are present on the refuges will also benefit. They are referred to here as other benefiting species. See Appendix C for a completed list of priority resources of concern, focal resources, and other benefiting species.

4.2.2 Priority Resource of Concern Analysis

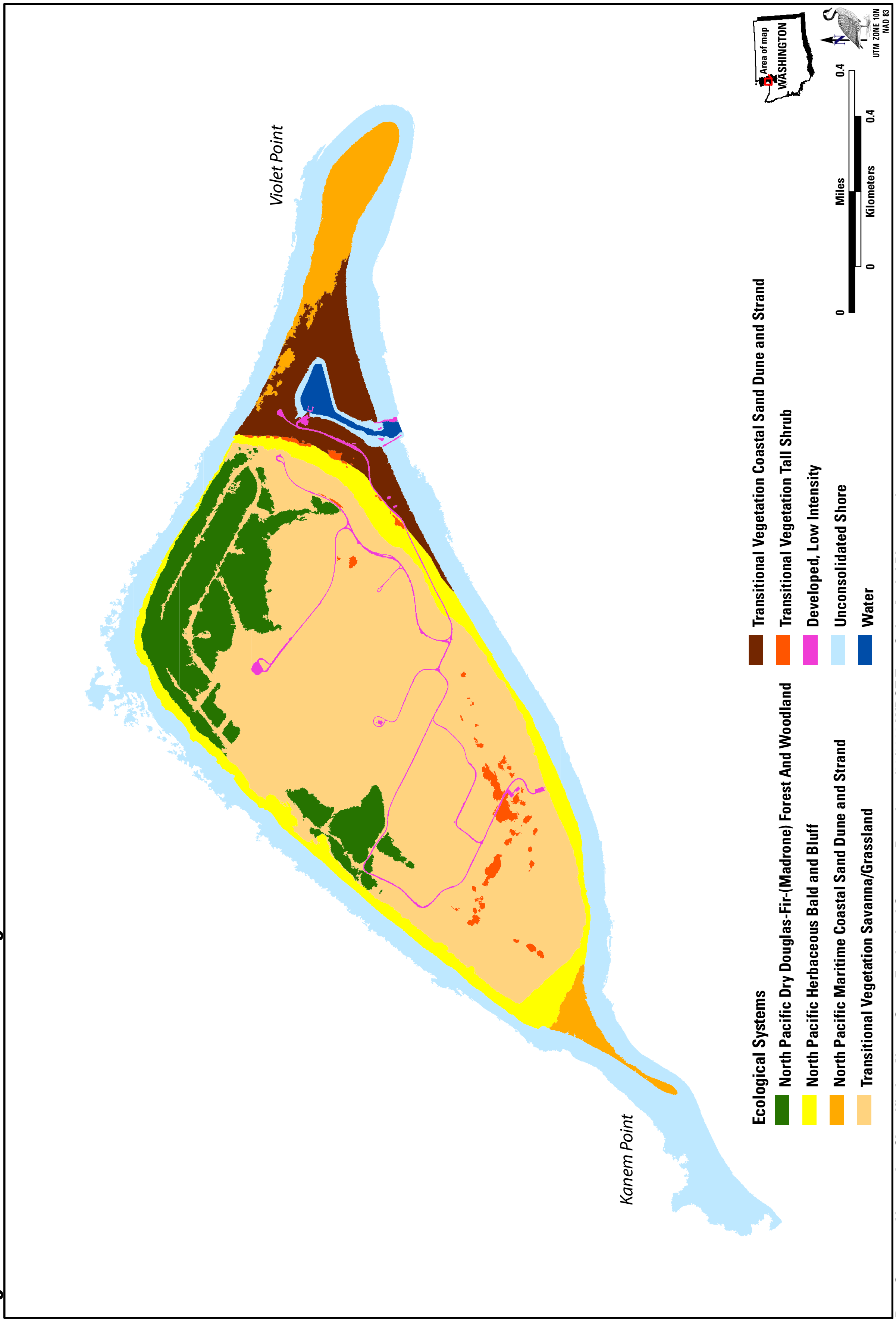
In the following sections, information is provided on the location, condition, associated wildlife, key ecological attributes, and threats for each priority resource of concern. There will be a description of location and condition of each priority resource of concern on Protection Island and San Juan Islands NWRs within the context of the Salish Sea ecosystem. Next, focal resources and other benefiting species are listed in the associated wildlife section. A preliminary analysis is then presented in the form of key ecological attributes. Key ecological attributes represent those aspects of the environment, such as ecological processes or patterns of biological structure and composition, that are key to sustaining the long-term viability of the resource. These key ecological attributes are further divided into measurable indicators that strongly correlate with the status of the attribute. The team developed desired conditions that were based on scientific literature review, consultation with species or area experts, and the team's professional judgment. Desired condition levels for each measurable indicator were used to help design objectives for the priority resource of concern as presented in Chapter 2. The last section includes a discussion on threats. Threats are defined as something that destroys, degrades, or impairs a priority resource of concern by impacting a key ecological attribute of that resource. Additionally, different threats place varying degrees of pressure on the environmental system and can become cumulative. Threats are of major concern and are addressed within this plan. A similar analysis is presented for focal resources (seabirds, marine mammals, etc.) following the analysis for priority resources of concern.

Table 4.1. Priority Resources of Concern, by Refuge Unit.

Refuge Unit	Shoreline	Sandy Bluff	Grassland/ Savanna/ Herbaceous Bald	Forest/ Woodland	Wetland
Protection Island NWR					
Protection Island	x	x	x	x	
San Juan Islands NWR					
1. Small Island	x				
2. Two Unnamed Islands (Ram Ils.)	x		x	x	
3. Unnamed Island (Fortress Island)	x		x		
4. Unnamed Island (Skull Island)	x				
5. Unnamed Island (Crab Island)	x				
6. Boulder Island	x		x		
7. Davidson Rock	x				
8. Castle Island	x		x		
9. 3 unnamed islands	x		x		
10. Aleck Rocks	x		x		
11. Unnamed Island (Swirl Island)	x		x		
12. Unnamed Rock	x				
13. 4 Unnamed Islands	x		x		
14. 3 Unnamed Islands	x				
15. Hall Island	x		x		
16. Unnamed Island	x				
17. Secar Rock	x				
18. Unnamed Rock (Round Rocks)	x				
19. 3 unnamed islets	x		x		
20. 13 unnamed islands	x		x		
21. Mummy Rocks	x				
22. Islets and Rocks associated with Deadman Island	x				
23. Shark Reef	x				
24. Harbor Rock	x				
25. Unnamed Rock (North Pacific Rock)	x				
26. Half Tide Rocks	x				
27. 7 Unnamed islands	x				
28. Low Island	x				
29. Unnamed Island (Pole Island)	x		x		
30. Barren Island	x		x		
31. Battleship Island	x		x	x	
32. Unnamed Rock (Sentinel Rock)	x				
33. Center Reef	x				
34. Gull Reef	x				
35. Ripple Island	x		x	x	
36. Unnamed Reef (Shag Reef)	x				
37. Unnamed Island (Little Cactus Isl.)	x		x		
38. Gull Rock	x		x		
39. Flattop Island	x		x	x	
40. White Rocks	x		x		
41. Mouatt Reef	x				
42. Skipjack Island	x		x	x	

Refuge Unit	Shoreline	Sandy Bluff	Grassland/ Savanna/ Herbaceous Bald	Forest/ Woodland	Wetland
43. Unnamed Island	x				
44. Clements Reef	x				
45. Unnamed Island	x				
46. Parker Reef	x				
47. The Sisters	x		x		
48. Unnamed Island (Little Sister)	x		x		
49. Unnamed Islet	x				
50. Tift Rocks	x		x		
51. Unnamed Rock(s)	x				
52. Turn Rock	x				
53. Shag Rock	x				
54. Flower Island	x		x		
55. Willow Island	x		x	x	
56. Lawson Rock	x				
57. Pointer Island	x				
58. Black Rock	x				
59. 3 unnamed rocks (Spindle Rock)	x				
60. Brown Rock	x		x		
61. Unnamed Rock	x				
62. South Peapod Rock	x		x		
63. Peapod Rocks	x				
64. North Peapod Rock(s)	x		x		
65. Eliza Rock	x				
66. Viti Rocks	x		x		
68. Unnamed rock (Bird Rock)	x				
69. Unnamed Islands	x				
70. Low Island	x		x		
71. Unnamed (Nob Island Group)	x		x	x	
72. Unnamed Island	x		x		
73. Unnamed Island	x		x		
74. Unnamed rocks	x				
75. Smith Island	x	x	x		x
76. Minor Island	x				
77. Matia Island	x		x	x	x
78. Puffin Island	x		x	x	
79. Turn Island	x		x	x	
80. Four Bird Rocks	x				
81. Three Williamson Rocks	x		x		
82. Colville Island	x		x		
83. Buck Island	x		x		
84. Bare Island	x		x		

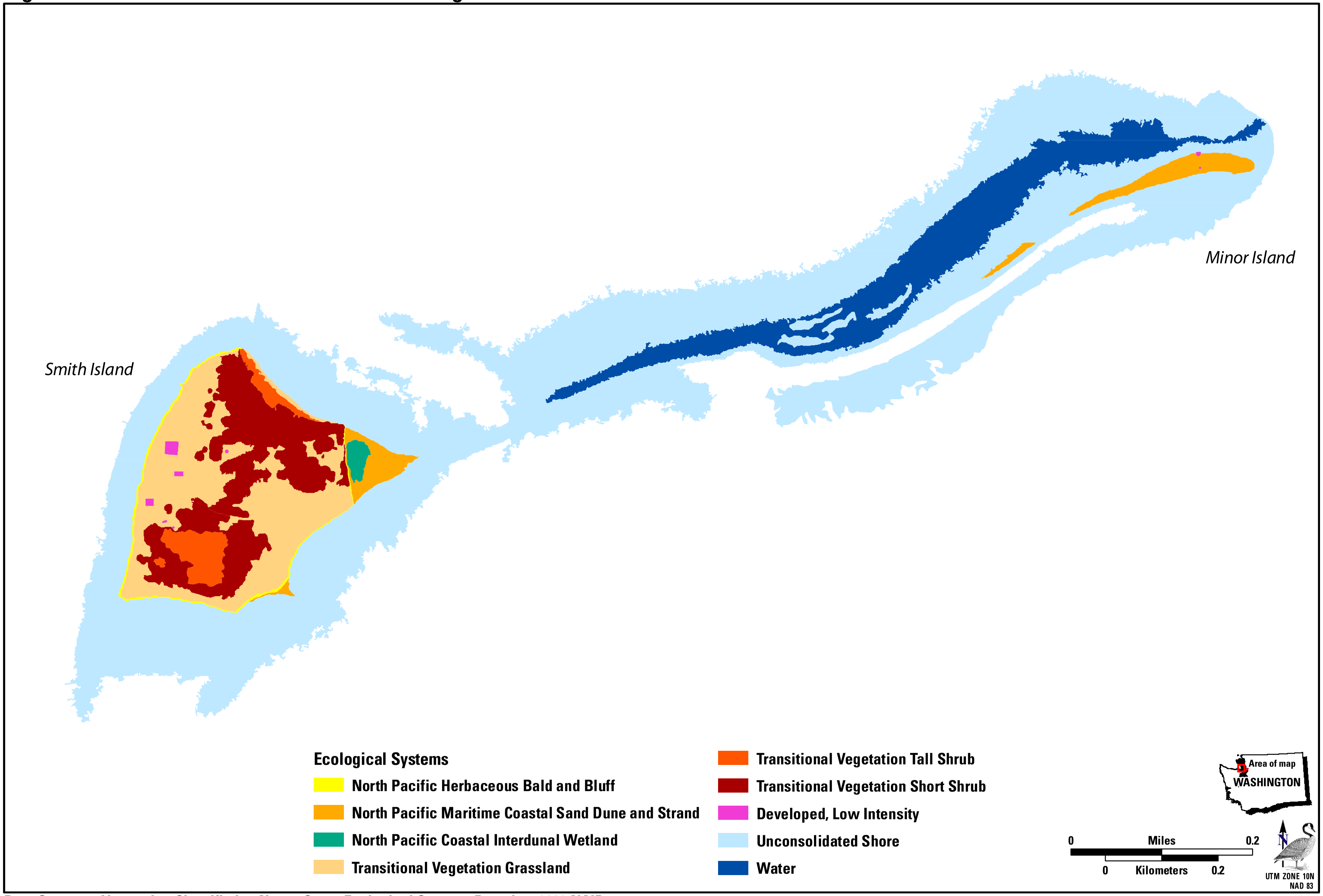
Figure 4.1 Protection Island Current Vegetation



Data Sources: Vegetation Classified to NatureServe Ecological Systems Based on 7/30/2003 WDOT True Color Aerial Photography

To preserve the quality of our map, this side was left blank intentionally.

Figure 4.2 Smith and Minor Islands Current Vegetation



Data Sources: Vegetation Classified to NatureServe Ecological Systems Based on 2006 NAIP

To preserve the quality of our map, this side was left blank intentionally.

4.3 Shoreline

4.3.1 Description and Location

This habitat type comprises sandy/gravelly (unconsolidated) shoreline, including spits, rocky (consolidated) shoreline, and associated rocky cliffs. Sandy/gravelly shoreline is defined by having substrata consisting of components smaller than cobble (10” diameter), including gravel, sand, mud, and organic materials (Dethier 1990). The North Pacific Maritime Coastal Sand Dune and Strand ecological system is associated with sandy/gravelly shoreline and spits. For more information, see Appendix C. Rocky shoreline is defined by having substrata composed of bedrock, boulders (rocks greater than 10” diameter that are large enough not to be rolled by moderate wave action), and/or hardpan. Steep, rocky cliffs can be associated with rocky shoreline and are generally devoid of vegetation with occasional wind sweep shrubs, succulents and grasses growing from fissures.

The amount of shoreline managed by the Service is roughly 4.7 miles at Protection Island and 34 miles in the San Juan Islands. Approximately 340 acres surrounding Protection Island from mean high tide to the mean low tide are managed by the Service under a WDNR aquatic lands lease. Additionally, the bedlands surrounding Protection Island extending to 600 feet beyond the extreme low tide line are withdrawn from “conflicting uses” for conservation purposes (WDNR 1988 Withdrawal Order 88 017).

Protection Island NWR
Sandy/gravelly shoreline comprises the entire perimeter around Protection Island. Kanem and Violet Point spits at the west and east ends of the island are formed by glacial deposits eroding from the high bluffs and transported by longshore currents. At the high water line, a backbone of driftwood helps to hold the sediment and provides beach nourishment.

The distribution of vegetation along the spits is affected by disturbance processes such as wave overwash during storm tidal surges, sand deposition, erosion, and lateral movement. Currently, on Violet Point, native species continue to dominate even when associated with introduced species such as European beach grass. Overall, Violet Point has higher native species richness and percent cover and lower introduced species richness and cover than the upland plateau (Cowles and Hayward 2008).

The tidelands surrounding Protection Island are considered intertidal mudflats. Since vascular plants are unable to persist due to the diurnal tidal flooding of salt or brackish water, algae are the dominant vegetation. Occasional small patch occurrences of eelgrass beds also border Protection Island (WDNR Nearshore Habitat Program 2001).

San Juan Islands NWR
Sandy/gravelly shoreline occurs in the San Juan Islands Refuge as either spits or isolated pocket beaches. Smith (#75) and Minor (#76) Islands, located in the eastern Strait of Juan de Fuca, are connected by a low spit that is covered at high tide. Small portions of the spit that are not frequently overwashed by tidal storm surges have vegetation communities associated with the dune and strand ecological system dominated by American dunegrass and other forbs adapted to salty dry conditions. Isolated pocket beaches contained by rocky headlands and consisting of sandy and/or gravelly shorelines exist on Turn (#79) and Matia (#77) Islands as well as many other small islands.

Rocky shoreline occurs extensively within the San Juan Islands Refuge as most of the islands are small rocky benches or outcrops that are sparsely vegetated, unvegetated, or tidally inundated reefs. Reefs are usually underwater at high tide and only support marine algae. The substrate is usually bedrock, sometimes in conjunction with boulders. On sparsely vegetated islands, lichens and mosses cover the bare rock within the backshore area and are occasionally joined by forbs that occur on small glacial outwashes that collect in rock crevices and depressions. Common herbaceous species adapted to the low moisture, intense wind, and salt spray experienced by these small rocky outcrops include sea plantain, lance-leaved stonecrop, and sea thrift (Atkinson and Sharpe 1993).

Cliffs with rocky ledges, outcroppings, and crevasses can be found on Castle (#8), Hall (#15), Battleship (#31), Flattop (#39), Skipjack (#42), Little Sister (#48), Willow (#55), South Peapod (#62), Viti Rocks (#66), Matia (#77), and Puffin (#78) Islands.

4.3.2 Associated Wildlife

Focal resources for this habitat type include the pelagic cormorant, double-crested cormorant, pigeon guillemot, glaucous-winged gull, black oystercatcher, and marine mammals. Detailed information on these species can be found in the Seabird, Marine Mammals, and Black Oystercatcher sections of this chapter.

Other benefiting species include the brant, harlequin duck, Brandt’s cormorant, black and ruddy turnstone, rock sandpiper, surfbird, dunlin, black-bellied plover and sanderling (migration and winter); wandering tattler and western sandpiper (migration); brown pelican (rare fall migrant); Heermann’s gull, and killdeer (breeding), and Caspian terns and peregrine falcon (breeding, though no known nests/eyries on refuges); great blue heron, river otter, herring, and sand lance (year-round).

4.3.3 Conditions and Trends

Prior to Euroamerican settlement, the condition of sandy/gravelly and rocky shorelines within the Salish Sea was primarily affected by natural processes and disturbances (i.e., accretion and erosion) and regional variations in geology, climate and precipitation, wave action, tidal range currents, and local sea level history. Currently, the condition of these shorelines is dramatically affected by human-caused modifications such as armoring and slope stabilization, groins and jetties, upland hydrologic changes, and fills. These modifications disrupt natural geomorphic processes, leading to altered accretion and erosion patterns.

Marine debris is a continuous source of pollution on the shorelines of both refuges. The only shoreline that is regularly cleaned is on Protection Island. The Smith Island shoreline is especially covered in marine debris. Creosote pilings that were used to build the docks on Protection and Matia Islands continue to leach contaminants into the shoreline sediment. In addition, some refuge shorelines have rogue creosote logs that have accumulated and continue to contaminate the sediment above the high tide.

Protection Island NWR
With the exception of the construction of a marina on Protection Island prior to refuge establishment, the refuge shorelines have not been directly modified. However, the disruption of geomorphic processes resulting from changes to off-refuge shorelines can indirectly affect the morphology of the refuge shorelines. Most of the shoreline showed little natural modification between 1956 and 1999 beyond what could be accounted for by differences in tides. However, exceptions include Kanem Point, which regressed 26 meters in length over this 43-year period due to erosion at the tip and narrowed slightly at the base below the bluffs. Violet Point increased from 915 to 957 meters in length and the wide beach that formerly spanned the region from the lagoon at the base of the Point north to the sea became vegetated due to filling and grading the area (Cowles and Hayward 2008). The marina was created by breaching Violet Spit and filling in the existing tidal wetland. The inner harbor shoreline lacks the amount of

woody debris and vegetation found on the spit shorelines. An extended user house was recently removed from the base of Violet Spit.

In addition to changes to the physical structure and stability of refuge shorelines, other recent anthropogenic impacts include altered vegetation communities and pollution. On Protection Island, European beach grass was planted by the 1920s to stabilize dunes. Other non-native species now found on the sand dunes, spits, and strand include grasses such as ripgut brome, common velvetgrass, Kentucky bluegrass, meadow barley, and orchard grass, and forbs including silver burweed and common sow thistle. However, now that agricultural and development activities on Protection Island have ceased, native species appear to be making at least a partial recovery (Cowles and Hayward 2008).

San Juan Islands NWR

The rate of erosion and subsequent supply of sediment on Smith Island continually affects the formation and maintenance of Minor Island. However, due to the resistance of the basalt bedrock and the lack of significant wave action, the other shorelines and rock cliffs within the San Juan Islands NWR have largely undergone negligible erosion and retreat.

Since refuge establishment, all shoreline habitats have been managed to minimize human-caused disturbance to nesting seabirds and other wildlife. Rocky cliffs are by their nature resistant to wave action erosion, however, projected sea level rise associated with climate change may reduce the quantity of this habitat in the future (Huppert et al. 2009).

4.3.4 Key Ecological Attributes

Table 4-2. Shoreline Ecological Attributes, Indicators, and Condition Parameters.

Key Ecological Attributes	Indicators	Desired Condition
Physical Structure and Stability	1. Presence/absence of human-caused alteration of longshore currents or sedimentation processes (PI only) 2. Abundance and density of driftwood	1. No structural interference of shoreline development on PI (exception of the marina) 2. Continuous expanses of driftwood
Plant Community Structure and Composition	1. Presence of native, sparse, short grasses on spit habitat 2. Ratio of native to invasive species on spit habitat 3. Presence/absence of rare plant species on cliff habitats	1. <30% cover and 3- 4 feet in height of native grasses 2. <25% of invasive species 3. Presence of brittle prickly pear cactus
Security and Human Impacts	1. Human activity on or near cliffs, rocky, and sandy/gravelly shorelines 2. Presence/absence of rabbits or mammalian predators 3. Presence/absence of marine debris or creosote-covered materials	1. No trespass on all closed shorelines and minimal boat disturbance within 200 yards of closed refuge islands and shorelines. 2. No rats, rabbits, red fox, feral or domestic pets; few to no other mammalian predators 3. No marine debris or creosote on shorelines

4.3.5 Threats

Threats facing the shorelines of Protection Island and the San Juan Islands refuges include climate change induced sea level rise, geologic events, invasive species, human intrusions and disturbance, and contaminants and marine debris.

Likely effects due to sea level rise and other climate-related factors include increased inundation, erosion, and overwash during storm events, leading to losses of shoreline habitats (Mote et al. 2008, Huppert et al. 2009). Additionally, climate-driven changes in ocean currents, sea temperatures, salinity, and the timing of resource availability have the potential to affect intertidal communities (Menge et al. 2008), eelgrass beds (Snover et al. 2005), seabirds, and marine mammals that use refuge shoreline and adjacent nearshore habitats.

Geologic events such as accretion and erosion affect the physical structure and stability of the refuge shorelines. Human-caused modifications such as armoring and slope stabilization, groins and jetties, upland hydrologic changes, and fills disrupt natural geomorphic processes, leading to altered accretion and erosion patterns which may degrade refuge shoreline habitat. Additionally, the presence of driftwood plays an essential role in maintaining the structure of refuge shorelines. Natural threats to the driftwood piles such as currents, decay, and fire in addition to human-caused threats such as collecting, moving, and illegal fires could also affect shoreline structure and stability. Fires, particularly, pose a serious threat as they have high potential to ignite vegetation and spread rapidly into adjacent habitats.

Non-native and invasive plant species threaten shoreline habitats by displacing the native sand dune, spit, and strand species, altering vegetation communities, and modifying ecosystem processes. Non-native and invasive plant and animal species directly compete with native species and often cause existing native species populations to decline or become extirpated.

Although the majority of the refuges' shorelines are closed to public access, human-caused disturbances and trespass still pose direct threats to seabirds and pinnipeds (refer to the Seabird, Black Oystercatcher, and Marine Mammal sections of this chapter for more information). Also, seabird nesting colonies and pinniped rookeries are extremely vulnerable to the effects of oil and other contaminants. Numerous oil tankers, cargo vessels, bulk carriers, and barges use the waters near the refuges as primary transportation routes. Any spill from these routes could potentially be devastating to populations of marine wildlife and habitat. In addition, non-point source oil tarballs, or slicks periodically wash up and impact wildlife. Non-point chronic sources may be products of vessels illegally pumping bilges, recreational outboard motors, and improper use of petroleum products in marinas (USFWS 2005).

4.4 Sandy Bluffs

4.4.1 Description and Location

Sandy bluffs are classified under the North Pacific Coastal Cliff and Bluff ecological system, which includes bluffs composed of glacial deposits (NatureServe 2009). Steep, eroding coastal bluffs are composed of a sequence of glacial and interglacial sedimentary units (Dragovich et al. 2005) with occasional sparse cover of forbs, grasses, lichens, and low shrubs. The area occupied by the sandy bluff habitat type within the Protection Island and San Juan Island Refuges has not been surveyed and is difficult to quantify.

Protection Island NWR
On Protection Island, bluffs completely surround the upland plateau. Large portions of the vegetated bluffs above Kanem and Violet Points are covered with non-native grasses including European beach grass, ripgut brome, and meadow barley. Occasionally codominant native grasses include Idaho fescue and red fescue. Yarrow and gumweed are typical native forbs while non-native forbs distributed in patches along the bluffs include hedge mustard, alfalfa, sow thistle, bull thistle, and field bindweed.

San Juan Islands NWR
On Smith Island, bluffs rise directly landward of the beach on the northwest, west, and southwest sides. Between the upland grassland and the unvegetated portion of the bluffs, the shallow soil on the steeply sloped areas supports some grasses and forbs.

4.4.2 Associated Wildlife

Focal resources associated with sandy bluffs include the rhinoceros auklet and tufted puffin. For more detailed information on these species, see the Seabird section in this chapter. Other benefiting species that use this habitat type include snowy owl (nonbreeding) and swallows and Canada goose (breeding).

4.4.3 Condition and Trends

Prior to Euroamerican settlement, the historic condition of the coastal bluffs on Protection Island NWR and Smith Island (within the San Juan Islands NWR) was largely driven by the natural, on-going process of erosion. The vegetated portions of the bluffs were likely dominated by native grasses such as Idaho fescue, California oatgrass, Lemmon's needlegrass, red fescue, and prairie junegrass and associated with a high diversity of forbs. Following Euroamerican settlement, practices associated with agriculture and development, including overgrazing, deforestation, and the introduction of non-native species (i.e., European beach grass), altered both the vegetative composition and erosional patterns of the islands.

Coastal bluff erosion is the result of numerous interacting variables including first-order factors such as climactic conditions and sea level rise and second-order factors such as geologic composition, surface and groundwater hydrology, and the relative rate of erosion at the bluff toe (Bray and Hooke 1997, Johannessen and MacLennan 2007). The cyclical process of bluff erosion is initiated when wave action removes material at the bluff toe creating an unstable bluff profile that eventually leads to landslides (mass-wasting) and the delivery of new material to the base of the slope (Emery and Kuhn 1982). Since Protection and Smith Islands both experience significant wave exposures along the Strait of Juan de Fuca, bluff erosion and recession rates are higher than at other less exposed areas of the Salish Sea.

Protection Island NWR
On Protection Island, early residents had reported rapid and extensive erosion of the northwest bluff (Cowles and Hayward 2008, Power 1976). This wasting may have resulted from unsustainable land uses, including overgrazing and deforestation. Since the 1950s, a slower rate of bluff erosion has occurred on the northwest margin where previous slide material was removed from the toe, leading to a steeper bluff profile. The northeast bluffs, which are nearly vertical and mainly bordered above by forest and woodland, showed little change. The southern bluffs, less steep and more protected from wave action, also showed little overall change (Cowles and Hayward 2008). During the 1800s, a road was built up the bluff overlooking Kanem Point. The road was used through the 1930s and has since eroded away, although some remnants can still be seen. During the 1960s, a dirt road was built at an angle up the bluff above Violet Point. Although still in use, it has already eroded away by half or more (Cowles and Hayward 2008). Otherwise, the overall physical structure of the vegetated portion of the bluffs overlooking both points has remained largely unchanged.

At a more localized scale, however, sheep overgrazing during the 1950s led to the formation of slide areas of loose soil and sand, which clearly adversely affected nesting seabirds (Richardson 1961). Since the early 1990s, black-tailed deer have been found on Protection Island. The abundance of deer steadily increased to approximately 80-100 animals by 2007/2008 and appears to have declined to about 70 in 2010 (P. Davis, pers. comm.). They have created deeply eroded pathways through the unstable slopes; caused auklet burrows to cave in; laid down on burrow entrances and thus effectively blocked adults from entering burrow to feed chicks; and caused disturbance to the gull colony on Violet Spit.

San Juan Islands NWR
At Smith Island, Keuler (1988) determined erosion rates of over 30 centimeters (11.8 inches) per year. The Smith Island lighthouse, built in 1858 about 200 feet away from the island's western edge, collapsed into the water in spring 1998 due to bluff erosion (Nelson 2009).

4.4.4 Key Ecological Attributes

Table 4-3. Sandy Bluff Ecological Attributes, Indicators, and Condition Parameters.

Key Ecological Attributes	Indicators	Desired Condition
Physical Structure and Stability	1. Presence/absence of human structures (roads, residences, etc.) 2. Degree of slope and friability of soil	1. No human structures 2. Stable slopes and suitable soils for seabirds to build burrows in restored areas
Plant Community Structure and Composition	1. Percentage of vegetative cover at the beginning of the rainy season 2. Presence/absence of invasive shrubs 3. Ratio of invasive to native plants	1. At least 50% vegetative cover 2. No invasive shrubs (Scotch broom) 3. <25% invasive plants
Security and Human Impacts	1. Presence/absence of human activity on or near bluffs 2. Presence/absence of deer, rabbits, and mammalian predators	1. Low human activity 2. No non-native rats, rabbits, red fox, feral or domestic pets on any refuge islands; no deer on Protection Island.

4.4.5 Threats

Threats facing the sandy bluffs of Protection Island and Smith Island (within the San Juan Islands NWR) include climate change, mass-wasting, invasive species, and human intrusions and disturbance.

Long-term climate change is expected to result locally in sea level rise, an increase in winter precipitation, and increased storm strength and frequency (Mote et al. 2008, Huppert et al. 2009). Among the key factors in bluff erosion are major storm events combined with high tides or elevated sea levels related to El Niño events (Shipman 2004). Storm events magnify the wave action on beaches and bluffs by increasing wave energy, wave height, and wind speed. Thus, sea level rise and the increase in storm severity and frequency will affect the future condition of the Protection and Smith Island bluffs by leading to larger and more frequent mass-wasting.

Introduced invasive plants (e.g., European beach grass, field bindweed) are a constant issue within the sandy bluff habitat. Many non-native species can directly outcompete native species by reducing light at the ground level and aggressively capturing water and nutrients. They also have the potential to alter ecosystem processes by producing nitrogen-enhanced litter, changing ground-level microclimates, altering fire regimes as a result of their flammability, enhancement of soil moisture deficits, and other characteristics.

Human intrusions, disturbance, and trespass within sandy bluff habitat have the potential to fragment, degrade, or destroy the habitat through trampling and erosion, cause tremendous disturbance to wildlife (refer to the Seabird section in this chapter for more information), and introduce invasive plant species into closed areas of the refuges.

4.5 Savanna, Grasslands, and Herbaceous Balds

4.5.1 Description and Location

Savanna, grasslands, and herbaceous balds are associated with dry sites in lowland and mid-montane western Washington and Oregon. Approximately 200 acres of Protection Island NWR and a total of 41 islands within the San Juan Islands NWR currently have these habitats. These areas can be categorized into 2 ecological systems: Willamette Valley Upland Prairie and Savanna and North Pacific Herbaceous Bald and Bluff (Natureserve 2009). The prairie and savanna system differs from herbaceous balds in the following respects:

- Prairies and savannas occur on relatively level terrain, primarily on deep, well-draining gravelly/sandy glacial outwash (Chappell and Crawford 1997, Crawford and Hall 1997, Chappell et al. 2001a, Natureserve 2009).
- Herbaceous balds typically occur in small patches on relatively shallow soils with an underlying restrictive layer of bedrock, and relatively dry topographic positions (e.g., on slopes) and can be intermixed with rock outcrops and fringed by areas of forest and woodland (Chappell et al. 2001a, Chappell et al. 2001b, Chappell 2006).

Protection Island NWR

On Protection Island, the Willamette Valley Upland Prairie and Savanna system is associated with the deep, coarse, well-draining Townsend series glacial outwash deposits constituting the majority of the undulating upland plateau. Currently, the prairie exists in a degraded state with rhizomatous exotic grasses dominating throughout the plateau (Cowles and Hayward 2008). Some native herbaceous component is still present in the least disturbed areas on the western and eastern fringes of the plateau.

The North Pacific Herbaceous Bald and Bluff system is found along the shallow soil, steep sloped, grassy areas on the southern or western aspects between the upland grassland and bluffs. While some native plants are still present, these areas are currently dominated by European beachgrass, meadow barley, alfalfa, and ripgut brome.

San Juan Islands NWR

Similar to Protection Island, the upland plateau of Smith Island is primarily composed of glaciomarine drift and till (Dragovich et al. 2005). These well-draining substrates support a degraded prairie interspersed with early successional deciduous-dominated forest and woodland. Non-native grasses (i.e., orchard grass, cheatgrass, and ripgut brome), forbs (i.e., Canada thistle, bull thistle, and field bindweed), and woody plants (i.e., Himalayan blackberry) are found throughout the island, particularly in or near heavily disturbed areas.

Most of the other islands in the refuge are small rocky benches or outcrops that are unvegetated, tidally inundated reefs or only sparsely vegetated. The North Pacific Herbaceous Bald and Bluff ecological system can be found on these sparsely vegetated islands where lichens and mosses cover the bare rock and are joined by grasses and forbs that occur on small glacial outwashes that collect in rock crevices and depressions. On larger islands, grassy balds are common on southern and western exposures. Matia Island, for example, has an extensive grassy bald lining its southern edge including areas with common camas and the white flowered death camas. Rocky outcrop species frequently mix with bald species. Also, scattered trees such as Garry oak, Pacific madrona, Rocky Mountain juniper and/or Douglas fir are present on Ram (#2), Boulder (#6), Castle (#8), Unnamed (#13), Battleship (#31), Ripple (#35), Flattop (#39), Skipjack (#42), Tift (#50), Flower (#54), Willow (#55), Nob (#71), and Unnamed (#73) islands in localized microsites that have greater late summer soil moisture. However, the majority of islands within the refuge are either too vulnerable to the erosion caused by wind and rain, too exposed, or too low in nutrient and moisture levels to support much more than lichens, mosses, and low, herbaceous vegetation.

4.5.2 Associated Wildlife

The following plants are considered focal resources for savanna, grasslands, and herbaceous balds due to high levels of conservation concern (e.g. Federal or state T&E listing): brittle prickly-pear cactus, golden paintbrush, California buttercup, and bear’s foot sanicle. All but golden paintbrush can be found on Refuge islands. Bennett (2007) has noted that Refuge islands within the San Juan Islands exhibit significantly greater species richness of native plants and less introduced species than adjacent islands. Osborne et al. (1998) reported that the brittle prickly-pear cactus, reputedly rare in Washington, occurs on Refuge lands, including Fortress (#3), Castle (#8), Aleck (#10), and Rum (#2). It has historically been found on Protection Island’s Violet spit. California buttercup on Aleck (#10) and Castle (#8), and Bear’s foot sanicle on Boulder (#6). Golden paintbrush is not known to occur on Refuge lands, however habitat is available (2005 SJI Floristic Survey Results, Refuge Files).

Other benefiting species include the northern harrier, American kestrel, savanna sparrow, purple martin, and shrews; Vancouver groundcone, camas , slender crazyweed, Alaska alkaligrass, black lily, white meconella, erect pygmy-weed, sharpfruited peppergrass and northern adder’s-tongue (DNR 2004b). The following rare butterflies are not known to occur on the refuges, however potential habitat is available, thus they are considered as other benefiting species for this plan: Taylor’s checkerspot, island marble, and valley silverspot, and plant host species for these butterflies: mustard, verbena, plantain, Viola adunca, and paintbrush.

4.5.3 Conditions and Trends

The predominant pre-Euroamerican settlement 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). Estimates of remaining prairie vary from 10% of the pre-settlement extent in south Puget Sound (Crawford and Hall 1997), to less than 5% (including savannas) in southwest British Columbia (Garry Oak Ecosystem Recovery Team cited in Sinclair et al. 2006). Currently, these places have been degraded, fragmented, and lost entirely in many areas. Losses of prairie and savanna were primarily due to fire suppression, invasive non-native species, grazing, and urban and agricultural conversion (Chappell and Crawford 1997).

Small areas of herbaceous balds can be found scattered throughout the San Juan Archipelago. On a regional scale, herbaceous balds cover a small portion of the total area. However, this habitat is particularly significant for the conservation of biodiversity since these small areas tend to have high plant species diversity and support plant species that typically do not occur elsewhere (Chappell 2006). Additionally, some rare or threatened animal species, such as the island marble butterfly, are limited to this type of habitat.

Protection Island NWR
Historically, the dominant vegetation on the upland plateau of Protection Island consisted of native perennial bunch grasses and abundant and diverse forbs (Menzies 1792 in Newcombe 1923, GLO 1858, Clark 1995). The “few clumps of trees” within the grassland referred to by Captain George Vancouver in 1792 were likely scattered deciduous and/or coniferous trees that formed a savanna-like structure in small patches (Lamb 1984, Clark 1995).

However, the history of Euroamerican settlement, which began in the mid-1800s, has resulted in significant changes in vegetation cover and floristics within the former grassland and savanna areas. Farming, grazing, dune stabilization, and then attempted development of the upland plateau led to the introduction of numerous exotic species. Cowles and Hayward (2008) found that only 41% of the non-woody grassland species found in transects that they surveyed were native. The least disturbed areas of the grassland had some thriving areas of native species; however, aggressive exotic species such has quackgrass in plowed areas, ripgut brome in former pastures, Canada thistle, and orchard grass continued to persist. In the most disturbed areas, several introduced species of grass had established themselves along with some forbs such as false dandelion, black medic, and sheep sorrel. European beach grass, a non-native, occurred near the bluffs over Violet Point; lichens were most evident on ground graded for the airstrip where much mineral earth was exposed. In the former plowed fields, introduced species including field bindweed, quackgrass, orchard grass, and Kentucky bluegrass still dominate. However, blue wild rye, a native species, was also widespread and covered substantial areas of former pasture. Copses of native snowberry and Nootka rose still could be found scattered throughout the grasslands in areas of low disturbance.

San Juan Islands NWR
In large part due to its relative isolation and the general limitations placed on recreational use and visitation, the grasslands and herbaceous balds on most of the refuge islands, except for Smith Island, have not been significantly impacted by human use. Natural processes are allowed to predominate without human intervention and successional vegetative changes occur naturally. Consequently, some of the refuge islands still harbor rare or special status flora including Vancouver groundcone, slender crazyweed, Alaska alkaligrass, California buttercup and bear’s foot sanicle (Dunwiddie and Giblin 2005). However, the herbaceous bald habitats on the northern edge of Turn Island and the southern edge of Matia Island have been adversely affected by recreational use. The proliferation of unofficial trails has led to the reduction of vegetation cover, increase of non-native species, and in some cases, the creation of bare ground and surface erosion.

On Smith Island, grassland formerly occupied the south and east ends of the upland plateau while woodland composed of low conifers and woody vegetation occupied the center, north, and west ends (Menzies 1792 in Newcombe 1923, Vancouver 1792 in Blumenthal 2004, USCS 1854). However, a lighthouse station was established in 1858 with additional facilities, including 3 residences, a watch shack, pump house, cistern, dock, and other utility buildings (Skiff 2009). The T-Sheet of area produced by the USC&GS in 1870 shows a road leading up from the spit on the east end of the island to the lighthouse had also been built (USC&GS 1870). The dwarf trees and low woody vegetation were largely cleared in order to afford a clear horizon in every direction and to open up areas that were fenced for cultivation (USCS 1869). The light house was staffed from 1858 until 1957 when it was abandoned due to erosion. A new lighthouse was established and it was automated in 1976 which decreased the amount of human activity on the island. However, several introduced species of grasses and forbs continue to persist and thrive throughout the grassland areas of the island.

4.5.4 Key Ecological Attributes

Table 4-4. Savanna, Grassland, and Herbaceous Bald Ecological Attributes, Indicators, and Condition Parameters.

Key Ecological Attributes	Indicators	Desired Condition
Disturbance Regimes	1. Areal extent, frequency, intensity, severity, and return interval of fire 2. Amount of fuel load	1. Every 3-5 years 2. Analysis not completed
Plant Community Structure and Composition	1. Proportion of shrub/tree cover 2. Proportion of native grasses 3. Ratio of native to non-native species 4. Presence/absence of butterfly host plants 5. Presence/absence of priority resource of concern plant species 6. Percent cover of invasive plants (Himalayan blackberry, Canada thistle, etc.) 7. Presence/absence of new noxious weed invaders (not currently present on these refuges)	1. <15-20% cover on PI; <30% on SJI 2. <50% cover of native grasses 3. <25% cover of non-native plant species 4. Larval and adult host plants established 5. One or more populations of priority resource of concern plant species 6. <10% cover of invasive plant species 7. No new noxious weeds
Security and Human Impacts	1. Presence/absence of human activity on or near grassland, savanna or herbaceous balds 2. Presence/absence of deer, rabbits, and mammalian predators	1. Low human activity 2. No non-native rats, rabbits, red fox, feral or domestic pets on any refuge islands; no deer on Protection Island.

4.5.5 Threats

Some of the threats to the savanna, grassland, and herbaceous bald communities on Protection Island and San Juan Islands refuges include climate change, the lack of fire, invasive species competition with native plants and animals, and recreational use. Additional threats faced by the grasslands and herbaceous balds of the San Juan Islands refuge potentially include overgrazing by native black-tailed deer, Canada goose, and European rabbits.

The warming trends within the Salish Sea leading to higher summer temperatures and anticipated minor precipitation increases (Mote and Salanthe 2009) will likely increase potential evapotranspiration, imposing water stress on native grassland and bald species. Increased stress on native grasses and forbs lowers productivity and decreases germination rates and seedling survival, making them more susceptible to invasion by invasive species. Additionally, warmer temperatures and summer drought may lead to an increased fire frequency and severity.

In pre-Euroamerican settlement times, fires were much more frequent and helped to maintain or expand the size of prairies and balds by killing small trees. In the absence of fire, trees show a tendency to invade, leading to conversion into forests and woodlands. The influence of fire in the development and maintenance of savanna, grassland, or bald communities likely was higher on larger islands such as Protection and Smith islands. Smaller islands probably had very little history of burning due to their size.

Currently, invasive species dominate the non-forested areas of the upland plateau on Protection Island.

Invasive grasses are also present on all of the San Juan Islands refuge islands. Invasive species can outcompete native species and result in decreased population levels and degraded habitats.

The severity of threat due to recreational use varies depending on the type of recreation and the severity. Historically on Protection Island, vehicular use (including aircraft) within grasslands and balds caused soil compaction, erosion, and facilitated the spread of invasive species. Trails and trampling created similar impacts. Currently, Protection Island is closed to the public, therefore no recreational activities occur. Limited vehicle use by staff, a life time user, and researchers have only a small impact on these habitat types. However, any forms of recreational use would likely adversely impact wildlife populations (See the Seabird section of this chapter).

Prior to the introductions of two large subspecies into the region, Canada geese were not common nesters in the San Juan Islands. Their abundance today, especially during the breeding season, may impact special status plants and plant communities due to grazing and may increase the dispersal of non-native plants (Dunwiddie 2007, pers. obs.). Further assessment and analysis of this threat is needed before management action can be taken.

4.6 Forest and Woodlands

4.6.1 Description and Location

Forests and woodlands currently occupy approximately 49 acres of Protection Island NWR and are found on 10 islands within the San Juan Islands NWR (see Table 4-1). These habitat types can be categorized into two ecological systems: North Pacific Dry Douglas-Fir (Madrone) Forest and Woodland and North Pacific Maritime Dry Mesic Douglas-fir-Western Hemlock Forest. A third ecological system, North Pacific Oak Woodland, could possibly have existed on a couple of islands within the San Juan Islands NWR during the pre-Euroamerican settlement period (pre-1880).

Forests are defined as stands with crowns overlapping (generally forming 60-100% cover) whereas woodlands feature open stands of trees with crowns not usually touching (generally forming 25-60% cover). The canopy tree cover of woodlands may be less than 25% in cases where it exceeds shrub, dwarf-shrub, forb, and nonvascular cover, respectively (Anderson et al. 1998).

Protection Island NWR
On Protection Island, North Pacific Dry Douglas-Fir (Madrone) Forest and Woodland occurs in two stands that occupy the northern edges of the prairie-dominated upland plateau. The forest stands provide a natural windbreak from the prevailing wind direction. Common trees occurring with the Douglas-fir are Pacific madrona, shore pine, grand fir, and Douglas maple. Red cedar and western hemlock are also present but not dominant. Scouler’s willow and Hooker’s willow occur in some areas as understory tree species.

San Juan Islands NWR
On Matia Island, the North Pacific Dry Douglas-Fir-(Madrone) Forest and Woodland system occurs in a mosaic with North Pacific Maritime Dry Mesic Douglas-fir-Western Hemlock forest, typically occupying upper slopes or ridgetops, steeper areas, or faces with southern to western aspects. Generally, this system is found adjacent to the herbaceous balds on the southern edge of the island. In contrast, the North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest system is found on north-facing slopes and in the protected interior valleys where cooler, humid, and low wind conditions occur. Old trees that predate Euroamerican settlement occur there as scattered individuals. These are primarily Douglas-fir, which is

the dominant tree across most of the island. Sites where moisture is high, such as in the central valleys, are co-dominated by western red cedar, Douglas-fir, and grand fir, with significant amounts of sword fern in the understory. Some of the cedars are up to six feet in diameter with 3-4 foot diameter individuals of both cedar and Douglas-fir not uncommon (Dunwiddie 2007b). Western hemlock, bigleaf maple, and red alder also occur in these areas. North-facing slopes are occupied by western red cedar and Douglas-fir with a diverse, yet generally sparse understory typically including salal. Fire scars are common on both the cedars and Douglas-fir.

On Turn Island, the North Pacific Dry Douglas-Fir-(Madrone) Forest and Woodland system covers almost the entire interior of the island with the exception of remnant North Pacific Oak Woodland communities centered around the 8-12 Garry oaks growing as scattered individuals on the southern, western, and north-northeastern shores of the island in association with Douglas-fir, Pacific madrone, and Rocky Mountain juniper. Most of the oaks are <18" in diameter and most appear to be relatively healthy with fairly full, vigorous crowns. In most areas, the canopy (especially of Douglas-firs) is not yet so dense as to be severely competing with the oaks, madrones, and junipers. The understory is typically comprised of low shrubs including snowberry and orange honeysuckle, grasses including blue wildrye, Alaska brome, Alaska oniongrass, and forbs such as Pacific sanicle, yerba buena, and sea blush (Dunwiddie 2007a).

The North Pacific Dry Douglas-Fir-(Madrone) Forest and Woodland system also occurs on larger islands such as Flattop (#39), Skipjack (#42), Willow (#55), Smith (#75), and Puffin (#78) Islands. Small patches of woodland also occur on the Ram Islands (#2) and Battleship Island (#31). Other refuge islands where Garry oaks grow include Ram (#2), Flattop (#39), the easternmost refuge island of the Nob Island Group (#71), and Unnamed (#73) Islands. However, the dominance and density of oaks is too little for those areas to be truly considered oak woodlands. Rather, they are more like herbaceous balds that support limited numbers of oak woodland species. Additionally, it is unlikely that lightning-caused fires were common on any of these smaller islands due to their size and relative lack of burnable fuels. If fires did occur, they probably burned with low intensity and were restricted only to those individual islands. Although there is evidence that Native Americans burned oak savannas and grasslands on some of the larger islands in the San Juan archipelago, there is no evidence of any cases on the refuge islands.

4.6.2 Associated Wildlife

Bald eagles are considered focal resources for these habitat types and more detailed information can be found in the Bald Eagle section of this chapter. Other benefiting species that use forests and woodlands include downy, hairy, and pileated woodpeckers, olive-sided flycatcher, American kestrel, great horned owl, and bats.

4.6.3 Condition and Trends

North Pacific Dry Douglas-Fir Forest and Woodland

Protection Island NWR

The current forested areas on Protection Island are smaller, more fragmented, and have more hardwoods and other early seral stage species compared to the pre-Euroamerican settlement time period (Cowles and Hayward 2008). In 1868, the forest and woodland area on Protection Island was approximately 120 acres. The acres of pre-settlement forest on Protection Island were probably slightly higher than that, since by 1868 some selective logging and agricultural activities had already occurred (USC&GS 1868, Power 1976). By the 1930s, the logging activities and conversion to agriculture had decreased the forested area to 81 acres. The large continuous forest on most of the north edge of the island became divided into two distinct forest stands separated by grassland with a few small patches of trees. The northwest grove consisted primarily of conifers while the northeast grove contained a mixture of conifers, deciduous trees, and shrubs (Einarsen 1945). Between 1944 and the 1950s, at least two major fires burned most of the uplands and both Kanem and Violet Points, including buildings and forested land (Power 1976, Clark 1995). Subsequent photos of the forested areas (Richardson 1961, Larsen 1982) show large numbers of snags mixed with shorter, healthy trees. Probably as a result of the fires, by 1956, the northwest grove had shrunk by 5% and the northeast grove by 10%, with small patches connecting the two groves absent (Cowles and Hayward 2008). The space between the two groves is now primarily composed of sand dunes and grassland. By 1974, roads had cut through both the northwest and northeast groves while the western end of the northeast grove was cleared and leveled for the airstrip. After refuge establishment in 1982, the airstrip and roads within the forest area were removed and the forest over-and understory began to recover. By 1999, the forested areas gradually expanded in range and closed over the roads built through them with the northwest grove recovering to roughly 82% of its 1930s area and the northeast grove 97% of its former extent. However, the composition of both forested areas contain a larger proportion of deciduous trees and shrubs which represents an earlier state of succession than the 1930s forest (Cowles and Hayward 2008).

The current forest stands are relatively healthy but the recruitment of tree saplings may be limited due to deer herbivory and/or competition with non-native species. Another important factor in the quantity of forested areas on Protection Island is erosion of adjacent bluffs. While the northeast bluff has showed little change between 1956 and 1999, the northwest bluffs have eroded and slumped considerably (Cowles and Hayward 2008).

San Juan Islands NWR

Overall, the dry Douglas-fir forest and woodland on Ram (#2), Battleship Island (#31), Skipjack (#42), Willow (#55), Puffin (#78), and Turn (#79) Islands appear to be relatively unaltered in extent from the late 1880s and 1890s (USC&GS 1888, USC&GS 1889, USC&GS 1894 a,b,c, USC&GS 1895a,b). [NOTE: There was no data available for Flattop Island (#39).] In 1892, a homesteader settled on Matia Island and cleared a small area near the southeast cove for a home, orchard, garden, and livestock (Oldham 2005). The clearing likely temporarily reduced the extents of both the dry Douglas-fir forest and woodland and the dry-mesic Douglas-fir-Western Hemlock forest. However, after roughly 30 years, the settler passed away and the clearing slowly reverted back to forest.

Overall, the forests and woodlands on Turn Island appear to be in good condition. The understory is generally intact, and consists primarily of native shrubs, grasses, and forbs under the oaks. However, in the immediate vicinity of the campsites, exotic grasses and weeds dominate and provide a striking contrast with the understory elsewhere on the island.

On Smith Island, woodland composed of low conifers (likely Douglas-fir) and shrubs formerly occupied the center, north, and west ends of the upland plateau (Menzies 1792 in Newcombe 1923, Vancouver 1792 in Blumenthal 2004, USCS 1854). However, with the establishment of a lighthouse station in 1858, the dwarf trees and low woody vegetation were largely cleared in order to afford a clear horizon in every direction and to open up areas that were fenced for cultivation (USCS 1869). With the decline in human activity on the island since 1976 when the lighthouse was automated, the woodland has somewhat expanded; however, the vegetation remains transitional as willows, oceanspray, snowberry, wild rose, and grasses still dominate while the Douglas-fir remain stressed and marginal. Around many of the structures invasive species, such as field bindweed, Canada thistle, and orchard grass, have become the dominant vegetation.

North Pacific Maritime Dry Mesic Douglas-fir-Western Hemlock

San Juan Islands NWR

Overall, the dry mesic Douglas-fir-Western Hemlock forest on Matia Island appears to be in good condition. The area cleared by the homesteader in the late 1800s and early 1900s has since filled back in. The fruit trees are still present though. Additionally, the understory has few invasive species – primarily a few holly trees, and a patch of English ivy near the eastern shore. Neither of these invasive species is abundant.

The old-growth stands on Matia Island are unique in the San Juan Islands. While there are other old-growth forests in the islands, they are few and far between, and primarily consist of Douglas-firs. What is remarkable about this stand is the size and abundance of red cedars. This species is considerably less common that Douglas-fir in the San Juans, and most large cedars have been logged many years ago in areas where they once existed.

North Pacific Oak Woodlands

Prior to Euroamerican settlement, oak woodlands were found throughout the Salish Sea in dry sites with shallow bedrock or deep, gravelly glacial outwash soils, and high growing season moisture stress (Natureserve 2009). The historical range of oak woodlands was also greatly affected by Native Americans who used low-severity fire, pruning, and knocking to favor oak savannas and woodlands over mixed conifer forests and to influence stand configuration and tree shape (Cole 1977, McCarthy 1993). However, the advent of Euroamerican settlement interrupted traditional forest management practices and further altered plant community dynamics by eliminating prescribed fires, introducing invasive plants, and overgrazing. As a result, areas with remnant oak woodlands commonly undergo successional changes that result in plant communities that diverge from a historic composition. These changes include an increase in conifers, the proliferation of a shrub understory, higher oak densities, and an increasing abundance of non-native annuals and perennials in the herbaceous understory (Hosten et al. 2006).

Consequently, throughout its range, this Garry oak dominated system is in precipitous decline. While it was historically much more abundant in the San Juan Islands Archipelago, it was never likely to be abundant on refuge islands. Currently, the presence of the North Pacific Oak Woodlands system within the refuge is essentially limited to the perimeter of Turn Island. It is likely however, that there once was a larger oak woodland on Turn Island and there may have been some full-size oak trees on other small but forested refuge islands that currently have only a few shrub-sized oaks. The primary factors responsible for oak stands being converted to conifer stands on refuge islands such as Turn Island are natural succession and fire suppression, which encouraged conifer growth. Elsewhere in the San Juan Archipelago some oak woodlands were undoubtedly lost to land development. On Turn Island, invasive species within the vicinity of the campsites, trail proliferation by the public, and grazing by deer all pose threats to the integrity of this habitat.

4.6.4 Key Ecological Attributes

Table 4-5. Forest and Woodland Ecological Attributes, Indicators, and Condition Parameters.

Key Ecological Attributes	Indicators	Desired Condition
Disturbance Regimes	1. Areal extent, frequency, intensity, severity, and return interval of fire 2. Rate of regeneration (saplings/acre)	1. Analysis not completed 2. Analysis not completed

Key Ecological Attributes	Indicators	Desired Condition
Plant Community Structure and Composition	1. Percentage of canopy cover of trees on PI (e.g., total canopy openness/closure and gap proportions) 2. Amount of snags and woody debris 3. Ratio of cover of native to non-native understory species 4. Presence/absence of late-seral or old growth stands 5. Percentage of invasive species cover 6. Presence/absence of new noxious weed invaders (not currently present on these refuges)	1. >25 canopy cover 2. Analysis not completed 3. >50% cover of native understory shrubs (ocean spray, Nootka rose, etc.) 4. Presence of > 200 year-old trees 5. <10% invasive species cover 6. No new noxious weeds
Connectivity	1. Presence/absence of shrub layer between forest patches	1. Gap between forest stands restored with shrubs to >50% shrub cover on PI
Security and Human Impacts	1. Presence/absence of human activity on or near forest and woodlands on Turn and Matia islands 2. Number of illegal fires on Turn and Matia 3. Presence/absence of human activity on or near forest and woodlands on PI and other closed islands 4. Presence/absence of deer, rats, rabbits, red fox, feral or domestic pets	1. Limited access to within campsites and designated trails 2. 100% use of liquid fuel camp stoves 3. Low human activity 4. No non-native rats, rabbits, red fox, feral cats or dogs on any refuge islands; no deer on Protection Island.

4.6.5 Threats

Threats facing the forests and woodlands of Protection Island and the San Juan Islands refuge include climate change, storm events, invasive species, insect or disease infestation, altered fire regime, herbivory, and human intrusions and disturbance.

For the forests and woodlands occurring on Protection Island and the San Juan Islands, the responses to climate change will vary according to regional and local topography, forest type, soil moisture, productivity rates, species distribution and competition, and disturbance regimes. However, based on the projected changes in the spatial and temporal patterns of temperature and precipitation associated with climate change, some general patterns can be described (adapted from Aldous et al. 2007):

- Species distributions are likely to change. Cool coniferous forests in the western part of the Pacific Northwest will contract and be replaced by mixed temperate forests over substantial areas (Mote et al. 2003). Douglas-fir appears relatively sensitive to low soil moisture, especially on drier sites (Case 2004; Hessl and Peterson 2004; Holman 2004 citations in UWCIG 2004).
- Increasing temperature will generally increase forest fire frequency and extent.
- Higher temperatures will increase rates of evapotranspiration, leading to greater water losses from forests.
- The change in seasonality of precipitation could lead to a drier growing season, increasing water stress.
- Warmer temperatures could lead to a change in the timing of reproduction, which may lead to asynchronies between flowering and pollinator activity, fruit ripening and foraging by fruit-

consumers, or predator behavior by pest-eating species.

- An increase in extreme weather events (e.g., wind storms) could change the frequency of disturbance, leading to a shift to forests that are younger and species that are more fast-growing, short-lived, and disturbance-tolerant.
- Warmer temperatures could increase development of insect and other pathogen outbreaks, as well as extend their growing season, potentially leading to an increase in the frequency and extent of outbreaks.
- Some tree species may experience an increase in productivity if carbon dioxide acts as a fertilizer and allows trees to increase their water use efficiency. However, this increased productivity, coupled with warmer temperatures, longer growing seasons, and prolonged drought, may also increase fire frequency and severity.

Introduced invasive plants (e.g., English ivy, holly, Scotch broom) pose a significant threat to the native forest and woodland communities on the refuges. By outcompeting native species, these invasive plant species can alter vegetation communities and modify ecosystem processes. Non-native animal species such as raccoons, feral cats, and rats may cause predation of and competition with native wildlife species utilizing the forest and woodland habitat. Additionally, some invasive insects (e.g., winter moth, jumping gall wasp, oak leaf phylloxeran, and gypsy moth) and other invasive pathogens have the potential to cause serious damage to Garry oaks and other tree species. Other potential insects or diseases that could affect the refuges' forests and woodland include aphids, scale and bark beetles, root rot, leaf cast, and other fungi. Sudden Oak Disease, caused by the fungus *Phytophthora ramorum,* has not yet been detected within Washington outside of nurseries; however, it should be considered a potentially significant threat.

Prior to Euroamerican settlement, oak woodlands were greatly affected by Native Americans who used low-severity prescribed burns to influence stand configuration and tree shape (Cole 1977, McCarthy 1993). Fire suppression within oak woodlands following Euroamerican settlement led to an increase in conifers, the proliferation of a shrub understory, higher oak densities, and an increasing abundance of non-native annuals and perennials in the herbaceous understory (Hosten et al. 2006). The continued lack of fire on Turn Island, the only refuge island containing remnant oak woodland, will likely lead to succession towards greater conifer dominance.

Due to lack of predation and hunting pressure, the population of black-tailed deer on Protection Island and within the San Juan Islands has also expanded to such densities that they are having an influence on vegetative cover. Typically, deer browsing helps to maintain herbaceous dominance by limiting sapling recruitment and retarding or delaying succession to forested habitats (Chappell 2006). However, deer browsing may impede the restoration of Protection Island's forest and on the San Juan Islands Refuge, researchers are concerned that excessive deer browsing is threatening oak woodlands (Dunwiddie 2007a).

Human-induced wildfire is a potential catastrophic threat to the late-successional and old-growth forest on Matia Island. Additionally, other illegal activities such as firewood collection, trail proliferation, and general trespass have the potential to cause tremendous disturbance to wildlife and also have the potential for introduction of invasive plant species into closed areas of the refuge.

4.7 Wetlands

4.7.1 Description and Location

Wetlands currently occupy a total of 0.9 acres on two islands within the San Juan Islands NWR. The wetlands currently occurring on refuge-managed lands can be categorized into two ecological systems:

Temperate Pacific Freshwater Emergent Marsh and North Pacific Coastal Interdunal Wetland.

Protection Island
Prior to development of the marina on Protection Island in the late 1960s, an 8.9 acre North Pacific Coastal Interdunal Wetland 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. However, the marsh was filled in and graded during the construction of the marina and no longer exists.

San Juan Islands
Matia Island is unique among the smaller of the San Juan Islands in that it includes a 0.4-acre Temperate Pacific Freshwater Emergent Marsh dominated by cattails and slough sedge. The areas of open water between the cattails and shore are partially covered by duckweed. Other than these species, there appear to be few others growing in the water or on the vegetation mat (Dunwiddie 2007b). The wetlands are surrounded primarily by tall red alder.

Smith Island contains a 0.5 acre North Pacific Coastal Interdunal Wetland on its eastern spit in a wind-scoured depression. Pickleweed and other salt-tolerant wetland species occurs along the perimeter of a small shallow swale that receives limited freshwater input from seeps coming down from the west in addition to direct precipitation. Consequently, 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 irregular, limited saltwater intrusion, especially during storm or overwash events. Vegetation has not been surveyed; however, a variety of emergent wetland species have been noted by staff.

4.7.2 Associated Wildlife

Since this habitat type consists of no more than approximately 1 acre, no focal resources have been selected for wetlands; maintaining biological integrity will be the focus for management. However, there are several other benefiting species associated with this habitat type including dunlin, northern pintail, mallard, Canada goose, great blue heron, amphibians, and bats. Black oystercatchers and glaucous-winged gulls nest in adjacent habitats and may use the wetlands on Smith and Protection islands during their lifecycle.

4.7.3 Conditions and Trends

Protection Island NWR

The wetland no longer exists on the island, however small pools of water do form after hard rains during the winter months.

San Juan Islands NWR
The freshwater emergent marsh on Matia Island seems to be unaltered and appears to be in good condition. The tidal wetland on Smith Island also seems to be in good condition, however staff are not sure if the natural hydrology of the area around the wetland has been altered.

4.7.4 Key Ecological Attributes

Table 4-6. Wetland Ecological Attributes, Indicators, and Condition Parameters.

Key Ecological Attributes	Indicators	Desired Condition
Hydrologic Regime and Water Quality	1. Water source, depth, annual cycle, temperature, pH, alkalinity, conductivity, dissolved oxygen, and phosphorous	1. Analysis not complete
Disturbance Regimes	1. Frequency, depth and duration of saltwater intrusion and flooding of Smith Island wetland	1. Analysis not complete
Plant Community Structure and Composition	1. Inventory plant community composition. 2. Proportion of native plant species 3. Presence/absence of trees and shrubs	1. Analysis not complete 2. Analysis not complete 3. Analysis not complete
Native Species Representation	1. Presence/absence of aquatic invasive animals and plants.	1. Analysis not complete
Security and Human Impacts	1. Presence/absence of human activity on or near wetlands. 2. Presence/absence of rats, rabbits, or mammalian predators.	1. Low human activity. 2. No non-native rats, rabbits, red fox, feral or domestic pets on any refuge islands

4.7.5 Threats

The amount of water and, consequently, duration of wetland on Matia Island varies with precipitation. Therefore, the wetland could be sensitive to climate change and altered precipitation patterns. Sea level rise could also threaten the current plant communities if the freshwater table is pushed upwards by salt water intrusion, leading to a higher salinity within the marsh.

The current plant communities of the Smith Island wetland may be threatened by climate change and sea level rise, which would likely increase the amount of tidal inundation and salt water intrusion. Also, any significant erosion of the low spit would likely damage or eliminate the wetland. In the event of sea level rise, additional threats from invasive species (e.g., European green crab and common cordgrass) could alter the present plant community.

4.8 Seabirds

Seabirds spend most of their time on the ocean and return to land only to reproduce and raise their young. There are six species of seabirds that commonly nest on the refuges and were selected as focal resources. They are rhinoceros auklet (RHAU), tufted puffin (TUPU), pigeon guillemot (PIGU), pelagic cormorant (PECO), double-crested cormorant (DCCO) and glaucous-winged gull (GWGU). Four of these species are emphasized in the refuge purposes for Protection Island NWR (Public Law 977-333), specifically: “The purposes of the refuge are to provide habitat…with particular emphasis on protecting the nesting habitat of…tufted puffin, rhinoceros auklet, pigeon guillemot and pelagic cormorant.”

A number of seabirds that may be seen in the vicinity of the refuges are not covered in detail in this plan because they do not nest on refuge islands. For instance, common murres (COMU) may be seen flying or swimming near the refuges during late summer through spring periods, but they are not known to nest on the refuges or anywhere else in the inner waters of Washington (Speich and Wahl 1989). They frequently forage in the waters surrounding refuge islands during the non-breeding season. Marbled murrelets (MAMU) nest in old growth forests on the Olympic Peninsula, Washington, and Vancouver Island, British Columbia, but have never been found to nest on small islands in the San Juan Archipelago (Raphael pers. comm. 2005). Brandt's cormorants (BRCO) are typically observed in the Salish Sea during the breeding season, but very rarely breed here, thus they have not been selected as focal resources.

4.8.1 Description and Location

Many of the seabird species that breed on the refuges are fairly site-faithful, returning to the same colony site year-after-year if successful in fledging young the previous breeding season. Seabirds have very specific nesting requirements, primarily habitat free of predators and human disturbance, particularly for ground or crevice nesting species, and with suitable soils for burrow nesting species (USFWS 2005). Protection Island and San Juan Islands NWRs provide some of the last remaining undeveloped seabird nesting habitat in the Salish Sea. The suitability of larger islands within the San Juan Archipelago for seabird nesting has been reduced due to habitat loss and threats associated with development and disturbance. Subsequently, the largest colonies and the vast majority of breeding seabirds are found on small (<40ha;100ac) islands on- and off-refuge (USFWS 2005). Protection Island is an exception as it is a relatively larger island that supports the third largest RHAU colony in North America and the single largest gull as well as one of the larger pigeon guillemot and double-crested cormorant colonies in the U.S. portion of the Salish Sea (Pearson et al. 2008, Roby et al. 2007, Cyra et al. 2007, J. Evenson pers. comm.). Protecting suitable seabird nesting habitat within these refuges is clearly a Service priority.

Rhinoceros Auklet
The breeding range of the rhinoceros auklet extends from the California coast northward around the Pacific Rim through the Aleutian Island to northern Japan (Speich and Wahl 1989). The majority of the birds that breed in North America (>95%) are located on islands in southeast Alaska (12%), British Columbia (73%) and Washington (13%), with most birds concentrated in 8 colonies (USFWS 2005). Two of the 8 key colonies are located in Washington: Destruction Island on the outer coast and Protection Island NWR in the Strait of Juan de Fuca (USFWS 2005). Smith Island within the San Juan Islands NWR also has a relatively small auklet colony.

Through the breeding season, rhinoceros auklets forage or raft up around Protection Island and within the Strait of Juan de Fuca. Wahl and Speich (1994) reported that approximately 59% of the birds within the Strait were observed in that area from June through July in 1978. An additional 29% were observed foraging near Admiralty Inlet to the east of the island. This data represents a snapshot of distribution within the Salish Sea and may vary based on distribution of forage fish. In addition, from early August through early September, fledglings can be found in the waters surrounding Protection Island. They typically remain close to shore for several days before dispersing (U. Wilson pers. comm.). Outside of the breeding season auklets disperse widely. The Service Seabird Conservation Plan notes that some birds move south during post-breeding dispersal to important wintering areas off the coast of California. A portion can be found within the Salish Sea during the nonbreeding season, in places like southern Puget Sound; however, their breeding origin is unknown (USFWS 2005). This species is typically observed at sea in mixed feeding flocks of seabirds and sea ducks (Gaston and Jones 1998).

Auklets are present on colony from March through late September. Egg laying is generally initiated in early May; hatching spans mid-June through mid-July and fledging follows through August (Wilson 1977, Richardson 1961).

Tufted Puffin

Tufted puffins breed from California around the Northern Pacific Rim to Japan. Approximately 0.8% of the global population of TUPU breeds in Washington (Piatt and Kitaysky 2002). Breeding in the inner marine waters of Washington is currently limited to Protection and Smith islands. Speich and Wahl (1989) reported low numbers "In the inland waters...at Protection Island, Smith Island, and at Colville and Bare Islands." The last recorded incident of TUPU nesting on Puffin Island was in 1963 with 7 individuals observed in the area during the breeding season but breeding status was not confirmed (Speich and Wahl 1989). In 1977, 6 TUPU were reported at Williamson Rock (Speich and Wahl 1989) and refuge staff observed 1 puffin flushed from Williamson Rock in 1985, but nesting status was not confirmed. Refuge staff reported 9 TUPU on Colville Island in 1983 and 5 in 1984. In 1984, staff observed a puffin flying into a burrow on Colville Island with fish. Recently, partners conducted a survey for TUPU on historical breeding islands in the San Juan Archipelago and reported no TUPU observed (S. Pearson pers. comm.).

TUPU arrive in April and are last observed in September. Egg laying through fledging spans from May through August (Piatt and Kitaysky 2002). This species winters off shore throughout the North Pacific.

Pigeon Guillemot

PIGU primarily nest in low abundance at many locations throughout the Salish Sea; however, they do concentrate at some sites such as Protection Island, where approximately 16% of the breeding population of the inner marine waters of Washington can be found each year (J. Evenson pers. comm.) This species nests on more than 1/3 of the islands in the San Juan Island NWR (Sanguinetti 2004). Refuge islands in the San Juan Archipelago with >200 PIGU include Castle, Flattop, Skipjack, Matia, and Williamson Rock.

This species can be seen throughout the Salish Sea year round, however it is unknown whether PIGU observed in the area during the nonbreeding season are the same individuals as those that breed here. PIGU can be found on the colony from April through September. Eggs are generally laid beginning in mid-May and fledgling runs through September (Speich and Wahl 1989).

Pelagic Cormorant

During the most recent comprehensive survey of the inner marine waters of Washington, three locations supported 75% of nests; all located off-refuge on unprotected properties. In the 1980s, the largest refuge colony, on Protection Island, ranged from 150 to 300 nests (Speich and Wahl 1989, K. Ryan, pers. comm). Historically, Bare, Castle, Colville, Protection, Smith, Viti, and Williamson islands have supported at least 100 nests each through the early 80s (Speich and Wahl 1989). During the 2003 survey, refuge islands supported 12% of nests. However, the number of nests observed did not exceed 65 on any San Juan Islands NWR islands (Nysewander 2003a). In 2009, refuge staff observed PECO on or near Barren Island, Bare Island, Bird Rocks, North Pacific Rock, Sentinel Rock, South Peapod, Unnamed Island (# 36), Smith Island, Williamson Rocks, Viti Rocks, and Protection Island; however, breeding status was only confirmed for Bird Rocks, Williamson Rocks, Viti Rocks, Smith Island and Protection Island.

PECO are on colony from April through October. Sensitive times include egg laying through fledgling which occurs from mid-May through September. They can be seen within the Salish Sea year-round.

Double-crested Cormorant

Similar to PECO, DCCO colony locations vary considerably. Historically, Colville, Williamson, and Bird Rocks have supported over 100 breeding birds, and Protection, Smith, Bare, and Viti have supported less than 50 (Speich and Wahl 1989). Results from surveys throughout the inner marine waters of

Washington in 2003 reveal that one location supported 67% of all nests observed in inner marine waters of Washington; however, this site is located off-refuge in a non-protected location. Five refuge islands (Smith, Protection, Viti, Williamson, and Hall) supported 33% (Nysewander 2003a). In 2009, refuge staff observed DCCO adults or nests on Bare Island, Bird Rocks, Barren Island, Crab Island, Gull Reef, Minor Island, North Pacific Rock, Smith Island, Small Island, Viti Rocks, and Williamson Rocks.

DCCO can be found on colony from late March through mid-November with egg laying through fledgling occurring from April through October. They are resident within the Puget Sound.

Glaucous-winged Gull
This species is found year-round throughout the Salish Sea. A comprehensive aerial survey of gulls throughout the Puget Sound in 2007 indicate that the largest GWGU colony with approximately 40% of gull nesting in the U.S. portion of the Salish Sea is located on Protection Island (Roby et al 2007, Cyra et al. 2007) Within the San Juan Archipelago, 7 refuge islands supported approximately 50% of gull colonies. They include Hall Island (11%), Smith Island (10%), Bird Rocks (9%), Viti Rocks (8%), Minor Island (5%), Williamson Rock (3%), and Pointer Island (3% Cyra et al. 2007).

4.8.2 Condition and Trends

A large portion of breeding seabirds in the Strait of Juan de Fuca and San Juan Archipelago nest on the refuges where they find relatively undisturbed habitat (J Evenson pers. comm., P Sanguinetti pers. comm.). However, extensive development and the resulting habitat loss and increased predation on larger islands in the Salish Sea (i.e., Whidbey and San Juan Islands) has lead to a decrease in the abundance of breeding seabirds on those islands. Further information on the conservation status of each species listed below can be found in Appendix C.

Rhinoceros Auklet

Approximately 66% of the estimated global population (1 million) breeds in North America (USFWS 2005). Because this species nests underground and is active on the colony primarily at night, determining trends in RHAU populations is logistically difficult. Table 4-7 shows the range of abundance on Protection Island (both on- and off-Refuge). It should be emphasized that this data represents the historical range of abundance of RHAU on the island only. Different methodologies, survey areas, and data analysis do not allow for a direct comparison of estimates, therefore the trend is unknown. The previous refuge biologist reported a noticeable decline in numbers on Protection Island after the Tenyo Maru oil spill in 1991 (K Ryan pers. comm. per Wilson). Currently, Protection and Smith islands support the only known RHAU colonies within the inner marine waters of Washington State.

Table 4-7. Range of Abundance of Breeding RHAU on Protection Island

Year surveyed	Estimated # RHAU	Source
1854	Colony present but no estimate provided	Speich and Wahl 1989
1956-1959	3000-4000 breeding pairs	Richardson 1961
1973	9,200 breeding pairs	Frazer 1973 in Speich and Wahl 1989 (Robel reported 12,50 br pr in 1973)
1976a	27,549 burrows 17,108 breeding pairs	Wilson 1977
1983	27,059 burrows	Thompson et al. 1985

1985	17,000 breeding pairs	USFWS 1985
2000	12,000 breeding pairs	Wilson unpublished data cited in Wilson 2005
2008	54,113 ± 9,390 burrows 35,715 ± 6,757 breeding pairs	Pearson et al. 2009

Number of burrows x 62% occupancy in 1976 = estimate of breeding pairs (Wilson 1977)

Breeding RHAU on Smith Island have not been counted since 1979 when the estimated abundance was 2,388 individuals (Speich and Wahl 1989). Refuge staff has reported a rough estimate of 1,500 burrows on Smith in 1984 using results from the San Juan Islands NWR Seabird Inventory. In 1983, burrows were observed on Bare Island, however surveyors were unable to verify whether they were active or occupied by RHAU or TUPU.

Tufted Puffin
The North American population estimate for TUPU is approximately 2,460,000 breeding birds (Piatt and Kitaysky 2002). Of that, approximately 1% breeds in USFWS Region 1. During the past 15 years, declines of 3-21% per year have been estimated for California, Oregon, and Washington (USFWS 2005). These trends may reflect a response to decadal changes in large scale ocean currents. Because the species nests in burrows that are difficult to access and breeding colonies are often located in inaccessible areas, current population estimates, and information on productivity is lacking (USFWS 2005).

Speich and Wahl (1989) estimate approximately 45 tufted puffins were located on Protection Island and 8 on Smith Island during the breeding season in the late 70s and early 80s. Galusha et al. (1987) reported approximately 50 puffins observed on or around Protection Island in 1984. Very little current information is available for this species, however incidental observations in 2008 account for approximately 37 birds on Protection Island and up to 34 birds on Smith Island (S Pearson pers. comm.). Breeding status was not determined, however some of the birds observed were exiting burrows near the top of the sandy bluffs of each island.

Pigeon Guillemot
The status of PIGU in the Salish Sea is unknown but some comparisons suggest that they may have experienced a moderate decline (Nysewander et al. 2001). The North American population estimate is 88,000 breeding birds (USFWS 2005). Confirmation of status is hindered by lack of comprehensive overall historic data collected throughout the Salish Sea with which to compare the 1999-2003 surveys. Recent surveys of PIGU in the inner marine waters of Washington State produce an estimate of 16,000 birds within 425 colonies (Evenson et al. 2002). The most current estimate of PIGU breeding on Protection Island is approximately 1,500 (J. Evenson pers comm.). This represents the second largest concentration of PIGU in the Salish Sea.

Pelagic Cormorant
The global population estimate is 400,000, with approximately 29,000 in Washington (USFWS 2005). Overall populations appear to be stable, however reproductive success declines during El Niño events (USFWS 2005). PECO colonies may move from year to year, particularly after years of colony or nest failure. This results in a high annual variation in abundance between years. Protection Island supports one of the largest colonies in the inner marine waters of Washington with the other three large colonies located off refuges. This colony supported 906 individuals (breeding status not confirmed) in 1984 (Galusha et al. 1987), however abundance has since declined and the colony has been abandoned in recent breeding seasons. The cause of abandonment is unknown; it may be due to predation, disturbance, or simply reflect a natural shift in colony sites. Protection Island is one of the few larger colony sites that

has some federal or state protective status associated with it.

Double-crested Cormorant
This species is expanding its range and abundance throughout the U.S. A recent survey of the U.S. Pacific Coast colonies in 2003, including the inner marine waters of Washington, reported an increase in abundance since 1991(25,600 pairs in 2003 vs. 12,200 pairs in 1991, USFWS 2005). Results from the surveys in 2003 show that sites supporting DCCO in high abundance are located off refuge where historically a large portion of the breeding birds in the Salish Sea nested on refuge islands. It is unknown if this reflects a population change or a shift in nesting outside of the survey area (Nysewander 2003a).

Glaucous-winged Gull
The North American breeding population size is approximately 380,000 breeding pairs (USFWS 2005). Protection Island and the San Juan Archipelago are located at the northern end of the Glaucous-winged Gull/Western Gull hybrid zone (Bell 1998). Because of the high degree of hybridization, developing population estimates for this species in the Salish Sea is difficult. In fact, surveyors participating in the comprehensive aerial survey in 2007 did not differentiate between the two species.

Historically large GWGU colonies including Buck Island, Colville Island, Gull Rock, Puffin Island, Skipjack Island, Sisters Islands, and White Rock have disappeared. It is unknown if this reflects a shift in the breeding population to urban areas or other factors, such as mammal predation, disturbance, or landfill remediation and closure in the past throughout the Salish Sea.

During the first 10 years of refuge establishment, the GWGU colony on Protection Island steadily increased, and then steadily decreased through 2006. During the 2005 breeding season an almost complete reproductive failure was reported on the largest colony, Violet Spit. This failure appeared to be in response to changes in vegetation and bald eagle predation (Galusha 2005). Researchers believe that this has caused the bulk of the gull colony on the spit to shift towards the bluff and marina where human presence may serve to reduce the abundance of eagles at any given time (J. Hayward and J Galusha pers. comm.).

4.8.3 Ecology

According to the Birds of North America species accounts, the breeding seabirds on these two refuges are relatively long-lived (up to 17 years) and begin breeding typically around their third year. Annual reproductive output is relatively low with RHAU, TUPU, PIGU laying 1 or 2 eggs, while GWGU, DCCO, and PECO will lay from 1-4 eggs (Ewins 1993, Gaston and Dechesne 1996, Hatch and Weseloh 1999, Piatt and Kitaysky 2002, Hobson 1997, Verbeek 1993). In addition, if disturbed, many of these species will abandon eggs or young, thereby further reducing reproductive output for the year. With such low clutch sizes and long life spans, adult survival is an important component of the status of each species.

Rhinoceros Auklet
Important characteristics for RHAU nesting habitat include soil, slope, elevation, and vegetation. They are further defined below:

Soils- Leschner (1976) noted that few generalizations about habitat preference can be made because of the variation in slope, substrate, vegetation, and weather conditions throughout the geographical range of the rhinoceros auklet. Nevertheless, the one common feature to all known rhinoceros auklet colonies is a well-developed soil into which they excavate burrows. Throughout their range and with few known exceptions, RHAU nest on islands with well-developed soils into which they dig burrows with their feet and beaks (Leschner 1976, Speich and Wahl 1989, Richardson 1961). On Protection Island, burrows averaged 2 to 2.4 meters with a range of 1 to 5.2 meters (Richardson 1961). A firm, sandy soil with some roots holding it together near the surface is preferred. RHAU burrows are often near the surface of the ground and can easily be collapsed (Sowls et al. 1980, Leschner 1976).

Slope- On both Protection and Smith Islands auklets do not burrow in the level open grass interior portion of the islands (Leschner 1976). This is primarily because the slope aids take-off. Birds burrowing on level areas must walk to the edge before departing (Leschner 1976). Richardson (1961) found burrows as far back as 100 to 200 yards back from the bluffs. Wilson and Manuwal (1986) found that burrow density was significantly correlated with angle of slope on Protection Island. From 1956-1959 the majority of the burrows were located on or just above the steep slopes (37 degrees to 45 degrees) of Protection Island, presumably to avoid trampling by domestic livestock (Richardson 1961). In 1975 and 1976 the colony expanded with 85% of burrows located on the more moderate southeastern and southwestern bluffs (Wilson and Manuwal 1986). In 1983 the colony was estimated to be approximately the same size as in the mid 1970s but there was another shift in density of burrows with higher densities on the gentler slopes than the bluffs (Thompson et al. 1985). The reason for this shift was unknown, however Thompson noted that two factors may be important: 1) over time, burrowing may deteriorate the soil and thus habitat in localized areas, and 2) the colony may be expanding into areas in which the soil has stabilized and vegetation regenerated after 70 years of overgrazing by sheep (Newcomb 1940, Richardson 1961, Wilson 1977). Whatever the case, this shift appears to have continued in 2008 (Pearson et al. 2009). In 2008, the largest extent of the colony was located on the south-facing slopes, although dense expanses of burrows are still located along the western bluff.

On Smith Island where moderate slopes are not available, most of the RHAU burrows are located in the flat grass-covered upper edge of the island, avoiding the very steep bluffs (Wilson and Manuwal 1986). Staff have noted that most burrows are located within the first 100 feet from the edge of the bluffs.

Elevation- On Protection Island, Richardson (1961) noted that auklets drop several feet when taking off from land and most burrows were located 30 feet or more above the level of the beach even where suitable nesting slopes extended to the bottom. Very few burrows were located as low as six feet above and 12 feet back from the mass of logs and flotsam marking the limit of highest water. Auklets leaving from these burrows scrambled through the flotsam to take off from the water. Auklets with burrows above the two wide spits did not tend to nest so low on the slope (Richardson 1961).

Vegetation- Vegetation primarily serves to stabilize the soil above-ground from erosion and root stabilizing the soil for burrowing activity. Range-wide, RHAU colonies can be found in many different habitat types under a variety of vegetative communities. On Protection and Smith islands, RHAU dig their burrows under dense grasses. Rhizomatous grasses with well developed root systems appear to provide the best stability for burrow construction on the island.

RHAU are wing-propelled, pursuit divers that typically forage in mixed flocks in waters greater than 20 meters deep (Wahl and Speich 1994). In the Salish Sea, their diet consists of small fish, such as herring and sandlance (Wilson and Manuwal 1988).

Tufted Puffin
The upper level of sandy bluffs on Protection and Smith Islands provide high quality nesting habitat for TUPU. This species digs burrows on Protection and Smith Islands and congregates in mixed foraging flocks on the water around the islands. TUPU are diurnal and feed on small fish, such as herring, salmon

smolt, smelt, and sandlance.

Pigeon Guillemot
PIGU will nest in a variety of habitats and forage close to land. On the rocky islands of the San Juan Archipelago, they nest in cavities and crevices. On Protection Island, the majority of guillemots nest in the driftwood on Kanem and Violet Spits, but they also dig burrows in sandy bluffs composed of clay, sand, or some combination. On Protection Island, these burrows tend to be near the top of the bluffs. This species feeds on small fish, such as blennies and sand lance. They often forage in small groups or pairs.

Pelagic Cormorant
Pelagic cormorants nest in small colonies on rocky ledges on steep cliffs. They also use human-created structures, such as channel buoys, which offer small cubbyholes or ledges. Some colonies are placed on larger, off-refuge islands, such as Henry Island near Roche Harbor, where ledges are completely inaccessible to humans. Cormorants are very sensitive to disturbance and will abandon the colony if disturbed during the breeding season. They are also sensitive to shifts in sea conditions, such as those that occur during El Niño events, and will abandon nesting if an adequate food supply is not available. PECO are typically solitary away from the colony and forage by diving for small fish along the rocky shore.

Double-crested Cormorant
On the refuges, DCCO build platform nests of sticks on rocky ledges, cliffs, and islands. Like PECO, DCCO will use human-created structures such as buoys, towers, and large signs. Although they build on the upland, the nests are placed so that the birds can easily access the surrounding water. Biologists believe that cormorants are laying later in the year and some colony locations have changed in response to eagle disturbance and predation (D. Nysewander pers. comm.). DCCO can be observed roosting on shorelines and shoreline pilings throughout the islands. They also dive for small fish among submerged rocks.

Glaucous-winged Gull
An invasion of non-native plant species (i.e., beach grass) has rendered sections of Violet Spit on Protection Island that once supported the highest abundance of gull nests as unsuitable. Closer to the marina, a remnant population of native plants remain that are associated with the strand assemblage with low vegetative density and ample open spaces between plants. Researchers have noted that gull nests located in or near dense vegetation are more susceptible to bald eagle depredation (80%) while those located in more open, strand habitats appear to be more successful (15%, J. Galusha, pers. comm.). This is due, in part, because the open space allows mobbing gulls better access to eagles that are on the ground.

In addition, research in other colonies has shown that a high degree of variability in topography (i.e., relatively small hillocks or divots in the sand or woody 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, such as 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). Components of strand communities that support successful gull productivity include: 1) sparse <30% grasses; 2) interspersed with gum weed and other natural forms of screening for nests such as driftwood. 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. Galusha, pers. comm.).

4.8.4 Key Ecological Attributes

Table 4-8. Seabird Ecological Attributes, Indicators, and Condition Parameters.

Key Ecological Attributes	Indicators	Desired Condition
Population Levels	1. # of breeding RHAU 2. # of breeding TUPU 3. # of breeding PIGU 4. # of breeding PECO 5. # of breeding DCCO 6. # of breeding GWGU	1. RHAU - maintain current population on PI 2. TUPU - reestablishment in SJs 3. PIGU - Increase 4. PECO - Increase 5. DCCO - Maintain 6. GWGU - Habitat management to maintain on the spits of PI
Clean Habitat	1. Presence of marine debris on shoreline and derelict gear in the water 2. Presence of creosote pilings and rogue logs 3. Presence of oil or other contaminants on shorelines	1. No marine debris on shoreline or derelict gear in waters 2. No creosote pilings on PI and Matia. No creosote rogue logs on Smith, PI, and other islands when observed 3. No oil or other contaminants on shorelines
Security and Human Impacts	1. Presence/absence of human activity on or near seabird breeding areas 2. Presence/absence of deer, rabbits or mammalian predators	1. Access limited to essential activities (research or management) 2. No non-native rats, rabbits, red fox, feral or domestic pets on any refuge islands; no deer on Protection Island

4.8.5 Threats

Because seabirds typically have a long life span and low productivity, threats that limit productivity and increase adult mortality are of the highest conservation concern. Known and potential threats to seabird populations include habitat degradation, climate change, disturbance and trampling, fisheries interactions, oil contamination, predation, and competition (USFWS 2005). Many of the threats below are linked. For instance, the larger islands within the inner marine waters of Washington, such as Whidbey and San Juan Islands, have been extensively developed leading to habitat alteration, higher threats of human disturbance, and introduced mammalian predators. These islands no longer support substantial seabird breeding colonies.

Habitat loss and degradation
Greater than 50% of the U.S. seabird population lives within 50 miles of the coastlines, and loss of habitat along the coast has been significant (USFWS 2005). Since 1889, approximately 70 percent of estuarine wetlands and 50 to 90 percent of riparian habitat throughout Washington have been lost. Habitat conversion, fragmentation, and degradation are pervasive threats throughout the Salish Sea and can compound the remaining threats below. For instance, removal of driftwood for fires or creation of driftwood structures degrades important nesting habitat for pigeon guillemot. Without abundant driftwood, chicks have less natural screens for use in camouflage from predators. Flight obstructions such as power lines and towers also deteriorate habitat quality, particularly for seabirds that access colonies at night. They can prove fatal to both fledglings and adults especially when placed on or near

colonies.

On Protection Island, black-tailed deer are impacting auklet habitat and directly and indirectly affecting RHAU. RHAU burrows are 1-5 m long, often near the surface of the ground, and are susceptible to collapsing. This may cause the egg or chick to be crushed or abandoned and this species rarely re-nests. As a result, disturbance or trampling of burrows can reduce reproductive success. Burrows collapsed by deer hoofs and deer bedding down in the colony, at times on top of the entrance to a burrow, have been observed by staff and researchers. In addition, deer have created deeply eroded pathways through the unstable slopes and are foraging in most of the suitable burrow nesting habitat. Cumulative impacts could negatively impact RHAU habitat on the island. This species of deer is native to the region, but with the recent high density of approximately 70 deer/0.5 mi^2, vegetative damage would be expected. Several studies in the literature have noted that the impacts of deer on vegetation and soil substrates increase substantially with an increase in the density of deer (Albon et al. 2007, Gillingham 2008).

Impacts to burrows from deer have only recently been noted by staff, however, historical instances of ungulate trampling have occurred on the island. In 1958, Richardson (1961) found trampling by domestic sheep on the island’s slopes led to the formation of many slide areas of loose sand and soil. Observations included unstable slopes and auklet burrows buried under slides or caved in by hoofs. During the 1958 and 1959 auklet breeding seasons, about 46% of the 76 burrows in the study area were buried by slides from trampling by sheep.

Human-caused Disturbance

Seabirds are very sensitive to disturbance during the nesting period (Speich and Wahl 1989). Cormorants are particularly susceptible to human disturbance during the nesting season and will desert eggs or young if disturbed. Disturbance can be caused by low-flying aircraft or boats approaching too closely to colony islands (Hatch and Weseloh, 1999). Studies of seabird colonies in California have revealed that most aircraft disturbance occurs when flyovers are less than 1,000 feet above sea level and boat disturbance occurred within 164 feet from shore and was most pronounced when boats remained in the area for extended periods (Rojek, et al. 2007). Boaters anchoring too closely to the islands, or those who have landed on an island and walked through a colony, have also caused colonies to fail. In fact, reports from biologists suggest that DCCO and PECO colonies on Viti Rocks have failed over the past several years. The cause of this failure possibly relates to bald eagle predation and harassment of breeding birds, but declines in forage fish stocks may also have played a role. Since this island is located near frequent boat traffic routes and rockfishing areas, biologists also suspect some degree of disturbance from recreational boating may have contributed to the failure (D. Nysewander, pers. comm.) In addition, on many of the navigational markers within the Salish Sea, GWGU and PECO nests are removed during maintenance.

Increased ecotourism and shoreline development within the Salish Sea create additional threats to breeding seabirds. TUPU are a favored species to see and ecotourism companies schedule cruises during the breeding season. With increasing human populations around the Salish Sea and ecotourism, boating is becoming an increasing source of disturbance. Fast boats are especially dangerous to alcids since the birds are slow to take to the wing and slow fliers. This is particularly of concern near Protection Island during the fledgling period when juvenile auklets are learning to fly and dive (U. Wilson, pers. comm.).

Climate Change

Habitat specialists, such as seabirds, face increased threats from climate change since they have a very restricted range during the breeding season. For instance, terns and gulls are vulnerable to loss of habitat and reproductive failure due to sea level raise and increased incidences of storm events because they typically nest on low-laying spits or sandy shorelines. Climate change will further exacerbate all of the threats listed in this section as they will likely be additive. Increased incidences of El Niño events, sea surface warming and ocean acidification, due in part to climate change, are already affecting seabird species by altering forage fish distribution (Walther et al. 2002, Wormworth and Mallon via climaterisk.net). Cormorants and alcids (e.g., guillemots) are expected to be highly susceptible to population declines due to a mismatch in life cycle events with prey as a result of climate change (Wormworth and Mallon via climaterisk.net). For instance, in 2005, seabird colonies failed along the west coast when a 2-month delay in northerly winds delayed coastal spring upwelling of nutrient rich waters. Delayed upwelling resulted in the lack of phytoplankton and subsequently a lack of fish foraging on the phytoplankton near seabird colonies. Without fish, a major prey species for seabirds, many seabird colonies failed along the Pacific coast (Wormworth and Mallon via climaterisk.net).

Environmental conditions in the Salish Sea are already changing with total annual temperatures increasing by 13% and annual inflow of freshwater from precipitation and snow melt decreasing. This change has lead to increased instances of harmful algal blooms and areas of low dissolved oxygen. This, in turn, will reduce plankton, the foundation of the food web in the Salish Sea (Snover et al. 2005). Reduced abundance of plankton will reduce forage fish for seabirds. Since seabirds, especially cormorants, will not nest or colonies will fail in years of low food resources, climate change has the potential to greatly reduce productivity and potentially adult survival of seabirds breeding on these refuges.

Fisheries interactions

Interactions with fisheries results in several different threats. Mortalities have been documented in Washington gillnet fisheries especially for RHAU and COMU, but PIGU and MAMU have also been affected (Thompson et al. 1998). Declines of RHAU on Protection Island are suspected to be caused, in part, by mortality in gill nets. Regulating the use of a visible mesh panel and eliminating dawn fishing has reduced bycatch in some fisheries and should be encouraged in all active gillnet fisheries in the Salish Sea (Melvin et al. 1999). Entanglement in derelict (lost or abandoned) gear or nets is increasingly becoming a problem in the Salish Sea. Cormorants appear to be most susceptible to this threat. During one study of 4 derelict nets in the Puget Sound, seabirds (88% of which were cormorants) were caught at a rate of 0.24 per day. At this rate, researchers calculated that each net could entangle approximately 7 seabirds per month. Compound that over the estimated 3,800 derelict nets distributed throughout the area and up to 26,600 seabirds per month could be lost to this threat (Natural Resource Consultants 2008). Additional threats include overfishing, which reduces prey species for seabirds, and disturbance from aquaculture fisheries off refuge islands, such as geoduck diving.

Oil contamination

There are 6 oil refineries in the Salish Sea and approximately 15 billion gallons of oil are moved through the area each year on over 1,000 tankers (WDOE 2009). Other sources of ‘oil’ pollution stem from diesel, gasoline, kerosene, lubricant, and various industrial oils that are just as toxic to wildlife but can occur at a much smaller scale (e.g., leaky bilges) and may not be properly tracked (USFWS 2005).

Species particularly at risk of contamination are those that roost, haul out, or feed in large flocks or rafts near shipping lanes and ports. Protection and Smith Island and many other important seabird nesting colonies in the San Juan Islands NWR (e.g., Williamson and Bird Rocks) are directly adjacent to the vessel traffic routes into the Salish Sea. Breeding RHAU, TUPU, PIGU and cormorants are highly vulnerable to oil spills because they tend to forage in large rafts near colony sites (Speich and Wahl 1989). In fact, RHAU was the second most common species killed in the Apex Houston oil spill off central California (Page et al 1990). Further, oiled birds that return to the nest can then transfer oil to eggs or chicks. Laboratory tests have shown that this significantly reduces hatching and fledgling success (Speich and Wahl 1989). The Nestucca (1988) and Tenyo Maru (1991) oil spills off the coast of Washington are considered as contributing factors to the decline in the common murre breeding population (USFWS 2005).

Predation

Predation targets both adult survival and productivity. This threat is especially prevalent on seabird colonies where seabirds nest in and on the ground and have not evolved a mechanism for predator avoidance. In fact, over 40% of island bird extinctions world-wide have been caused by introduced species (Courchamp et al. 2003). Potential introduction of cats, rats, raccoons, or other predators into Washington colonies is a primary concern (Speich and Wahl 1989). Raccoons have eliminated seabird colonies on two islands in B.C. and caused serious decline on two additional islands (Golumbia et al. 2008).

Avian predators are also of concern. Mortality has been documented at breeding colonies from bald eagles, peregrine falcons, and other avian predators (Harfenist and Ydenberg 1995, Thayer et al. 2000, Wilson and Manuwal 1986). Hayward and Henson (2008) observed both indirect and direct mortality of gulls due to eagle disturbance on Protection Island. As the population of eagles rebounds, incidences of seabird mortality may increase. Gulls in turn, prey on RHAU and BLOY chicks. Hayward (2004) noted dead RHAU fledglings in gull territories east of the marina and channel on Protection Island where they were killed and eaten by gulls.

Competition

Competition for food resources and nesting areas can have serious effects on reproductive success of seabirds. Some species compete for nesting space. For instance, rabbits will compete for burrows and can change vegetation at colony sites (Courchamp et al. 2003). Rabbits were introduced to San Juan Island and have drastically changed the vegetative community on the island. TUPU are less susceptible to competition with rabbits since their burrows are typically found within very steep bluffs or cliffs. However TUPU may decline at some locations as a result of reestablishment and recovery of RHAU since the two species compete for burrows (USFWS 2005). Other species compete with seabirds for food in the form of kleptoparasitism. Gulls and raptors are known to steal fish from seabirds returning to the colony to feed chicks (Gaston and Deschesne 1996, Speich and Wahl 1989). RHAU almost always enter and leave colonies at night when feeding chicks (Speich and Wahl 1989). This predominantly nocturnal behavior may have evolved as a means of reducing kleptoparasitism or simply to exploit different prey species (Wilson and Manuwal 1988). Wilson (1993) noted that the presence of gulls nesting near auklet burrows did not affect auklet burrow use, breeding success or egg-laying dates, however chick growth was slower than that of chicks in gull-free areas.

4.8.6 Information Gaps/Research Questions

Seabirds

- What additional limitations could climate change impose on breeding seabirds or what limitations will be exacerbated by climate change?
- Is there additional high quality seabird nesting habitat worth protecting through acquisition or easement?
- Is availability of forage fish a factor in the decline of seabirds? How far away do they forage? How good are the forage resources?
- Was establishment of Cherry Point oil refinery a factor in the disappearance of seabird colonies on islands in the northern portion of the archipelago (e.g., puffins on Puffin Island) or the crash of the herring fishery north of Lummi Island?
- Are there mammalian predators or herbivores impacting focal resources on any of the San Juan NWR islands?

Rhinoceros Auklet
- What is the current estimate of RHAU nesting on Smith Island?
- What the population trend of RHAU nesting on PI and Smith Island?
- Is it feasible to restore and establish other colonies of RHAU in the San Juans?
- Is the area of PI occupied by the RHAU colony shifting (using more of the upland) and if so, why?
- What is the best vegetation cover for RHAU nesting habitat?

Tufted Puffin
- What are the current estimates of TUPU nesting on the refuges?
- Is it feasible to restore and establish other colonies?

Pelagic and Double-crested Cormorants
- Why has caused the decrease in nesting of PECO and DCCO on PI?

Glaucous-winged Gull
- Why did the large GWGU colony stop nesting on Colville Island?

4.9 Bald Eagles

4.9.1 Description and Location

The enabling legislation for the development of the Protection Island Refuge lists the protection of nesting habitat for bald eagles as one of its establishing purposes. Thus, they have been selected as a focal resource for this CCP. Three nests and one breeding pair of eagles can be found on Protection Island, however many bald eagles forage or roost on the island. In fact, a peak count of 50 bald eagles was counted in one day during the breeding season of 2007 on Protection Island (Hayward and Henson 2008).

The following table shows current territory counts for San Juan, Island, and Jefferson counties as well as the number of refuge islands encompassed by eagle territories (J. Stofel pers. comm.). However, bald eagles use all the islands as perches or roosts.

Table 4-9. Bald eagle nesting territories that encompass refuge islands, by county.

County	County total	# Territories that encompass refuge islands
San Juan	122	8
Island	81	1
Jefferson	91	1

During the 2009 San Juan Island NWR Summer surveys, 57 bald eagles were observed on refuge islands throughout the San Juan Archipelago and another 19 were observed on Smith and Minor Islands.

Nest building begins in early January, egg laying and incubation runs from late January through May, hatching and rearing young from February through July, and young fledging from May through August (USFWS 2007). Abundance decreases shortly after the breeding season when breeding birds move north during the fall to feed on salmon runs in British Columbia and SE Alaska and return in January (WDFW 2001).

4.9.2 Condition and Trends

The bald eagle has undergone significant changes in population. Early 19th Century reports describe the bald eagle as common in the Pacific Northwest (Buehler 2000). By the mid-1900's, the bald eagle population was decimated by human persecution and pesticide contamination. In 1978, the species was listed as threatened throughout the contiguous United States under the Endangered Species Act of 1973. Legal protections under the current Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c) and Migratory Bird Treaty Act (16 U.S.C. 703-712) combined with the ban of DDT have led to a dramatic recovery of the bald eagle. In 2007, the bald eagle was removed from the Endangered Species List.

In Washington State, bald eagle occupied territories increased from about 100 in 1980 to about 650 in 1998 (WDFW 2001). There are approximately 700 resident pairs and abundance swells up to 4,000 during winter in the state (WDFW 2001). Since receiving protection under the Endangered Species Act and the Bald and Golden Eagle Protection Act, bald eagle abundance has increased in the San Juan Archipelago (R Milner pers. comm.). Abundance of this species also has increased on Protection Island with as many as 50 observed at one time (J. Hayward pers. comm.). As a result, predation by eagles has increased and may be limiting abundance of other native wildlife, including cormorants and gulls (Galusha et al. 2005). However, due to concerns for maintaining recovery levels and continued protection provided by the Bald and Golden Eagle Protection Act, no management actions will be taken against eagles.

4.9.3 Ecology

Bald eagles build nests in large trees or snags that can support nests that may weigh more than 1,000 pounds. However, on islands where trees are limited, they can place their nests on the ground. Eagles may build additional nests and alternate use between years. They exhibit strong nest site fidelity and will return yearly to the same nest locations.

Hayward (2005) found that the main prey species for bald eagles nesting on Protection Island are gull eggs and chicks as well as dead harbor seal pups and afterbirths.

4.9.4 Key Ecological Attributes

Table 4-10. Bald Eagle Ecological Attributes, Indicators, and Condition Parameters.

Key Ecological Attributes	Indicators	Desired Condition
Population Levels	1. # of occupied nests 2. # bald eagles observed using refuges	1. Have an occupied nest in each of the ten current territories 2. Maintain # of bald eagles using refuges maintain what?
Clean Habitat	1. Marine debris observed on refuge shorelines 2. # of oil or other pollutant spills 3. Creosote pilings and rogue logs on refuges	1. No marine debris observed on shorelines 2. No incidence of spills 3. No creosote pilings and creosote rogue logs on refuges

Key Ecological Attributes	Indicators	Desired Condition
Security and Human Impacts	1. # of incidents of trespass or other non-authorized, human-caused disturbance at nest sites 2. # of motorized and non-motorized craft within 330 feet of nest sites during breeding season 3. # of aircraft operating within 1,000 feet of a nest during breeding season 4. # of incidents of intentional harming or killing eagles	1. Eliminate non-authorized, human-caused disturbance to nest sites. Reduce need for Coast Guard emergency maintenance to signal towers during the breeding period 2. No watercraft within 330 feet of nest sites 3. No aircraft, except by refuge authorization, within 1,000 feet of a nests during breeding season 4. No incidents of harming or killing eagles

4.9.5 Threats

Bald eagles nesting or over-wintering in the Salish Sea face the same threats as seabirds. They include:

- Disturbance by human activities such as boats and low-flying aircraft approaching too closely to nests during critical time periods: courtship and nest building, egg laying, incubation and hatching.
- Decreased food supply brought on by changes in prey availability from over-harvesting or climate change; human development that reduces suitable feeding sites;
- Habitat loss, particularly around nest sites, through human-caused fires on refuge islands or increasing development on islands adjacent to refuge islands.
- Mortality or reduced production through contamination from catastrophic events such as oil spills or exposure to persistent sources of contaminants such as pesticides and creosote on pilings and rogue logs.
- Mortality or injury from entanglement in marine debris or derelict gear.
- Harassment or illegal take of eagles and their parts by uneducated public, disgruntled anglers, or others.

According to the National Bald Eagle Management Guidelines (USFWS 2007), buffer zones around a nest shall be maintained in the following ways to avoid disturbance:

- If the activity will be visible from the nest, maintain a buffer of 660 feet
- For activities not in sight of a nest, maintain a buffer of 330-660 feet depending upon the activity and whether there is a similar activity within 1 mile of the nest (e.g., an activity that the eagles have become accustomed to). For a more in-depth description of those threats, see the Seabird section in this chapter.

These guidelines will be followed on all refuges in order to avoid disturbance to eagles, a violation of the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act.

4.10 Black Oystercatchers

4.10.1 Description and Location

The Black Oystercatcher (BLOY) is a large shorebird that ranges from the Aleutian Islands to Baja California. The BLOY is a rocky intertidal obligate species that can be found in the Salish Sea year-round. During the last comprehensive survey of 95 islands in the inner marine waters of Washington in 2003, 40 islands within the San Juan Islands NWR supported approximately 80% of breeding pairs (Nysewander 2003b).

Wintering distribution and seasonal movements are poorly understood, however, birds breeding in the San Juan Archipelago appear to be resident. A tracking study to determine if breeding birds do remain on or near their territories year-round is currently underway in the San Juan Archipelago. During the winter months, BLOY tend to aggregate in groups of tens to hundreds. Winter flocks stay relatively close to their general breeding areas, and some individuals may maintain territories year-round (Nysewander 1977, Hartwick and Blaylock 1979).

4.10.2 Status and Trends

The global population is estimated at between 8,900 and 11,000 birds (median = 10,000; Morrison et al. 2006). This estimate, however, is based largely on observations from seabird surveys that do not specifically target black oystercatchers. These surveys are not optimal for detecting oystercatchers because they are focused on large seabird colonies, not the widely distributed islets and rocky intertidal areas where oystercatchers commonly occur. In addition, they are conducted later in the breeding season when oystercatchers are less vocal and visible. The population trends for BLOY in the inland marine waters appear to be stable (Salo 1975, Speich and Wahl 1989, Golumbia et al. 2009) at approximately 350–400 total individuals with at least 250 breeding birds (Tessler et al. 2007). BLOY nests on Protection Island have decreased from 13 to a low of 4 since Refuge establishment in the 1980s. This is believed to be due to an increase in glaucous-winged gulls and bald eagles (P. Sanguinetti, pers. comm.).

4.10.3 Ecology

Rocky islands, islets, and headlands are favored breeding habitats, although birds will occasionally nest on gravel beaches in Washington. There are several islands that support 2 or more nesting territories. With few exceptions, all of the refuge islands are within a breeding territory of a black oystercatcher pair and used for nesting, foraging, or both. BLOY favor rocky shorelines in areas of high tidal variation to forage. They forage exclusively on intertidal macroinvertebrates (e.g., limpets and mussels, Tessler et al. 2007). Because they are so dependent on marine shorelines, the black oystercatcher is considered a sensitive indicator of the health of the rocky intertidal community.

Highly territorial, breeding birds exhibit strong site fidelity to nesting sites. Typically three eggs are laid in May. Incubation ranges from 26-28 days, and nestlings are generally observed from mid-June through late July. Fledgling occurs approximately 40 days after hatching with chicks remaining in the adults' territory through as late as October. One brood is raised per season; however, when a clutch is lost, pairs can lay up to two replacement clutches, which tend to be smaller than initial clutches (Andres and Falxa 1995). Age of first reproduction is believed to be five years, and their life span ranges from 9-15 years (Andres and Falxa 1995). Once individuals reach breeding age, it is generally assumed that they attempt to breed every year.

4.10.4 Key Ecological Attributes

Table 4-11. Black Oystercatcher Ecological Attributes, Indicators, and Condition Parameters.

Key Ecological Attributes	Indicators	Desired Condition
Population Levels	1. # of refuge islands with nests 2. # of BLOY nests 3. # of BLOY observed foraging on islands	1. Maintain or slightly increase 2. Maintain or increase #s on smaller islands; increase nests on larger islands, such as Matia, Turn, and PI 3. Determine winter concentrations on refuge islands
Clean Habitat	1. Marine debris observed on refuge shorelines 2. # of oil or other contaminant spills 3. Creosote pilings and rogue logs on refuges	1. No marine debris observed on refuge shorelines 2. No incidence of spills 3. No creosote pilings and creosote rogue logs on refuges
Security and Human Impacts	1. # of incidents of trespass or other non-authorized, human-caused disturbance at nest sites 2. # of incidences of disturbance caused by boats approaching too closely to nest sites	1. Eliminate non-authorized, human-caused disturbance to nest sites 2. Minimal boat disturbance within 200 yards of closed refuge islands and shorelines

4.10.5 Threats

Black oystercatcher populations are ultimately regulated by the availability of nesting and foraging habitat and the quality habitat is more or less saturated at the moment (Tessler et al. 2007). Habitat quality in this sense depends in part on predation risk; some otherwise suitable habitat may remain unoccupied in areas exposed to high densities of avian or mammalian predators (i.e., main islands of the San Juan Archipelago).

Climate Change
Due to a restricted breeding range and habitat specialization, oystercatchers are highly vulnerable to climate change through habitat loss and/or changes in intertidal prey abundance or distribution. In addition, oystercatchers are vulnerable to reproductive failure due to nest flooding as a result of increased incidences of storm events because they typically nest on low-laying gravel beaches or rocky shorelines. Climate change may further exacerbate all of the threats listed in this section as they will become additive. For instance, the predicted increase in the severity and number of storm events caused by climate change may lead to an increased threat of a contaminant spill in the Salish Sea.

Contaminants
Oil spills such as the Exxon Valdez in 1989 can have immediate impacts on local black oystercatcher populations, and persisting contamination can slow recovery by depressing breeding efforts and chick survival (Andres 1997). Up to 20% of BLOY breeding in the area of the Exxon Valdez spill were killed by oiling (Andres and Falxa 1995). Oystercatchers and their prey may be at risk from low-level contamination by diesel fuel, gasoline, oil residues, and other contaminants along shorelines resulting from tankers or cargo ships expelling water from their ballast tanks and increased recreational activities (Tessler et al. 2007).

Predation and Competition
Predation is a primary cause of mortality to oystercatcher eggs and chicks (Tessler et al. 2007, Morse et al. 2006). In a study of productivity at four breeding areas in Alaska from 2003 to 2006, predation accounted for 48% of all egg losses where a cause could be positively identified. Because 27% of all egg losses were of unknown cause, egg depredation could be even higher. Small chicks are particularly vulnerable to predation during the first two weeks after hatching (Andres and Falxa 1995). Pinnipeds hauling out on land may also cause decreased reproductive success by crushing eggs and chicks and causing oystercatchers to leave nest sites during incubation or brooding periods (Warheit et al. 1984).

Human Disturbance
Growing pressure from recreational activities and development in and around breeding areas can negatively impact oystercatcher productivity. For instance, expanding use of the Salish Sea by commercial and private vessels may increase the probability that nests will be flooded by large wakes, especially when vessel traffic coincides with periods of the highest tides. Increasing human presence may directly impact oystercatcher productivity at the nest site through accidentally trampling nests and eggs, or indirectly affect them through interference with foraging, parental care, or causing nest abandonment. It is important to note that these threats are cumulative, since isolated incidences of low levels of recreation have been shown to have no effect on oystercatcher productivity in Kenai Fjords National Park (Morse et al. 2006). However, when taken as whole, increased incidences of human disturbance at the nest site combined with increases in nest flooding may decrease productivity and subsequent population growth of oystercatchers in the Salish Sea.

In addition, recreational uses of the Refuges can attract predators to campgrounds, picnic areas, and nearby shorelines in search of garbage. There are no oystercatchers nesting on Turn Island, despite the presence of suitable habitat. This may be the result of predation or because some of the best habitat for oystercatcher nesting is used as a landing area for the campground and accessible to dogs daily during the breeding season.

4.11 Marine Mammals

NOAA Fisheries and the Service share responsibility for implementing the Endangered Species Act (ESA) of 1973. NOAA Fisheries has jurisdiction over the four species of seals or pinnipeds that occur on the refuges (Steller and California sea lion, harbor and northern elephant seal) under the Marine Mammal Protection Act (MMPA) of 1972. However, the Service manages land these species use to pup, molt, or haul out. For this reason, four marine mammal species were selected as focal resources for this plan.

Although many species of marine mammals can be observed in the waters surrounding the refuge islands, four species regularly use the Refuge shorelines and rocks: harbor seals (*Phoca vitulina*), northern elephant seals (*Mirounga angustirostris*), California sea lions (*Zalophus californianus*), and Steller (Northern) sea lions (*Eumetopias jubatus*). Although all pinnipeds forage on fish, they must come to shore at various times to breed, have pups, or molt (shed hair and top layer of skin). Coming on shore is referred to as “hauling out” and a social group of seals on shore is often referred to as a “haulout.” Pinnipeds also haul out to sleep and conserve energy.

4.11.1 Description and Location

Harbor seal
The most abundant, widespread marine mammal on the refuges is the harbor seal. Protection Island and Smith/Minor Island both have large haulouts, often peaking above 500 seals. Refuge wildlife surveys

have documented harbor seals hauled out on most of the islands within the San Juan Islands NWR. The highest count of adult harbor seals (725 seals) was on Minor Island in 2009. Other islands with high counts of adult harbor seals (>200) included White Rock, Clements Reef, Puffin Island, the North Peapod, Unnamed (# 63, Peapod Rocks), South Peapod and Bare Islands. Harbor seal pups counts >35 were recorded on Flattop Island, Unnamed (#45), Lone Tree Island, Puffin Island, and Colville Island.

Harbor seals are present year round, but haul out in greatest numbers during their summer/fall pupping and molting season. Pupping season begins in mid-June, peaking from mid-July through August, with some pups born as late as the end of September (Calambokidis et al. 1978).

Elephant seal
A few elephant seals have been documented to breed and pup on Protection Island and Smith Island. Like harbor seals, elephant seals also use the refuge islands to breed and molt, but their seasons are very different. They can be found on Protection or Smith and Minor islands year-round. Breeding males arrive on Protection and Smith/Minor Island in November or December, with females following in December. Pups are born late December through January. Breeding occurs from January through early February. Adult females and juveniles molt from March through June. Adult males molt from May through September. Juveniles will haul out again from July through January (LeBoeuf and Laws 1994).

California sea lion
The inland waters of Washington State are a foraging area for California sea lions. They do not breed in Washington State and primarily are present from September to May. Only male California sea lions are observed in the Salish Sea. They tend to haul out on rocky shorelines in the Straits and can often be seen on refuge islands that serve as navigational markers.

Steller sea lion
Primarily coastal, Steller sea lions (or Northern sea lions) haul out in small numbers in the inner waters of Washington State. They have been observed hauled out within the San Juan Islands NWR on Peapod Rocks (#s 62-64), which are in Rosario Strait (Jeffries pers. comm.). Refuge staff have observed non-breeding Steller sea lions on Eliza Rock (#65) and Bird Rocks (#80) within the San Juan Islands NWR (Sanguinetti 2004).

4.11.2 Condition and Trends

Harbor Seal
Until 1960, Washington State managed population through a “bounty.” This species’ population was severely depleted until protected by the MMPA. The population for Washington is estimated at more than 35,000 (NOAA Fisheries 2004). Based on summer haulout counts, the population estimate for the San Juan Islands is 5,000 seals and the population for the Strait of Juan de Fuca is estimated at 2,000 seals (Jeffries et al. 2003). The Strait of Juan de Fuca and San Juan Islands harbor seal populations have reached “optimum sustainable population.” Population growth in the Strait of Juan de Fuca has slowed, but San Juan Island’s population may still be increasing (Jefferies et al. 2003). Research partners reported a large number (>60) of harbor seal pup deaths in 2005 on Smith and Minor Island, but did not indicate the causes of death.

Northern Elephant Seal
This species was almost extinct by 1900. However they have recovered and the species population is estimated at 150,000. Northern elephant seals are rapidly colonizing new areas in the Pacific Northwest (LeBoeuf and Laws 1994) and are reestablishing themselves in the Northern Puget Sound. In 1977, a molting tagged female was identified at Discovery Bay near Protection Island (Everitt et al. 1980), while

the first elephant seal to be observed on Protection Island was reported in 1989 and appeared to be in molt. The recent increase or reestablishment of their breeding range includes small colonies on Protection and Smith/Minor Islands. In 2004, a peak year for breeding, three pups were born on Protection Island. In 2006, 1 pup was born on Protection Island, but it died with the cause of death unknown.

California Sea Lion
The California sea lion population estimate for the west coast of the U.S. is roughly 167,000 to 188,000 (NOAA Fisheries 2004). In 1995, a peak count of 1,100 animals was reported for the Everett area (NOAA Fisheries 2004). No trend data available.

Steller Sea Lion
The Steller sea lion is listed as a threatened species under the ESA. The current population estimate for the eastern distinct population segment is between 46,000-58,000. Declines are due, in part, to decreasing fish stocks.

4.11.3 Ecology

Harbor Seals
This species exhibits strong site fidelity to their usual haulout locations during pupping and molting seasons (Suryan 1998). They use both rocky and sandy/gravely shorelines for haulouts. Haulout locations are vital to seals during molt and rearing of young. This species feeds primarily on fish including rockfish, cod, herring, flounder, and salmon (Eder 2002).

While harbor seals typically pup during the summer months, they can pup at any time of the year. Pups are born on land and can swim immediately, but they remain close to their mothers. The first hours after pupping are critical for the pup to imprint on the mother. Without proper imprinting, the mother will not recognize the pup if separated. Abandonment of pups was found to be the primary cause of pup mortality at Grays Harbor (Stein 1989).

During pupping, mother seals haulout for longer periods of time to care for their pups (Stein 1989, Watts 1991, Kroll 1993). Mothers with nursing pups can spend more than 90% of their time onshore (Huber et al. 2001 as reported in Jefferies et al. 2003). Mother-pup pairs usually segregate from main haulout groups (Kroll 1993).

Elephant Seals
Elephant seals spend the majority of their life cycle at sea and return to land only to breed, pup, and molt. They use sandy/gravely shorelines to haul out and are known for digging sand and flipping it over their backs to regulate their internal temperatures. The largest of the pinnipeds, the males weigh, on average, 4,000 lbs. in contrast to the average female’s 1,800 lbs. (Wynne 1992). The males are easily recognized by their distinctive proboscis (snout). Elephant seals feed on a variety of marine life including squid, octopus, and large fish (Eder 2002).

This species has a drastic molt where the upper layer of epidermis peels off in patches (Reidman 1990). Molting season is determined by gender and age. Elephant seals fast during their time at shore and conserve energy by lowering their metabolic rate. As a result, they spend most of their time sleeping and moving very little (Reidman 1990). Pups are very dependent on their mothers and are unable to swim until weaned at approximately 27 days (Reidman 1990). On Protection Island, elephant seals breed and pup on the shores and upland of Violet Spit. Pups on Minor Island have been lost to winter storms.

California Sea Lion
This species hauls out on rocky shorelines and navigational buoys or markers. Only non-breeding males are observed in the inner marine waters of Washington. California sea lions feed on a wide variety of fish, squid, and octopus; however, within the Puget Sound they consume several different species of salmon. They tend to mix with Steller sea lions and can be difficult to differentiate.

Steller Sea Lion
Steller sea lions use rocky shorelines and navigational buoys or markers to haul out. This species feeds opportunistically, often including octopus, squid, and a variety of fish (herring, rockfish, and greenling, Eder 2002). Steller sea lions mix with California sea lions and can be difficult to differentiate.

4.11.4 Key Ecological Attributes

Table 4-12. Marine Mammal Ecological Attributes, Indicators, and Condition Parameters. HASE=Harbor seal; ELSE=Elephant seal; CASE=California sea lion; STSE=Stellar sea lion

Key Ecological Attributes	Indicators	Desired Condition
Population Levels	1. # of seals using refuge 2. Count of HASE pups in summer survey 3. # of ELSE born 4. # of ELSE weaned	1. HASE - existing ELSE - increase CASE - existing STSE - increase 2. Maintain 3. Maximize 4. Maximize
Clean Habitat	1. Marine debris on shoreline 2. Creosote-covered logs, oil, or other contaminants on shorelines	1. Marine debris removed from the Salish Sea 2. Provide quality haulouts with no incidence of contamination or marine debris
Security and Human Impacts	1. Incidents of human-caused injury or mortality	1. Public is educated about lone pups and pups are left alone 2. Provide quality haulouts with no incidence of human-caused injury or mortality 3. Maintain low levels of disturbance on PI 4. Reduce disturbance incidences in the SJs

4.11.5 Threats

Although pinnipeds react differently to disturbance depending on their degree of previous experience, age, sex, location, and life cycle stage, they are all highly vulnerable to human-caused disturbance (Boren et al. 2003, Sanguinetti 2003, Hoover-Miller 1993). Seals and sea lions are popular ecotourism targets, which can multiply the disturbance instances in a day. Increasing ecotourism combined with an increasing human population and marine recreation in the Salish Sea pose a threat to stable and declining populations of pinnipeds in the area. Several studies have noted that pinnipeds have a disproportional, negative response to approaches by kayaks in contrast to other recreational vessels (Szaniszlo 2001, Grella et al. 2001) potentially due to a kayaks stealthy, low profile approach (Hoover-Miller et al. 2003).

Disturbance can interrupt nursing or cause pups to be separated from their mothers (Fisheries and Oceans Canada 2002). Also, well-meaningbut misinformed people will remove pups that have been temporarily left by their mothers. Persistent human-caused disturbance can reduce fitness or increase mortality, especially during molt or nursing. Seals and sea lions repeatedly forced into the water during these time periods expend more energy maintaining their body temperature and must then spend more time in the water foraging. Pups repeatedly forced into the water have less time to nurse, which decreases blubber production. This increases the potential for mortality once pups are weaned and must rely on stored energy in blubber to survive while learning to forage. Elephant seal pups are particularly at risk because they cannot swim until weaned. During this period, if the mother is disturbed and retreats to the water, the pup is vulnerable to predation. In addition, they are unable to retreat from natural or catastrophic disturbances such as fire or oil spills. Finally, all seal and sea lion pups are at risk of being crushed by adults stampeding to the water when disturbed at a haulout.

Fisheries interactions also pose direct and indirect threats to marine mammals. Seals and sea lions are susceptible to intentional killing or harassment by humans because of the marine mammals' perceived fishery impacts. Roughly 3-6 reports of dead sea lions are reported per year in the Puget Sound due to gunshot wounds. However, this number rose to 7 in 2007, including one threatened Steller sea lion (Rasmussen 2007). While each species forages on different fish, California sea lions pose a management challenge because they forage on salmon. Unfortunately, other pinnipeds in the area are persecuted in the mistaken assumption that they are also depleting commercially viable fisheries. Seals and sea lions in the Puget Sound are also killed in net fisheries and through entanglement in derelict gear (Natural Resource Consultants 2004). Seals have been observed with wounds and scarring from entanglement with derelict gear and interactions with aquaculture (net pen) operations. Over-fishing is a threat to pinnipeds to varying degrees depending on species and forage fish affected.

Pinnipeds are susceptible to catastrophic events, such as oil spills. Due to their restricted distribution within the Salish Sea, elephant seals are particularly susceptible to oil spills. In addition, persistent contaminants, such as PCBs and dioxin, accumulate in pinniped blubber and create elevated levels in inland harbor seals (Ross et al. 2004).

Additional threats to pinnipeds include an increased potential for inter-species transfer of diseases, such as canine distemper. This threat is particularly relevant on refuge islands which allow dogs access (i.e., Matia, Turn, and those close to the main islands in the archipelago). Climate change may produce several threats: exacerbating the threat of oil spills; loss of protected haulout habitat due to rising sea levels; increases in the severity and incidences of storm events; and changes in sea temperatures adversely affecting availability of food supply. Finally, rising ocean temperatures or El Niño events may increase the potential for bacterial infections.

4.11.6 Information Gaps

- Use of the San Juan Islands by Steller sea lions (abundance, distribution, phenology).
- Determine the number of elephant seal use days throughout year, especially on Smith Island. What is their survival rate and site fidelity to refuge islands?
- What are the migration patterns of the harbor seals? Are the Smith Island stocks more closely aligned to PI or to the San Juans? Do the seals move into the Georgia Strait in the winter? Or into the Hood Canal?

4.12 Herbivores and Predators of Management Concern

Herbivores and predators of management concern are defined in this document as native or non-native species whose expanding abundance or potential presence represents a threat to native wildlife or plants, especially breeding seabirds. There are several native and introduced species on refuge islands that pose a threat to healthy populations of our focal resources, their habitats, or native plant revegetation efforts. They include black-tailed deer, European rabbits, raccoons, mink, otter, Canada geese, and avian predators. Rats, red foxes, and feral or domestic pets are not known to exist on refuge islands; however, they pose a threat and therefore are addressed in this section.

Species found within island habitats are particularly vulnerable to extinction. Approximately 93% of bird species or subspecies that have become extinct since the 1800s were found on island habitats (Courchamp et al. 2003). A primary contributing factor to these losses has been the successful establishment of alien species. Native species, not typically found on islands, can have just as much of an impact on island nesting species as non-native species. This is due, in part, because many island nesting species have not developed defenses to avoid or life history traits to accommodate disturbance or predation. Further, non-native species introduced to seabird nesting islands may become prey to sustain native predators during the non-nesting season (Courchamp et al. 2003, Mills et al. 2005). In extreme cases, ecosystems have not recovered to historical conditions even after invasive or native species were removed (Ebbert & Byrd, 2002, Courchamp et al. 2003).

4.12.1 Black-tailed Deer

Black-tailed deer are abundant in Northwest Washington with a Washington Natural Heritage Program ranking of ‘demonstrably secure’ both globally and by state (WDNR 2009). They are native from the Cascade crest west toward the coast range. Throughout the state, deer occupy nearly all ecological zones, from alpine to valley and have adapted to varied climate regimes. Their average life span is five years and few deer live longer than ten years. In general, does breed in their first or second year and two fawns are common.

Historically, this species constituted the highest number of deer harvested in Washington State with an average annual harvest of about 14,000 individuals (WDFW 2008). According to models developed by WDFW, the black-tailed deer population estimate has nearly doubled over the last 5 years within WDFW’s Coastal Region (6), which includes the Olympic Peninsula (WDFW 2009). They occur in high numbers on the Quimper and Miller Peninsulas, the closest landmasses to Protection Island, and are capable of swimming approximately 1.5 miles from the tip of either peninsula to the island. Black-tailed deer use all habitat types present on Protection Island.

There are no historic records of black-tailed deer on Protection Island. From 1956-59, Richardson (1961) made 18 trips to the island and reported that the only native mammals on the island were Townsend chipmunk and a shrew. In addition, the Protection Island Master Plan (USFWS 1985) makes no mention of deer in the species list. Three adult deer were first observed on the island in 1991 (Hayward 2008). Due to a high reproductive rate and lack of natural predators on Protection Island, this number has increased to a high estimate of 100 deer in 2008/2009 (J. Hayward pers. comm.). Current estimates are approximately 70 deer (P Davis pers. comm.). With approximately 360 acres (0.562 mi^2) on the island, that abundance is equivalent to 124 deer/mi^2,which is considered a very high density (A. Clark pers. comm.). According to ungulate biologists, 10-30 deer/mi^2 is considered normal along the Columbia River of Washington. No hunting has been allowed on the Refuge since designation and there are no natural predators (e.g., mountain lion, bear,and coyotes). In the absence of hunting and predators, population growth is limited only by habitat capacity. Refuge staff have also observed black-tailed deer on refuge islands in the San Juan Archipelago. For more information on the effects of deer under current management, see Chapter 6.

4.12.2 European Rabbits

Rabbits are one of the fastest colonizing mammals in the world, primarily because of their high reproductive rate (Hall and Gill 2005). European rabbits do occur on the larger islands within the San Juan Archipelago; however, the sign of rabbits on a refuge island has been of rabbit pellets observed on Nob Island within the San Juan Islands NWR (Murphy pers. comm.).

4.12.3 Canada Geese

The abundance of Canada geese within the San Juan Archipelago has increased over the years and limited effects of trampling and introducing non-native plant species to refuge islands have been noted (Bennett 2007). However, little information exists to assess the extent of their effect on all refuge islands, and management may not be warranted given the potential to damage fragile plant communities. Increased presence of refuge staff on the islands for other management actions will provide opportunities to monitor goose abundance and assess impacts to native vegetation.

4.12.4 Mammalian Predators

Non-native mammalian predators in this area include rats, red fox, dogs, and cats. 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). They can be found primarily on the larger, developed islands of the San Juan Archipelago and are non-native; however, they have not been reported on refuge islands. Rats have not been observed on Protection Island either, but they could potentially colonize the island via a ship wreck or by accessing the island on authorized or unauthorized vessels. Red fox are non-native west of the Cascades in Washington and were introduced on San Juan Island in the early and mid-20th century (Aubry 1984, R. Milner pers. comm., WA GAP). There have been no reports of red fox on refuge islands, although fox are occasionally reported on San Juan Island. Dogs and feral and domestic cats are not native in the Salish Sea. Dogs have been allowed on two refuge islands that support camping (Turn and Matia islands), but feral and domestic cats are not known to occur on refuge islands.

Native mammalian predators include raccoons, river otters, and mink. Raccoons can be found on islands within the San Juan Archipelago, but they have not been observed on Protection Island. River otters have been observed on both refuges, and mink have been noted on islands within San Juan Islands NWR. Both species are native to this area, however, there are reports of mink introductions to the San Juan Archipelago in the early 20th century for fur farming (R. Milner pers. comm.). Due to the close proximity of islands within the San Juan Archipelago, these species could be virtually ubiquitous to the islands.

4.12.5 Avian Predators

Native avian predators include crows, ravens, gulls, and bald eagles. These species occur throughout the Salish Sea. No management actions have been identified for control of avian predation and limited information is available on the effects of native avian predators on the refuges.

4.13 Paleontological Resources

4.13.1 Geological Background

During the late Jurassic and early Cretaceous periods, numerous blocks of exotic terranes were added to the western edge of the North American continent to form Washington, British Columbia, and Oregon. These terranes consist mostly of rock sequences that formed far from their current location. They include volcanic island rocks and fossiliferous marine sediments that originated elsewhere in the Pacific Ocean. Jurassic and Cretaceous fossils from these rock sequences occur in the north-central and northwestern part of Washington.

Marine fossiliferous sandstone and siltstone of Cenozoic age cover most of Washington west of the Cascades Mountains. The Olympic Mountains consist of marine sedimentary rocks uplifted about 10 million years ago. The Cascade volcanic chain began to form in the mid-Cenozoic and has been active ever since. During the late Cenozoic, the Cordilleran Ice Sheet covered the northern third of the state and alpine glaciers covered the higher elevations of the Cascade and Olympic Mountains.

A variety of rock units ranging in age from early Paleozoic to late Cretaceous are exposed in the San Juan archipelago. These rock units are separated by faults and fault zones. The San Juan faults are part of a broader fault system that extends 80 km eastward into the North Cascade Mountains.

The landscape of the Puget Lowland and Juan de Fuca Strait is largely the product of repeated glaciations by the Cordilleran Ice Sheet during the Pleistocene Epoch (~ 2 million years ago to ~11,000 years ago). Dated samples of wood, peat, and shell from southern British Columbia and northern Washington provide age control on the growth and decay of this sector of the Cordilleran Ice Sheet during the last (Fraser) glaciation (Clague and James, 2002). Starting about 22,000 years ago, the ice sheet first started to form in the Coast Mountains and on Vancouver Island of British Columbia, but did not extend south of the international border. This advance was followed by a period of climatic amelioration and glacier retreat about 19,000 to 18,000 years ago (Hicock et al, 1982). Shortly after 18,000 years ago, the Cordilleran Ice Sheet started to advance again. After passing Vancouver Island, it advanced southward as two lobes. At its maximum extent 14,500 years ago, the Puget Lobe filled the Puget Lowland, where it was nearly 1000 m thick over Seattle, and its southern edge extended south to its maximum position near present-day Olympia (Thorson, 1980). At about the same time, the Juan de Fuca lobe moved westward along the Strait of Juan de Fuca, where the ice sheet covered southern Vancouver Island, filled the Strait of Juan de Fuca, and rose against the Olympic Mountains to an elevation of 840 m. Retreat of both lobes began shortly after 14,500 yr BP, and by 12,000 yr BP the northeastern Olympic Peninsula and northern Puget Lowland were ice free.

4.13.2 Paleontological Resources

Paleontological resources, also known as fossils, are the remains or traces of prehistoric plant and animal life that are found in the geologic formations in which they were originally buried, typically within units of limestone, sandstone, mudstone, and shale. Paleontological resources are considered to be nonrenewable and sensitive scientific and educational resources.

The major laws protecting paleontological resources on Service lands are the National Environmental Policy Act of 1969 (NEPA), the Paleontological Resources Preservation Act of 2009 (PRPA), and various sections of Service regulations.

Fossil record in Northwest Washington

Because of their large size and taphonomic durability, mastodon and mammoth remains (mostly molars) are the most commonly reported Pleistocene vertebrate fossils in Washington (Barton, 1998). Unlike mastodons, which were not elephants, mammoths (genus *Mammuthus*) were large specialized elephants that were common during the Pleistocene epoch. This genus first evolved in the early Pliocene (4.0 to 5.0 Ma) of Africa, and by the early Pleistocene (ca. 1.7 Ma), mammoths had spread throughout Asia and into North America (Shoshani and Tassy, 1996; Webb et al., 1989; in Barton, 1998). Mammoths were obligate herbivores with a dietary preference for grasses and sedges, herbs, and meadow-bog mosses, ferns and aquatic plants.

In western Washington, mammoth finds are heavily concentrated in the central and northern Puget Lowland. The earliest mammoth finds recovered from western Washington were discovered at Scatchet Head on Whidbey Island (located 45 km southeast of Protection Island) around 1860, but these were destroyed in the San Francisco earthquake and firestorm of 1906 before they could be identified to species level (Lawson 1874, in Barton 1998). Another specimen from the same locality was recovered in the 1880s and is currently part of the University of California Berkeley paleontology collections. This specimen is clearly from a Columbian mammoth. Of two species of mammoth found in Washington (*M.imperator* and *M. columbi*), Barton (1998) states that the Columbian mammoths are by far the most common. Of 31 previously reported finds that could be analyzed to species level in the Puget Lowland, 27 proved to be from Columbian mammoths (Barton, 1992). The Columbian mammoth formally became the Washington state fossil in 1998.

Protection Island

A search of the paleontology online collection at Burke Museum of Natural History and Culture was completed in May 2009. The records search identified five specimens (B2424, B2436, B2448, B2451, B2452) that were collected from Protection Island, but specific location is unknown. These resources are all foraminifera (shells) dating to the recent period/epoch. The paleontological site nearest to the Refuge on Protection Island is one containing mammoth remains identified in the Zella M. Schultz Seabird Sanctuary. Other unprovenienced bones have been collected from other areas of the island as well. In addition, a collection of 164 fossils (mostly unidentifiable) from Protection Island which includes a mammoth tooth is curated at the offices of the Washington Maritime NWR Complex. In 2008, a partial skull of a giant beaver (*Castoroides*) including incisors was located but has not been formally recorded.

Paleontological materials (mammoth tusks and a tooth) have been recovered from Dungeness National Wildlife Refuge, located approximately 15 km to the west of Protection Island. Another nearby paleontological site which is also known for its archaeological importance is the Manis Mastodon site located in Sequim, Washington, approximately 15 km southwest of Protection Island. Mastodon (*Mammut americanum*) and bison (*Bison sp.*) bones, caribou antlers (*Rangifer sp.*), and pollen, fruits, and seeds were recovered from a colluvial brown, gravelly, silty sand with organic detritus grading upward to sandy silt. Radiocarbon dates from fossil pollen and seed assemblages suggest the fossils are 11,000 – 12,000 yr BP (Petersen et al., 1983).

San Juan Islands

Although paleontological resources have yet to be identified on the refuge, they are common within the broad vicinity of the San Juan Islands, with associated ages ranging from the Paleozoic Era to the Holocene Epoch. A search of the paleontology online collection from the Burke Museum of Natural History and Culture indentified 60 fossils that have been collected from the San Juan Islands, specifically Sucia, Waldron, and Spieden islands. The specimens, primarily mollusca and foraminfera, were collected from sandstone, shaly sandstone, and glacial drift deposits from the Pennsylvanian (n=1) and Cretaceous (n=25) Periods and the Pleistocene (n=32) and Holocene (n=2) Epochs, ranging in age from 320 million years to 10,000 years old.

Other known paleontological resources within the San Juan Islands include those at Deadman Bay on San Juan Island, where crinoid debris and fragments of other fossils can be found in limestone pods. Crinoids appeared during the Lower Ordovician roughly 490 million years ago and underwent several major radiations during the Paleozoic Era. Triassic age (~200 million years) conodont fauna, which are elongate worm-like organisms, were identified at Limestone Point on the northwest coast of San Juan Island (Savage 1984). On Lopez Island, brownish-red mudstones containing foraminifera dating to the mid-Cretaceous (~100 million years) were discovered in a road-cut by Danner (1966). This site is important because it provides the youngest dates of the rocks in the San Juan fault system.

A *Bison antiquus* cranium and partial skeleton dating to 11,760 ± 70 14C yr BP was located in lacustrine sediments below peat on Orcas Island. These resources were found unconformably above emergent Everson Glaciomarine Drift (>12,000 14C yr BP), which often contains fossil marine shells. Several bison finds in similar contexts on Orcas and Vancouver Islands, dating between 11,750 and 10,800 14C yr BP, have also been found and indicate an early postglacial land mammal dispersal corridor with reduced water barriers between mainland and islands (Wilson et al. 2009).

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Chapter 5. Human Environment

5.1 Cultural Resources

5.1.1 Native American Overview

This section provides an overview of the known archaeological and ethnographic uses of the San Juan Islands Archipelago region in which the San Juan Islands NWR is located. It is excerpted from a cultural resource overview prepared by SWCA (2007) of the study area, which includes all lands in and within one mile of the congressionally authorized boundaries of the San Juan Islands NWR. Protection Island was not included within the study area for the 2007 cultural resource overview, however much of the general history is applicable to that island as well. Information specific to Protection Island is summarized from an overview prepared by Daugherty (1988).

Protection Island: Prehistoric and Early Historic Period - Protection Island is located off the northeast coast of the Olympic Peninsula. Ethnographic sources indicate that the area was occupied by the Chemakuan-speaking Chemakum people (Daugherty 1988). According to early ethnographer Frederick Hodge, the Chemakum fought with their Salish neighbors, including the Klallam, and their numbers dwindled significantly (Hodge 1907). The ethnohistoric record assigns Protection Island to the territory of the Klallam Indians, who ranged over most of the southern shore of the Strait of Juan de Fuca in the early historic period. The Klallam followed a seasonal subsistence strategy which included winter villages comprised of cedar plankhouses and summer settlements with smaller and more informal structures (Daugherty 1988: 46). Their subsistence activities included fishing for salmon and other fish, hunting both marine and terrestrial mammals, and gathering plant materials.

San Juan Islands: Prehistoric Period - Native Americans have long utilized the diverse resources (e.g., water, fish, wild game, plants, living areas, and burial areas) present in the San Juan Islands to maintain many of their cultural lifeways and spiritual connections to the land. Previous archaeological investigations have demonstrated the presence of human occupation in the region for a minimum of 11,500 years.

Several cultural models have been developed in order to explain the history and cultural development of Native American peoples in the San Juan Islands. In this region, cultural sequences have been divided into five general time periods or phases: Paleo-Indian Period; Cascade or Island Phase; St. Mungo, Mayne, and Locarno Beach Phases; Marpole Phase; and San Juan Phase. These periods are based on cultural change in the region, including shifts in the organization of subsistence patterns, land-use, and technological developments (SWCA, 2007).

Ethnographic Period - A number of researchers have compiled extensive ethnographic accounts for the San Juan Islands. Much of the following ethnographic account relies on Wessen's (1988) ethnographic overview of the study area conducted for the National Park Service, Stern's (1934) ethnographic study of the Lummi, and Suttles' (1951) unpublished Ph.D. dissertation and subsequent ethnographic accounts (Suttles 1990a).

During the ethnographic period, multiple Native American groups occupied the San Juan Islands Archipelago. The inhabitants of the San Juan Islands belong to a more general group of people who speak Central Coast Salish languages (Stein 2000, Suttles 1990a, Wessen 1988, 2006). The Salish is a broad language family that ranges from Montana to the Pacific Coast (Wessen 1988), and during the ethnographic period, Central Coast Salish was spoken from Western Washington to parts of British Columbia. The inhabitants of the San Juan Islands belong to one of five language groups of the Central Coast Salish, called the Northern Straits Salish (Suttles 1990a, Wessen 1988).

The Northern Straits Salish occupied an area that included the southeastern part of Vancouver Island, the San Juan Islands, and portions of the southern Gulf Islands and mainland shore. The Northern Straits Salish were further divided into seven tribes with distinct but similar dialects. These groups included the Lummi, the Samish, the Saanich, the Sooke, the Semiahmoo, the Swinomish, and the Songish (Boxberger N.D., Suttles 1990a). Of the seven tribes of the Northern Straits Salish, five occupied the San Juan Islands, including the Lummi, the Samish, the Saanich, the Swinomish, and the Songish (Suttles 1990a, Wessen 1988).

In addition to different language dialects, an extensive marine-based economy distinguished the Northern Straits Salish from other Coastal Salish groups. Reef-netting for salmon, particularly sockeye, was a practice unique to the people living in the San Juan Islands Archipelago (Ames and Maschner 1999; Stein 2000; Suttles 1990a; Wessen 1988, 2006). In mid-July, sockeye salmon entered the Strait of Juan de Fuca and swam up to the San Juan and Gulf Islands and into the Fraser River. Large nets were suspended between two canoes along routes taken by the salmon and were situated with anchor lines in order to guide the fish into the nets (Suttles 1990a, Wessen 1988). Reef-netting enabled Native American groups to collect large quantities of salmon at one time. It was practiced until the 1890s when commercial fisheries took control of the resource locations (Boxberger 1980, Marino 1990, Kopperl 2006, Suttles 1954).

The economic, social, and political organization of the inhabitants of the San Juan Islands was similar to other Central Coast Salish groups, characterized by complex and overlapping local lineal groups. Families held the rights to knowledge and access of reef-netting and other resource locations, as well as ceremonial rights and practices, all of which were passed down for generations. Locally, residential groupings of the Central Coast Salish included the family, household, local group, winter village, tribe, and language group (Suttles 1990a, Wessen 1988).

The Native American groups occupying the San Juan Islands during the ethnographic period practiced a seasonal subsistence and settlement pattern. The diversity of subsistence resources on the islands included camas, deer, elk, salmon, herring, fruit, and shellfish. These resources were accessible at various islands during particular times across the seasons. Multiple families gathered in winter villages with multiple large split-cedar plank longhouses with either gable or shed roofs (Wessen 1988). In the early spring, groups left their winter villages and divided into smaller camps occupying mat lodges, rectangular-framed structures covered in cattail rush and cedar bark mats, and procured duck, herring, shellfish, camas bulbs, bird, halibut, and spring salmon (Wessen 1988). Both the camas bulbs and the fish were dried and processed for storage.

During the summer months, the smaller Native American groups converged into larger communities or reef-net camps to prepare for the reef-netting season. The summer camps contained large-pole drying racks, which were used to dry large amounts of sockeye salmon (Wessen 1988). In addition to fishing, deer and elk were hunted and fruits, shellfish, and sea urchins were collected (Suttles 1990a, Wessen 1988).

In the fall, the summer camps once again divided into smaller groups and collected and processed clams for storage, hunted deer, elk, and duck, and fished for cod. There has been discussion that most Native American groups temporarily left the San Juan Islands during the fall for riverine salmon weir camps on the mainland and Vancouver Island (Wessen 1988). Wessen (1988) argues that all but the Lummi and the Samish departed the San Juan Islands directly after reef-netting season. In some instances, Lummi and Samish groups moved into camps on the mainland leaving only a few small groups behind on the San Juan Islands. In late November, when the riverine salmon season was over, all Native American groups returned to the winter village with food that had been processed and stored, thus commencing the subsistence cycle over again.

Indian Reservation Era - In the late 18th century, Europeans had started exploring the San Juan Islands and the surrounding region. Disease, traders, missionaries, and new technology had severe impacts on the Native American people living on the islands at the time. Population numbers declined dramatically due to introduced infectious diseases such as smallpox. As a result, surviving Native Americans relocated their winter villages from the islands to the mainland. Stein (2000), Wessen (1988), and Schalk (1998) suggest that by approximately A.D. 1850, no winter villages remained on the San Juan Islands.

The Treaty of Oregon in 1846 divided the region into British and American jurisdictions, and subsequent governmental treatment and recognition depended upon which side of the boundary the Native American groups were located. British and Americans both started procuring tribal lands and established treaties with Native American groups that were within their own jurisdiction but were not living within the disputed area of the San Juan Islands (Suttles 1990a, Wessen 1988).

In 1853, Isaac Stevens became the governor of Washington and the superintendent of Indian affairs. One of his tasks as the head of Indian Affairs was to convince Native American groups to sign treaties, referred to as the Stevens Treaties. He aimed to quickly consolidate multiple tribes onto a limited number of reservations (Richards 2005). Two of Stevens' treaties, the Point Elliot Treaty and the Treaty of Point No Point, pertain to tribes and lands located within the study area. In 1855, Stevens, along with 82 chiefs and headsmen of various Native American tribes in the Western Washington region including the Lummi and the Samish, signed the Treaty of Point Elliott (Marino 1990, Wessen 1988).

By signing the treaty, the Lummi subsequently ceded all of their lands to the U.S. Government and were required to move onto reservation lands. The reservation included lands around their primary village, the Lummi Peninsula, uninhabited Portage Island, and specific fish weir sites. The reservation was also shared with the Samish and Nooksack (Kopperl 2006, Suttles 1990a, Wessen 1988). In 1875, the Samish were forced to abandon their village on Samish Island. Instead of relocating to the reservation, they moved to Guemes Island and established a new village which was later abandoned in the 20th century (Wessen 1988, Suttles 1990a).

Despite signing the Treaty of Point Elliott, Native Americans continued to struggle with maintaining their rights and access to subsistence locations. In the late 19th to early 20th century, the Lummi struggled to keep lands and rights obtained through the treaty. In the 1890s, they lost the use of the reef-netting sites at locations such as Point Roberts and Lummi Island due to heavy competition from non-Indian commercial fishing companies. Additionally, logjams and flooding prevented access to their village (Boxberger 1980, Marino 1990, Suttles 1954).

5.1.2 Euro-American Overview

Protection Island: Early Exploration: The first Europeans recorded visiting the island in 1790, when Spanish explorer Manuel Quimper sailed into the Strait of Juan de Fuca for the first time;the island was dubbed Isla de Carrasco after his ensign, Juan Carrasco. It was renamed Protection Island 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: 87). Suckley (1859), an early naturalist, referred to Protection Island as a favored breeding ground of the rhinoceros auklet.

Euroamerican Settlement: The lands of Protection Island were patented by the United States from the public domain to private ownership through presidential actions from 1861 to 1865. Settlers first moved onto the island with their cattle, sheep, and horses, and planted alfalfa, barley, and potatoes during the mid-to late-1800s. Over the next 100 years, several different families attempted to live on and farm the island without success. Heavy grazing caused extensive damage to the native vegetation and severe erosion on the slopes.

From 1937-42, a ring-necked pheasant research project released at least two cats on the island to observe the effect of this predator on the isolated pheasant population (Einarsen 1945). Although sheep were not on the island during this period, much of the habitat was still recovering from past overgrazing. About 30 percent of the island was intensively farmed for wheat, alfalfa, and potatoes at this time.

With the onset of World War II, the U.S. Government assumed control of the island and established a Coast Artillery battery as a measure to protect the straits.

At least two major fires burned much of the island between 1944 and the 1950s. Prior to 1969, Protection Island passed through several ownerships. The major land use during this time was farming, with various other uses such as hunting and research.

In 1969, subdividing and development of the island for homes was initiated. Eventually 580 lots were sold and owners began building houses and barging camp trailers to the island. There was no electric or telephone service and drinking water had to be transported from the mainland. Although the developers did stop the overgrazing, the increased human presence and new activities such as lot development, road construction, and gravel pits destroyed some valuable rhinoceros auklet breeding habitat and impacted other species. Due to the lack of a drinking water source, the development came to a halt in 1972. In 1982, Congress established the island as a National Wildlife Refuge, and by 1985 many of the lots had been acquired by the Service from willing sellers. A 48-acre parcel at the southwestern tip of the island was established as the Zella M. Schultz Seabird Sanctuary.

San Juan Islands: Early Exploration: During the late 18th century, the strait originally discovered by and named for 16th century Spanish sailor Juan De Fuca (1592), was explored by numerous expeditions, including those of English Captain Charles Barkley (1787) and Spanish Ensign Manual Quimper (1792) (Suttles 1990a, Wessen 1988). In 1791, Francisco de Eliza, who gave the San Juan Islands their name, explored the southern end of the Straight of Georgia and the San Juan Islands (Wessen 1988). In the following year, English Captain George Vancouver sailed through the islands as well. None of these early explorers provided accounts of Native American groups in the San Juan Islands. It has been suggested that early European contact had great impacts on Native American people on the islands. In the 18th and 19th centuries, epidemics decimated Native American populations and may have reduced their numbers to 20% of the original population (Wessen 1988, Suttles 1990a).

In addition to disease, other events impacted Native American groups in the region during this time period. In the early to middle 19th century, both missionaries and trading companies pursued opportunities in the region. Hudson’s Bay Company established two large trading posts in the region, Fort Langley in the Fraser Delta and Fort Victoria on Vancouver Island. Traders employed Native Americans as trappers, fishermen, mill-hands, loggers, farm hands, sailors and middlemen in the fur trade. They also sold items such as fish, shellfish, and fruits to non-Native American peoples (Suttles 1990a). While it appears that trading companies did little directly on the islands, they still impacted Native Americans within the region, including the San Juan Islands, by instituting changes in their subsistence and settlement patterns (Wessen 1988).

Missionaries also had a great impact on the area. In 1841, the first Catholic missionary, Modeste Demers, settled at Fort Langley (Suttles 1990a, Wessen 1988). This marked the beginning of the missionary movement into the area which continued throughout the late 1800s. Many Native Americans converted to these new religions, thus altering their social and religious structures. While there are no accounts of missionaries traveling to the San Juan Islands, this does not necessarily mean that people living in the San Juan Islands never had contact with them.

During the 19th century, American and British interests grew in the region and tensions continued to rise between the two nations over the occupation of the San Juan Islands, leading to the signing of the Oregon Treaty in 1846 (National Park Service n.d., Vouri 2004). This treaty gave the US control over land south of the 49th parallel and also divided the water channel that separates Vancouver Island from mainland Washington. However, the treaty failed to recognize that the channel splits into two straits, the Haro and the Rosario, with islands in between them. No references of the San Juan Islands were provided, and due to a dramatic increase in military presence from both countries in the area, tensions built on this omission. Eventually, conflict escalated between the two nations and reached its climax during the “Pig War,” discussed in detail in the overview along with other major historical events in the region (SWCA 2007). In 1872, the Treaty of Washington was signed and the boundary was set through the Haro Strait, giving the US control of the San Juan Islands and setting the boundary between America and Canada.

There is a general lack of settlement or other development within the San Juan Islands NWR during the historic period. One story of interest which occurs on an island within the Refuge is that of the “Hermit of Matia Island” (Elvin Smith, 1835-1921), who made his way west after the Civil War and settled on Matia Island. He sustained himself on the island with fishing and raising chickens, sheep, and rabbits, traveling by boat only periodically to Orcas Island for supplies. In 1921, he and a friend disappeared on the return leg of one of these supply trips, and though fragments of the boat were later found, their bodies were never recovered.

5.1.3 Current Knowledge of Local Cultural Resources, Archaeological Surveys On and Nearby Refuge Lands

Protection Island: Apart from the emergency removal of a human burial in 1980 (see below), only one intensive survey and cultural resource overview has been conducted on Protection Island (Daugherty 1988). A project-specific survey prior to the removal of several structures on the northwest face of the island was conducted in 2001 with negative results.

San Juan Islands: Washington State’s Department of Archaeology and Historic Preservation (DAHP) Geographic Information System (GIS) database indicates that 165 inventories have been previously conducted in the study area as of March 2007. A complete listing of these studies is included in the Overview (SWCA 2007, Appendix A). Of the 165 inventories, five occurred on one or more of the islands within the San Juan Islands NWR. Two of the inventories (NADB 1331698 and 1332069), which encompassed the San Juan Islands NWR, were part of a series of assessments conducted by the University of Washington of archaeological sites on State Parks property. Another archaeological inventory (NADB 1331172) was conducted on 189 sites containing shell deposits. The survey examined distribution patterns for sites perceived to relate to economic activities or human behavior. Many of the 189 sites were previously recorded by the University of Washington field schools; although 82 new sites were recorded within the San Juan Islands Archipelago.

A fourth inventory was conducted at least partially within the San Juan Islands NWR (NADB 1332339). The survey attempted to relocate and document 271 known prehistoric archaeological sites on 32 islands in the San Juan County section of the archipelago as well as obtain micro-environmental samplings of previously unexamined settings. An additional 51 new archaeological sites were also recorded during the survey efforts. A fifth inventory within the San Juan Islands NWR (NADB 1333658) took place solely on Smith Island. The survey was conducted on a small section of Smith Island for the installation of a Hyper-Fix Navigational Beacon Antenna, during which only a few historic artifacts were located. The project area was located within the NRHP-listed Smith Island Light Station site boundaries.

A more intensive survey of Smith and Minor Islands conducted by SWCA in 2008 covered 64 acres and culminated in a review of the structures associated with the light station in order to assess and update their determinations of historic significance (see below).

5.1.4 Archaeological Sites on and Nearby Refuge Lands

Protection Island:
No significant cultural resources were identified as a result of the intensive 1988 surface survey within the boundaries of the Refuge, although a prehistoric site (never formally recorded) and a paleontological site containing mammoth remains were documented within the Zella M. Schultz Seabird Sanctuary.

Also in the vicinity of the sanctuary, a human burial encased in sediments that had slumped from the top of a bluff was removed from the base of the bluff in 1980. The skull and a long bone were transferred to Washington State University. In her reminiscence of eight years spent on the island as a young girl, Mrs. Doris Prim Hufford noted that she and her siblings "found many arrowheads and spear points: the Indians used to have many feasts but there were no graves" (Hufford MSS 66, n.d.). Daugherty notes that the thriving population of the camas plant on the island would make likely the presence of aboriginal camas ovens. He also notes that subsurface testing an evaluation could reveal remains of historic or prehistoric utilization of the island in areas that have not been previously disturbed.

A National Register Nomination form was prepared for Protection Island in 1970. The Period of Significance was cited as the 18th century, specifically 1792, and the Areas of Significance included: Historic Aboriginal, Agriculture, Conservation, and Military. Apparently, the form was submitted for consideration, but no action was taken. Therefore, there are no listed historic properties on Protection Island.

San Juan Islands:
The DAHP GIS database search indicated that 457 archaeological sites have been recorded within the sections containing and proximate to the study area, including 418 pre-contact or "prehistoric" sites, 13 sites with both prehistoric and historic components, 15 historic sites, and 11 archaeological sites of unknown component (SWCA 2007, Appendix A and Table 2). Seven of the 457 archaeological sites and 28 historic properties found within the study area are located on 5 different islands within the San Juan Islands NWR. Other features are typically earthworks, like trenching or depressions, mounds or hearth remnants. In addition to the 457 archaeological sites, 28 historic properties were located within the study area in the DAHP WISAARD GIS database (SWCA 2007 Appendix D). In this context, historic properties are resources that are eligible for or listed on the National Register of Historic Places (NRHP). Only one of the 28 historic properties in the study area is located within the San Juan Islands NWR, and that is the light station located on Smith Island, discussed in more detail below.

5.2 Refuge Facilities

The infrastructure and facilities discussed in this section include buildings, roads, trails, recreational and docking facilities, regulatory and interpretive signs, and other physical structures. Refer to Chapter 2, Alternative A, Figures 2.1, 2.2, and 2.3 for maps which show the location of existing facilities on Protection Island NWR and Turn and Matia Islands in the San Juan Islands NWR.

5.2.1 Entrance and Access Points

Protection Island: Protection Island has a single, non-public, access point located in the man-made armored harbor (two rock jetties totaling approximately 500 ln. ft.) on the southeast end of the island. The facility consists of a concrete boat ramp and a two-dock floating pier (131 ln. ft. with 40 ln. ft. gangway) system capable of accommodating four small vessels . There are no other landing facilities on the island. Accessing the island via the shoreline is not allowed.

San Juan Islands: Matia and Turn are the only islands in the San Juan Islands NWR open to the public. Both are open year-round, however, the majority of Matia is designated as wilderness and is closed to public entry. All other islands in the Refuge are closed year-round to provide undisturbed habitat for wildlife.

Matia Island: The primary and only Federally-approved access point for upland areas on Matia Island is Rolfe Cove, on the northeast side of the Island adjacent to the 2-acre, non-wilderness, recreation area maintained as a State marine park by Washington State Parks and Recreation Commission (WSPRC). Larger vessels can moor to one of 2 seasonal buoys or land on a seasonal dock if space is available (approximately 70 ln. ft. of dock space including 2 sides and 60 ln. ft. gangway). The dock and buoys are available approximately April through September. Installation and removal times vary due to weather and scheduling. Smaller vessels such as kayaks can land on the dock or on the adjacent beach.

Although boaters may access other Matia coves from the water, they are not allowed to access upland areas from these "pocket" coves. Island visitors are not allowed to access the water outside Rolfe Cove from upland areas. However, the presence of a number of unauthorized "social" trails in wilderness areas suggests visitors are accessing the Island from coves located on the north, west, and south sides of the island and are accessing closed areas from the wilderness loop trail.

Turn Island: Unlike Matia Island, visitors may currently land anywhere that is suitable on Turn Island. While there are no docking facilities, the State does maintain 3 seasonal mooring buoys just off the north beach.

5.2.2 Roads and Trails

Protection Island: Protection Island has approximately three miles of primitive dirt roads. The main road begins at the marina, ascends the bluffs on the south side of the island, and circles the island's high plateau. There are three small arterials extending from the main road which provide access to a private residence and the island caretaker's cabin, the research station bunkhouse, and the east overlook.

There is a 4,000 square foot parking area associated with the marina where vehicles used by refuge staff, researchers, and extended users are located. Vehicles are brought to the island by an infrequent supply barge.

San Juan Islands: There are only two islands with foot trails in the San Juan Islands NWR. Matia Island has a 1.2 mile wilderness loop trail which circles the island's interior, and Turn Island has a 0.9 mile loop trail which circles the island's outer perimeter. Also, both Islands have several short trails which access camping, picnic, and restroom areas.

5.2.3 Administrative Buildings and Other Infrastructure

Complex Headquarters: Management of Protection Island NWR and San Juan Islands NWR is carried out from the Washington Maritime National Wildlife Refuge Complex headquarters located at 715 Holgerson Road, Sequim, Washington. The headquarters consists of an administrative building (3756 sq. ft.), shop building (3848 sq. ft.), and an equipment storage building (2220 sq. ft).

Protection Island: There are a total of twelve buildings on the island. See table 5.1. Seven are directly related to island management. One building functions as a research station/bunk house and another is a shop/storage area for the research station. There is a 140-ft. well, 33,000 gallon water tower, and 10,200 linear feet of water distribution systems. The office, maintenance shop/garage, and fire cache/storage building are all located on the lower level of the island, approximately 10 feet above sea level.

Table 5.1 Protection Island NWR Buildings

Refuge Maintained Buildings		Size: Sq. Ft.	Location	Condition
1	Maintenance shop/garage	864	South lowlands	Very good
2	Office	468	South lowlands	Poor
3	Fire cache/storage	240	South lowlands	Poor
4	Pump/well house	80	Central uplands	Fair
5	Research station/bunkhouse	768	East uplands	Fair
6	Research storage/shop	120	East uplands	Poor
7	Caretaker's cabin	1280	South uplands	Good
8	Caretaker's cabin car port	312	South uplands	Fair
9	Caretaker's cabin generator shed	80	South uplands	Fair
Buildings not maintained by the Refuge				
10	Private residence	800	South uplands	Fair
11, 12	Unoccupied residences (2)	1700 total	Central uplands	Poor

Because most of the electrical power consumed on the Island is supplied by gasoline generators, there is a need to upgrade Island infrastructure to include more solar power. Currently, the caretaker's cabin and research station/bunkhouse utilize solar power; however, these small systems supply only a portion of the energy requirements.

San Juan Islands: There are no buildings maintained by the Refuge in the San Juan Islands NWR. However, there are camping and picnic facilities, including composting toilets, on Matia and Turn Islands which are maintained by the WSPRC. These include picnic tables and fee collection equipment such as pipe safes and registration envelope dispensers. Matia has a double composting toilet and Turn has two single composting toilets.

5.2.4 Signs

A complete sign inventory for both Protection Island NWR and San Juan Islands NWR can be found in Appendix D of this document. The U.S. Fish and Wildlife Service maintains both informational and regulatory signage in accordance with standard Service policy; however, due to the nature of these island refuges, a series of non-standard signs has been adopted. These include "large format," heavy duty signs approximately 5 feet wide by 4.5 feet tall. Such signs are used in particularly sensitive habitat marine areas susceptible to disturbance by watercraft. These signs may be either white or brown and typically warn boaters to remain 200 yards from shore to protect wildlife. The size allows for text large enough to be clearly legible from a distance.

Protection Island: Signs on Protection Island include six "large format," 200-yard boater warning signs, a large sign that reads "Protection Island NWR, Established August 26, 1988", a reflective "Marina Closed" sign, various standard 11-inch x 14-inch "Closed Area" signs to warn residents and researchers of sensitive habitat and dangerous areas, and a sign maintained by the Washington Department of Fish and Wildlife which designates the Zella M. Schultz Seabird Sanctuary. See Protection Island NWR sign plan, Appendix D.

Matia and Turn Islands: Currently there are no interpretive Service signs located on either Matia or Turn Islands, the only areas open to the public in the San Juan Islands NWR. However, each island does have minimal informational signage such as the island name with agency logo and minimal standard regulatory signage. The WSPRC maintains signage on both islands which provides general information such as camping and fee information.

San Juan Islands NWR, closed islands: The majority of rocks and islands within the Refuge are marked. Areas that are marked generally have standard Service 11-inch x 14-inch "Closed Area" signs in tandem with similar sized "blue goose NWR" signs. However, 15 islands are marked with "large format," 200-yard boater warning signs. Due to the harsh marine environment a great majority of these signs are worn and need replacing. In addition, See San Juan Islands NWR sign plan, Appendix D, for a complete inventory.

Two standard signs are prevalent within the Refuge. Currently these signs measure 11-inch x 14-inch and read either: "NATIONAL WILDLIFE REFUGE, UNAUTHORIZED ENTRY PROHIBITED" or "AREA BEYOND THIS SIGN CLOSED, All Public Entry Prohibited". Due to the need to place signs outside of dynamic boundary areas such as shorelines, the latter text is often rendered confusing and inappropriate for island units which are completely closed. In addition, due to their size, they are legible only after an individual has trespassed and as such are visually inadequate.

5.3 Research

Research activities have taken place on Protection Island NWR and the San Juan Islands NWR for many years, some prior to the Refuges' establishments. Over 80 research projects reported in published or grey literature have been conducted since the late 1930's with the majority since the mid-1980's. Primary research has been focused on glaucous-winged gulls, rhinoceros auklets, pigeon guillemots, and bald eagles.

5.3.1 Research Activities Prior to Refuge Establishment

The Oregon Cooperative Wildlife Research Unit of the U.S. Fish & Wildlife Service conducted ring-necked pheasant studies on Protection Island from 1937 through 1942 for the purpose of accumulating information as a guide to their management in the Northwest. A long-term bird banding operation of glaucous-winged gulls was conducted by the Western Bird Banders Association. Gulls were banded in the trans-boundary area of Canada and the U.S. starting in 1940 and continuing thru 1973. Banding on Colville Island in the San Juan Islands NWR was carried out for the longest period of any U.S. gull colony followed by Protection Island.

In the 1960's, a Cooperative Agreement between the Bureau of Sport Fisheries and Wildlife and the University of Washington allowed the University's Friday Harbor Lab to conduct research studies on marine resources on tide flats and shorelines of Colville, Jones, Matia, Turn and Smith Islands. In 1967, Colville Island was removed from the agreement to reduce potential adverse impacts to glaucous-winged gulls nesting there. Glaucous-winged gull and bird population studies were conducted on Colville, Four Bird Rocks, Three Williamson Rocks, Flower Island, Pointer Island and Ram Island by researchers from Walla Walla University.

During the 1970's, glaucous-winged gull studies and bird population studies continued on Colville Island, Williamson and Bird Rocks, and on Protection Island by staff and students of Walla Walla University. Additional bird population studies were conducted in 1970 on Flower, Pointer, and Ram Islands by the University.

National Oceanic and Atmospheric Administration (NOAA) biologist Clifford H. Fiscus conducted research on harbor seals on Smith and Minor Islands and on Protection Island as part of NOAA's Marine Ecosystem Analysis (MESA) Project from 1977 to 1979. Funded by NOAA and EPA, the MESA Project set out to record the distribution and abundance of a wide range of marine species and habitats over the northern portion of Washington State's inland waters. Fiscus's study characterized marine mammal populations and their habitats vulnerable to petroleum-related activities. Regular surveys were used to determine times and places for breeding, feeding, and rearing of young as well as timing of entrance and departure of seasonal pinniped migrants.

Also as part of NOAA's MESA Project, a SUP was issued to Stephen M. Speich in 1978 and 1979 to conduct low level aerial surveys to characterize the distribution, abundance, and time of occurrence of all the breeding and non-breeding birds in the Strait of Juan de Fuca, San Juan Islands, and the Strait of Georgia. Dr. David Manuwal and Terry Wahl also participated in the study.

5.3.2 Protection Island NWR Research Activities

Dr. Joseph G. Galusha, Walla Walla University, began his work in 1979 and to-date has had 21 graduate and 11 undergraduate students work on projects. A majority of his work has dealt with glaucous-winged gulls. Research topics include time budgets while in the colony; spatial aspects of territorial behavior; parent-chick recognition, social behavior of gulls living in different habitats; behavior of resident and intruder gulls; behavior and survival of families of differing size; egg-laying chronology and reproductive success of glaucous-winged gulls; and social facilitation of chicks and parents while on territory. He also studied the impacts of an increasing bald eagle population on the glaucous-winged gull colony, and conducted periodic total gull colony censuses. Dr Galusha and his students studied pigeon guillemot breeding success and daily time budgets of this species as it relates to human disturbance. Northwestern crow population and breeding success and double-crested cormorant colony utilization and flight patterns were also studied.

Thomas A. Lee, Walla Walla University, also conducted research on the natural history and aspects of behavioral ecology of the Northwestern Crow on Protection Island.

Dr. James L. Hayward, Andrews University, has conducted a number of research studies and investigations on the Refuge since 1987. Ten graduate and 22 undergraduate students of his have worked on projects primarily studying glaucous-winged gulls, including: eggshell taphonomy, bone growth and developmental bone histology, egg-laying synchrony, reproductive success, pellet counts, prediction of habitat occupancies by gulls in relation to environmental factors, and impacts of bald eagles on gull behavior. In addition, Dr. Hayward's research topics include great-horned owl pellet contents; historical changes in island structure and vegetation, prediction of harbor seal haul-out times, Protection Island food web, and a Protection Island flora and vegetation map.

Steve Jeffries, WDFW, has conducted marine mammal studies on Protection Island NWR and the San Juan Islands NWR since the 1990's. Studies have included harbor seal and elephant seal census, food habits, health monitoring (blood and tissue samples), contaminant research, and mortality event investigations.

Scott Pearson, WDFW, **Peter Hodum**, University of Puget Sound, **Michael Schrimpf**, **Jane Dolliver** and **Julia Parrish**, University of Washington, and **Thomas Good**, NOAA Fisheries, studied long-term changes in seabird diet and the potential impacts of these changes on seabird populations since 2006. Work on Protection Island has focused on rhinoceros auklets and included burrow counts, burrow density, occupancy rates, and associated habitat variables.

Lee Robinson, Refuge volunteer, has conducted long-term monitoring of pigeon guillemots on Protection Island. This work began as part of the Puget Sound Ambient Monitoring Program in 1994. Nest boxes were established and are monitored throughout breeding and chick rearing. Data on chick weight and wing length measurements are collected.

Ulrich Wilson, retired Refuge wildlife biologist, conducted long-term rhinoceros auklet research that spans over 25 years. Studies included burrow use, breeding success, chick growth, chick survival, diet studies, population estimates from burrow counts, and effects of El Niño events on Protection Island rhinoceros auklets. He also investigated DDE, PCB's, cadmium, lead, and mercury concentrations in rhinoceros auklets from Washington State.

Brent Norburg from NOAA's National Marine Mammal Laboratory and WDFW was issued SUPs to conduct research on harbor seals on Protection Island NWR and San Juan Islands NWR. This research included radio tagging harbor seals, food habits, pupping phrenology, and population assessment.

Western Heritage, Inc., of Olympia, Washington, conducted cultural resource surveys on Protection Island in 1988.

5.3.3 San Juan Islands NWR Research Activities

Joe Bennett, University of British Columbia's Center for Applied Conservation Research, has conducted research in support of his doctoral thesis, "Determinants of plant community composition in coastal meadow ecosystems of Vancouver Island and adjacent islands," on a number of Refuge islands in the San Juan Archipelago. Floristic surveys and soil samples were collected to assess drivers of savanna ecosystem composition and vulnerabilities.

John Calambokidis of the Cascadia Research Collective, a non-profit research organization, has been issued SUPs to continue work begun in the 1970s to determine long-term trends in concentrations of chlorinated hydrocarbon contaminants in harbor seals and other environmental components (mussels and sculpins) at Smith and Minor islands. In 1977, John conducted research on habits, behavior, and population dynamics of harbor seals on Smith and Minor Islands. He has been particularly interested in harbor seal pup mortality on the islands, which some years have totaled 60+ animals. John has also assisted Steve Jeffries**,** WDFW, with his work on marine mammals.

R. Wayne Campbell, British Columbia Provincial Museum, Victoria, B.C., conducted a nest use survey of double-crested cormorant colonies on the Sisters Islands, Viti Rocks, and Bird Rocks in 1976.

Dr. Mark Dybdahl, University of Washington's Friday Harbor Laboratories, conducted research in the San Juan Archipelago in the 1990s, which included a census and some collection of tide pool copepods.

David Giblin, University of Washington Herbarium, Burke Museum of Natural History, and **Peter Dunwiddie**, TNC, began a systematic effort to collect, archive, and disseminate floristic information concerning the smaller islands (<100 hectares) of the San Juan Archipelago in 2005, 2006, and 2009. Preliminary results show that the small islands in the San Juan Archipelago harbor substantial numbers of rare plant populations. In addition, due to the lack of residential or agricultural development, several small islands harbor some of the most pristine examples of Puget Sound prairies in the region. These surveys have generated important baseline data in light of anticipated vegetative changes in response to climate change.

Dr. David A. Manuwal conducted studies on dispersal of rhinoceros auklets from disturbed natal colony sites on Smith and Minor Islands and Protection Island.

Ruth Milner, WDFW, lead a research project entitled "Post-breeding movement of the black oystercatcher in the North Puget Sound – VHF Tracking Study". This study extends the VHF tracking portion of a larger 2007 study of black oystercatcher movements between breeding, stopover, and over wintering sites at Prince William Sound, Middelton Island, Stephens Passage near Juneau, Alaska, Kodiak NWR, and along the west coast of Vancouver Island.

On a larger scale, this effort will increase our understanding of how animals breeding in different segments of the black oystercatcher's range behave in winter and is important to the effective management of this species (e.g., oil spill response, habitat conservation, and monitoring response to disturbance). Some of the birds captured for this study came from islands within San Juan Islands NWR.

Sue Thomas (USFWS), Dave Nysewander, Joe Evenson and Tom Cyra (WDFW) also participated in this study. Ruth was also issued a SUP in 2007 to ground truth a west-coast-wide aerial survey of gulls. That SUP allowed access to Hall Island, Gull Rock, Three Williamson Rocks, and Peapod Rocks in the San Juan Islands NWR.

Dave Nysewander and **Joe Everson**, WDFW, have conducted pigeon guillemot and black oystercatcher censuses on the San Juan Islands NWR since the 1990's. Their recent surveys have been conducted using amplified black oystercatcher calls, a study technique they developed.

Richard Knight, Coordinator of the Washington Eagle Study for the Washington Department of Game, was issued a SUP in 1980 to visit active eagle nests, band and mark young, take blood samples for heavy metal and PCB analysis, and collect food habit data.

Steven Speich was issued a SUP in 1983 to survey the breeding marine birds of the San Juan Islands to determine breeding status, stage of nesting, status of tufted puffins and rhinoceros auklets, and to describe the habitat.

Research on Refuge lands requires submission of a research proposal, which is reviewed by Refuge staff, and if approved, a Special Use Permit with special conditions to ensure compatibility is issued to conduct the study.

5.4 Refuge Recreation

5.4.1 Open and Closed Areas

Protection Island: All of Protection Island National Wildlife Refuge is closed to the public year-round.

San Juan Islands: Turn and Matia Islands are the only units open to the public within the San Juan Islands National Wildlife Refuge. The remaining 81 rocks, reefs, and islands are closed to public entry year-round to provide undisturbed habitat for wildlife. Currently the whole of Turn Island and 2 acres on Matia Island are managed as State Marine Parks under a Memorandum of Understanding (MOU) with the WSPRC. Of all the State Parks in Washington, Matia and Turn are the only ones located on a National Wildlife Refuge (WSPRC 2007a). These unique Refuge units are the only places in northwest Washington State where boating visitors can experience island wildlife and their habitat on a National Wildlife Refuge. Both Islands are accessible year-round.

Matia Island: The 2-acre recreation/camping area located adjacent to Rolfe Cove and a 1.2 mile wilderness loop trail are the only areas open to the public on Matia Island. The remaining 140 acres of the Island are designated as a National Wilderness Area. Except for the 1.2 mile loop trail, the wilderness area is closed to the public to provide undisturbed habitat for wildlife. Visitors are required to stay on the trail and are not allowed to access other areas from the trail. The wilderness trail offers a unique glimpse of protected old growth island forest habitat present in only a few places in the region.

The nearest safe harbor to Matia Island is Sucia Island State Marine Park, approximately 1.3 nautical miles to the west (Carlten Tripod 2009). However, Sucia Island and its associated smaller islands comprise a large, busy park offering a very different experience at 564 acres, including two docks (660 feet of space), 48 mooring buoys, and 55 campsites (WSPRC 2009).

Turn Island: There are currently no closed areas on Turn Island and boaters may access all beaches; however, future management strategies may include closing some areas to benefit wildlife and vegetation.

Turn Island's close proximity to busy Friday Harbor makes it an ideal destination for those seeking an easily accessible Island experience. At just 35 acres, Turn Island is relatively small, but offers safe and easy access for small boats. Unlike Matia Island, Turn is not designated as wilderness. However, much of the Island is relatively undisturbed so whether wandering the wide open beaches or hiking the Islands 0.9 mile perimeter loop trail, there is a very good possibility of encountering some of the Island's protected wildlife.

Because Turn Island has no docking facilities, larger vessels looking for dock access often bypass Turn, instead choosing to head for the much larger Jones Island State Marine Park approximately 6 nautical miles to the north (Carlten Tripod 2009). At 188 acres, Jones Island has 320 feet of seasonal dock, 7 mooring buoys, and 21 campsites including the ability to accommodate large groups (WSPRC 2009).

5.4.2 Annual Recreation Visits

Matia Island is remotely located at the far north east corner of the San Juan Islands Archipelago which is a popular tourist destination. Many Refuge visitors likely come from the nearest large population center, Bellingham, Washington. Bellingham is approximately 17 nautical miles to the east (Carlten Tripod 2009) and has a population of more than 77,000 people (CityData.com 2009). However, Matia Island receives visitors from across the region and beyond.

According to data collected by the WSPRC, it is estimated that Matia Island received 1,868 day use and 2,228 overnight use visitors in 2008 (WSPRC 2008a). However, recorded figures are likely to be much lower than the actual visitation numbers due to limitations of survey timing and techniques. Matia figures are calculated by recording the number of boats in the approved landing area in Rolfe Cove multiplied by a factor of 5.25 to determine a day count. These figures do not account for vessels landing in other areas. WSPRC staff members suggest the actual figures could be as much as four times higher (USFWS 2007a).

Turn Island is located approximately two nautical miles southeast of Friday Harbor, Washington, the most populous city in the San Juan Islands with just over 2,000 residents and also the primary transportation hub for the Islands (CityDate.com 2009). It is estimated that Turn Island received 10,248 day use and 3,061 overnight use visitors in 2008 (WSPRC 2008a). As with Matia Island, recorded visitation figures for Turn Island may be less than 25percent of the actual number of visitors using the Island (USFWS 2007a).

WSPRC's data for visitation between 2002 and 2007 can be interpreted to indicate visitation overall remained fairly steady for both islands (WSPRC. 2008a). However, WSPRC staff indicates that kayak visitation increased on Turn Island during that time while it remained fairly stable on Matia Island. Staff members also indicate that larger vessel use of Matia may be declining (WSPRC. 2007c). This could be, in part, due to the limited docking space available in Rolfe Cove, combined with the nearby alternative, Sucia Island, which offers considerably more docking facilities.

5.4.3 Wildlife Observation and Photography

Wildlife observation and photography are primary uses of Matia and Turn Islands. However, Refuge wildlife, especially birds, can also be viewed and photographed from the water near other Refuge islands, including Protection Island NWR. There are numerous commercial ecotourism charters operating in both areas. Wildlife observation and photography is covered more in the following section titled Regional Recreation Opportunities and Trends.

Matia Island: Matia Island presents a unique opportunity to walk and camp among old growth trees and listen to the sounds of wildlife and waves in one of the most beautiful and peaceful settings in the Salish Sea. The 1.2 mile wilderness loop trail provides limited wildlife viewing and photography opportunities, as well as a peaceful respite from the busier 2-acre recreation area. The wilderness loop trail begins and ends in the 2-acre recreation area and is not intended to provide access to other parts of the Island. In addition to wildlife viewing and photography, and walking the wilderness trail, Matia provides opportunities to experience wildlife by day and at night while camping in one of the 6 primitive sites.

Turn Island: Turn Island has a 0.9 mile perimeter trail which provides visitors with opportunities to view and photograph wildlife. This short walking trail encircles the island passing through a variety of wildlife habitat from rocky shorelines to meadows to mixed forests. Future plans for this trail include the addition of interpretive information and some changes to protect sensitive vegetation. In addition to the loop trail, Turn Island has an extensive open beach area suitable for observing aquatic species and landing small craft. The shoreline outside of the beach areas is available for wildlife viewing and photography from the water but is not suitable for landing vessels. In addition to wildlife viewing and photography, and walking the loop trail, Turn currently provides opportunities to experience nature by day and at night while camping in one of the 13 primitive sites.

5.4.4 Environmental Education and Interpretation

Protection Island NWR: The primary education opportunities on Protection Island NWR are in association with volunteers and college students conducting or assisting with research projects.

San Juan Islands NWR: Currently the San Juan Islands NWR has no formal environmental education or interpretation programs, and many visitors are not fully aware that Matia and Turn are part of a national wildlife refuge. Additionally, information provided via travel websites and elsewhere often neglects to mention that these islands are part of the National Wildlife Refuge System. Future plans for both islands include increasing interpretation opportunities with the goal of helping visitors understand and appreciate their unique value as island national wildlife refuges.

5.4.5 Hunting and Fishing

Currently there is no hunting on refuge lands; for information regarding nearby hunting see section 5.6.1 below. There are no fish-bearing water resources on any of the refuge islands. There are, however, fishing opportunities in the marine waters that surround refuge islands. For more information about nearby fishing, see section 5.6.2 below.

5.4.6 Camping

In 1960, WSPRC began planning and installing camping and picnicking facilities on Matia and Turn Islands as provided for under MOU's with the U.S. Fish and Wildlife Service. It was determined that *"Seasonal use of the islands by wildlife affords an opportunity for controlled recreation use without limiting the function of the islands as wildlife sanctuaries; thus, the Bureau of Sport Fisheries and Wildlife* (USFWS) *has concurred in the development of docking and picnicking facilities at designated locations"* (Laythe 1959 pers. comm.). Since that time, camping, picnicking, restroom, and boating facilities have been developed and maintained by the WSPRC.

Currently, camping is allowed year-round on a "first-come, first-served" basis. Camping fees are $12 – 14 per night, no reservations required. All fees are collected by the WSPRC. Additionally, mooring buoys are $10 per night and overnight dock fees on Matia are 50 cents per foot, $10 minimum.

Matia Island: Matia has 6 primitive campsites and one additional picnic site, all with picnic tables. In addition, Matia has a composting public toilet, 2 seasonal mooring buoys, and a seasonal dock located in Rolfe Cove.

Turn Island: Turn has 13 primitive campsites and a picnic site, all with picnic tables. In addition, Turn has 2 composting toilets and 3 seasonal mooring buoys.

Camping affords visitors an opportunity to view wildlife at times when animals are particularly active, such as dawn and dusk, and to experience the sounds of wildlife at night. In addition, visitors who have traveled by human-powered craft may be afforded safe refuge to rest, and to allow wind and inclement weather to abate.

5.4.7 Pets

WSPRC regulations currently allows pets on leashes in the campground areas on Turn and Matia Islands. Visitors however, routinely allow pets off-leash and on trials and other areas where they are not allowed. Pets other than authorized hunting dogs and service animals are not typically allowed on national wildlife refuges because they disturb and/or prey on wildlife; decrease the presence of wildlife; decrease opportunities to view wildlife; can be involved in disease transmission to or from wildlife; and can be a safety hazard to humans or the pets themselves.

5.4.8 Unauthorized Refuge Uses

Protection Island NWR
Due to the frequent presence of refuge staff, volunteers, and researchers on Protection Island, unauthorized activities are uncommon.

San Juan Island NWR
Pets are frequently observed off-leash on Turn and Matia Islands. People and their pets also trespass on closed refuge islands. Impacts of pets are described above under 5.4.7. People disturb driftwood on closed islands to build makeshift sculptures. Disturbing driftwood impacts the wildlife values of this important habitat component. Wildlife such as shorebirds, seabirds, and marine mammals require areas of sanctuary where they can rest, nest, and forage free from human disturbance. The presence and activities of people and/or their pets can make otherwise suitable wildlife habitat unavailable to these species. These activities are in violation of chapter 50, section 26.21, of the Code of Federal Regulations.

Matia Island: The shoreline perimeter around Matia Island is closed, with the exception of Rolfe Cove. However, due to the inviting nature of Matia Island's many "pocket" coves and the lack of clear regulatory signs, a number of unauthorized "social trails" have developed through closed areas leading from the wilderness loop trail to bluff areas and beaches around the Island. These areas are important habitat for sensitive species, such as eagles, cormorants, and black oystercatchers, which may be harmed by disturbance. Wildlife such as marine mammals, shorebirds, and seabirds will avoid shorelines that are frequented by people. This otherwise suitable habitat becomes unavailable to these species due to human activities.

Unauthorized wood cutting and collection occurs on Matia Island even though open fires are not allowed and cooking grills have been removed by the WSPRC. Unauthorized fire rings, where materials such as driftwood and cut tree branches are burned, are evidence that refuge regulations are sometimes ignored. An important reason for prohibiting open fires is that Matia Island is considered to be at high risk of catastrophic wildfire. The incredible old-growth forest on Matia Island might never fully recover its habitat and aesthetic values if a stand-replacing forest fire occurred.

Turn Island: WSPRC has reported that Turn Island has among the highest number of incidents of unauthorized activities among all of the marine state parks. Refuge staff are concerned that Turn Island has become a destination for non-wildlife dependant recreation inappropriate for a National Wildlife Refuge and incompatible with the refuge purpose. Its close proximity and easy access to Friday Harbor makes it popular with visitors, including those exhibiting undesirable behaviors. Unauthorized wood cutting and collection also occurs on Turn Island, even though open fires are not allowed and cooking grills have been removed by the WSPRC. Unauthorized cutting and collecting of firewood is resulting in damage to native vegetation. Uncontrolled "social trails" have been created on fragile slopes and meadows.

5.4.9 Law Enforcement and Resource Protection

There is one dual function officer assigned to cover all of the six refuges in the Washington Maritime National Wildlife Refuge Complex. That officer is based out of the Refuge Complex headquarters located at the Dungeness National Wildlife Refuge near Sequim, Washington. As a result of the geographic distances, and their remoteness, Matia and Turn Islands are patrolled very infrequently, less than 5 days per year.

The Service entered into an MOU with WSPRC in 1959. This MOU with WSPRC was in response to "uncontrolled public use" which "created litterbug and sanitation problems" (Laythe 1959 pers. comm.) and was designed to convey authority to WSPRC to manage and regulate recreational activities, including camping and picnicking, on the non-wilderness portion of Matia Island and on the whole of Turn Island. As a result of that and subsequent modified MOUs, WSPRC has served as the primary law enforcement agency on Turn and Matia Islands. In a 2007 meeting, WSPRC staff indicated that Turn Island typically has a much higher law enforcement incident rate than other State Marine Parks (USFWS 2007a).

5.5 Other Refuge Uses

5.5.1 Proprietary Uses

United States Coast Guard
The U.S. Coast Guard operates and maintains a number of aids to navigation structures on or immediately adjacent to refuge islands in the San Juan Islands and Protection Island. Nineteen of these are covered under a 2005/2006 MOU. Also see Appendix A and Appendix E.

NOAA
The National Oceanic and Atmospheric Administration's National Data Buoy Center established the Coastal-Marine Automated Network (C-MAN) for the National Weather Service in the early 1980s. A C-MAN Station (S1SW1) was established on Smith Island in 1984. The development of C-MAN was in response to a need to maintain meteorological observations in U.S. coastal areas. Such observations, which had been made previously by USCG personnel, would have been lost as many USCG navigational aids were automated under the Lighthouse Automation Modernization Program.

C-MAN station data typically include barometric pressure, wind direction, speed and gust, and air temperature; however, some C-MAN stations are designed to also measure sea water temperature, water levels, waves, relative humidity, precipitation, and visibility. The station on Smith Island is mounted on a tower and is powered by marine batteries charged with solar cells. Standard meteorological data has been collected since 1984 and continuous wind data since 1997.

5.5.2 Non-proprietary Uses

Island Oil Spill Association, San Juan County
Island Oil Spill Association (IOSA) is a unique, community-based, private non-profit organization that provides a range of response services including initial assessment, containment and clean-up, and oiled wildlife rescue. The association is volunteer-based with more than 200 trained responders. It is fully recognized by the U. S. Coast Guard as a Federal Oil Spill Response Organization and by the Washington State Dept. of Ecology as an Approved Primary Response Contractor. It has field-tested and developed 54 geographic response plans to protect the most sensitive resources in the San Juan Islands area. The refuge has worked with this group by providing anchoring points on Fortress, Crab, and Blind Islands to help with the deployment of containment booms.

Low Island – Yellow Island Marine Research Preserve
Working with the University of Washington Friday Harbor Lab and The Nature Conservancy, the refuge has permitted the placement of two signs on Low Island. These signs inform the public that the area around Low and Yellow Islands is a marine research preserve and a no fishing area.

5.6 Regional Recreational Opportunities

5.6.1 Hunting

The quantity of **waterfowl hunting** near the refuges is low in comparison to the rest of Washington State (Davison 2008 pers. comm.). Dabbling ducks such as mallards, wigeons, and pintails are hunted primarily by local residents on bays, inlets, ponds, lakes, and other public and private wetland areas. However, due to an increasing interest in hunting sea ducks including scoters, harlequin, and long-tailed ducks, the North Puget Sound area has become a “destination” for sea duck hunting (WDFW 2007, WDFW 2008b**,** Nysewander 2008 pers. comm.). Sea duck hunting guides in the area attract a growing clientele of domestic and international hunters (Davison 2008 pers. comm.) interested in a “once-in-a-lifetime” opportunity to hunt these unique species of ducks (Peninsula Sportsman 2008, Wings and Waves 2008). Most of the sea duck hunting seems to occur from areas close to the mainland (outfitters and guides operate out of Quimper Peninsula and Skagit Valley area shorelines). Boats typically used for sea duck hunting are not well equipped to make the often challenging crossing from the mainland to the islands.

Island County has the highest sea duck harvest numbers in the state (WDFW 2008b). Skagit and Whatcom Counties are also among the highest while Jefferson County has lower sea duck harvest averages. In San Juan County, 2007 was the first year that any sea duck harvests were reported since mandatory reporting started in 2004. If interest in sea duck hunting continues to grow it is likely to increase in this county as well (WDFW 2008b). As resident goose populations rapidly increase in the San Juans, goose hunting opportunities are increasing because more private landowners are opening their properties to hunters (Davison 2008 pers. comm.).

There are limited opportunities for **deer hunting** near either refuge. In the vicinity of Protection Island NWR, there is a small amount of public land open to deer hunting in the northern portions of Quimper and Miller Peninsulas and in the Sequim vicinity. In addition, a few nearby private landowners allow hunting on their properties (Schirato 2008 pers. comm.).

Island County allows public hunting on three of their Whidbey Island properties near Greenbank and Penn Cove (Joantha Guthrie 2008). In the San Juan Islands area there are high concentrations of deer, but most land is privately owned (WDFW 2008a) and San Juan County requires hunters on private land to carry written permission from the landowner to hunt (San Juan County Code 9.08.040). Because public hunting is limited and the best opportunities are on private lands, primarily local residents engage in these nearby deer hunting opportunities (Milner 2008 pers. comm.).

5.6.2 Fishing

There are numerous charter operators in the region that specialize in fishing throughout the San Juan Islands area. A handful of charters operate out of harbors within the San Juan Islands while others operate from harbors in nearby Anacortes and Bellingham. In addition, the waters around the San Juan Islands offer endless opportunities to fish from private vessels. While lingcod and other bottomfish are the most common targets, fishing for salmon is also popular. Unlike the San Juan Islands, few charter fishing operations are based near Protection Island. However, the area is popular with local sport fishers.

It is estimated that more than 10% of the State's residents participate in recreational saltwater fishing from private vessels while less than 2% do so from charter vessels (RCO, 2007). The peak sport fishing season in the San Juan Islands begins in May for most species and continues through September. Lingcod, with a very short peak season occurring in May and June, is one of the most popular species. Other species with peak seasons from May through September as well as generally good fishing during the non-peak months support a year-round draw for the industry. The peak month for participating in saltwater fishing from charter vessels is May, while the peak month for fishing from private vessels is July (RCO, 2007).

5.6.3 Diving

There are many popular dive sites throughout the San Juan Islands and associated areas. Attractions in the San Juan region often include diving the steep vertical island and rock edges, commonly known as walls. There are a few wrecks that also attract divers. WSPRC manages three underwater state parks in the region and many of the marine parks that they manage offer shore diving opportunities. Several commercial operators offer diving charters throughout the island waters. Purchases related to diving needs and services contribute to the local economies, but likely not as strongly as sea kayaking, and certainly not as strongly as whale watching. Some of the well-known and/or frequented sites are listed in Table 5.2.

Table 5.2, Nearby Popular Diving Locations

Shore diving locations near PINWR		Boat diving near PINWR
Port Townsend	• North Beach Park • Fort Worden State Park	• None
Whidbey Island	• Fort Casey Underwater State Park (Keystone)	
Shore diving locations near SJINWR		**Boat diving near SJINWR**
Lopez Island	• Odlin County Park • Spencer Spit State Park • Agate Beach County Park	• Pea Pod Rocks * • Cone Islands • Brown Rock • Brown Rock • Henry Island • Spieden Island • Turn Island * • Doe Island • Frost island • James Island • Long Island • Patos Island • Sucia Island • Iceberg Island • Bell Island • Matia Island * • Waldron Island • Jones Island
Orcas Island	• Doe Bay • West Beach • Lover's Cove	
San Juan Island	• Reuben Tarte Picnic Area • San Juan County Park • Lime Kiln Point State Park • Deadman Bay • Eagle Cove • South Beach • Smallpox Bay	
Stuart Island	• Turn Point	
Whidbey Island	• Washington Park • Rosario Beach • Burrows Pass	

Sources: Fischnaller 2000. Northwest Diver 2007. Pratt-Johnson 1994, San Juan Islands Directory 2007, Washington State Parks and Recreation Commission 2007b

Note: * indicates Service-managed lands where diving activities may be impacting refuge wildlife.

5.6.4 Wildlife Observation and Photography

Wildlife Observation and Photography
Washington State offers some of the most fantastic and unique opportunities to view and photograph wildlife in the U.S. In particular, the areas around Protection Island and the San Juan Islands offer endless opportunities to experience rare sea birds such as tufted puffins, rhinoceros auklets, and black oystercatchers. These rich waters are home to large numbers of marine mammals, including seals, porpoises, and whales, as well as a myriad of other creatures. It is estimated that nearly 40 percent of Washington residents participated in nature and wildlife observation and photography in 2006 (RCO, 2007), although the actual percentage may be well over that (IAC, 2003). The Washington State Recreation and Conservation Office's 2006 Outdoor Recreation Survey reported such activity occurred more than 35 million times that year. Participation in nature-related activities is growing in popularity in Washington and is expected to increase significantly in coming years (IAC, 2003).

San Juan Islands
There are many opportunities for wildlife observation near the refuge. While many of the commercial wildlife observation charters focus specifically on whales, most offer seabird viewing when opportunities arise. The majority of the charter operators are members of the local whale spotting network and Whale Watch Operators Association which includes at least 30 operators. But there are at least another dozen operators who are not members of the association. Most companies offer whale watching cruises along the west side of San Juan Island, although they will go just about any place where whales are present. In addition, destinations for seabird and marine mammal viewing include Spieden, Cactus, Flattop, Goose, Long, Yellow, and O'Neill Islands and Whale and Sentinel rocks. Whether commercial or private, marine mammal and seabird observation and photography are popular activities throughout the islands.

Whale watching and sightseeing guided tours serve more than 50,000 – and possibly as many as 100,000 – visitors to the islands each year. Of those completing the 2005 and 2006 San Juan Islands Visitors Bureau exit surveys, between 38 and 51 percent marked whale watching as the favorite part of their trip. Whale watching is second only to dining and shopping for activities in which visitors completing the surveys engaged. Whale watching and sightseeing is likely one of the top economic resources for the region.

Protection Island
The Port Townsend Marine Science Center offers opportunities to view seabird colonies on their cruises around Protection Island. Observers are also likely to catch a glimpse of seals hauled out to rest along the shores of Protection Island. In addition, Protection Island waters are a popular destination for private vessels including kayaks, sailboats, and power boats. Although the Island is closed to the public and vessels are required to remain a minimum of 200 yards from shore to minimize disturbances, there are ample opportunities to view seals and seabirds in the waters around the island and onshore, especially with the aid of binoculars.

5.6.5 Environmental Education and Interpretation

Walla Walla University offers summer marine biology courses at its Rosario Beach Marine Laboratory in Anacortes; students attending these summer courses routinely examine the marine flora and fauna present in the San Juan Islands. For the past 10 years, Professor Jim Nestler has incorporated data produced by students studying inter-tidal areas around Swirl Rocks in annual marine invertebrate surveys.

A variety of other natural and cultural education and interpretation programs and facilities are available near the refuges (See Table 5.3). They are primarily managed by the WSPRC; the National Park Service, and the Port Townsend Marine Science Center. Unfortunately the lack of funding in recent years has reduced or eliminated the environmental education opportunities at several State Parks Environmental Learning Centers in the region (Graham 2007 pers. comm.). This trend of reduced services at State Parks is likely to continue at least into the near future due to budget reductions (Niel 2009 pers. comm.)

Table 5.3, Area Environmental Education & Interpretation Opportunities

Facility by Location	Focus	Features
San Juan Island		
Lime Kiln Point State Park	▪ Whale watching ▪ Local history	▪ Lighthouse tours ▪ Self-guided, signed interpretive trail ▪ Interpretive center ▪ Seasonal guided walks and marine mammal programs
American Camp **San Juan Island National Historical Park**	▪ Local history	▪ Visitor center ▪ Environmental education programs ▪ Signed interpretive walks ▪ Encampment re-enactments ▪ Wildlife viewing
English Camp **San Juan Island National Historical Park**	▪ Local history	▪ Royal marine barracks contact center ▪ Environmental education programs ▪ Signed interpretive walks ▪ Encampment re-enactments ▪ Wildlife viewing
Orcas Island		
Camp Moran **Moran State Park**	▪ Wetlands ▪ Old growth forest ▪ Forest ecology	▪ Nature programs for youth ▪ Kayaking ▪ Backpacking
Moran State Park	▪ Local history ▪ Beach ecology ▪ Old growth forest ▪ Forest ecology	▪ Jr. Ranger program ▪ Interpretive story of Robert Moran ▪ Low tide beach walks ▪ Self-guided interpretive trail with signage ▪ History talks ▪ Family nature crafts ▪ Guided hikes to waterfall and through old growth forest ▪ Campfire program
Blake Island		
Blake Island State Park	▪ Native plants ▪ Trimble Estate history	▪ Signed nature trail ▪ Historic interpretive signage
Whidbey Island		
Bowman Bay Interpretive Center **Deception Pass State Park**	▪ Wetlands and sand dunes ▪ Samish Indian Nation story ▪ Discovery and naming of Deception Pass and Whidbey Island	▪ Maiden of Deception Pass story pole ▪ Historic interpretive signage ▪ Frequent weekend and evening lectures and slide shows
Port Townsend		

Facility by Location	Focus	Features
Port Townsend Marine Science Center **Fort Worden State Park**	▪ Marine ecosystems ▪ Intertidal ecosystems	▪ Protection Island wildlife cruises ▪ Touch tanks ▪ Marine exhibit ▪ Natural history exhibit
Fort Worden State Park	▪ Local military history	▪ Coastal Artillery Museum ▪ Commanding Officer's Quarters ▪ Rothschild House
Marrowstone Island		
Fort Flagler State Park	▪ Local military history	▪ Military museum ▪ Historic buildings

Sources: Washington State Parks and Recreation Commission 2008b, National Park Service 2008, Personal Communications: Linda Sheridan and John Graham, Washington State Parks and Recreation Commission.

5.6.6 Camping

There are more than 400 public campsites within 15 miles of Turn and Matia Islands (See Tables 5.4 for Matia and 5.5 for Turn). Another 400 private campsites are available on San Juan, Orcas, Lopez, and Canoe Islands (Doe Bay Resort 2007, Lucas 2004, Mitchell Bay Landing 2007, Mueller and Mueller 1985, NW Source 2007, San Juan County Parks 2005, San Juan Islands Directory 2007, TheSanJuans.com 2007, SanJuansSite.com 2007). Many of these campgrounds are accessible from the saltwater shoreline, but a few are located off the water.

The Washington State Parks and Recreation Commission (WSPRC 2007b) and the Washington Department of Natural Resources (WDNR) manage 7,006 acres for parks and recreation within San Juan County including Moran State Park, Washington's largest state park (San Juan County 2005). These State-managed properties include 282,886 linear feet of shoreline, 368 camping sites, and 108 day-use sites (San Juan County 2005).

San Juan County manages 3 camping facilities with a total 112 campsites (San Juan County 2005). These three parks total approximately 152 acres with 11,195 linear feet of shoreline (San Juan County 2005). The County also manages several day-use only park facilities.

Table 5.4, Designated Public Camping Facilities Within 15 Miles of Matia Island

Campground	Miles to Matia	Acres	Saltwater Shoreline (linear feet)	Campsites	Mooring Buoys	Firepits	Water	Toilets	Hiking Trails	Setting
Sucia Island Marine State Park	1.5	564	77,700	55	48	▪	▪	▪	▪	Forest, rock cliffs
Clark Island Marine State Park	4	55	11,292	7	9	▪		▪		Forest, sandy beaches, rock outcrops
Patos Island Marine State Park	6	207	20,000	7	2	▪		▪	▪	Forest, sandy beaches, rock outcrops

Campground	Miles to Matia	Acres	Saltwater Shoreline (linear feet)	Campsites	Mooring Buoys	Firepits	Water	Toilets	Hiking Trails	Setting
Moran State Park	5	5,252	-	151	-	▪	▪	▪	▪	Old growth forest, lodge pole pine forest, freshwater lakes and shoreline
Obstruction Pass Park	9	80	450	11	3	▪		▪	▪	Forest, tide pool shoreline
Doe Island Marine State Park	9	6	2,000	5	-	▪		▪	▪	Forest, rock outcrops
Lummi Island DNR	12	ND	ND	10	1	▪		▪	▪	Forest
Pelican Beach DNR (Cypress Is.)	12	*	*	*	*	▪		▪	▪	Forest
Cypress Head DNR (Cypress Is.)	14	*	*	*	*	▪		▪	▪	Forest
Strawberry Island DNR	13	*	*	*	*	▪		▪		Forest
TOTALS		**6,164**	**77,700**	**246**	**63**					

ND = No Data
DNR = WA Department of Natural Resources
*These numbers are included in Table 3.
Sources: Mueller and Mueller 1995, NW Source 2007, San Juan County Parks 2007, San Juan Islands Directory 2007, TheSanJuans.com 2007, SanJuansSite.com 2007, Washington State Department of Ecology 2007, Washington State Department of Natural Resources 2007, Washington State Parks and Recreation Commission 2007b.

Table 5.5, Designated Public Camping Facilities Within 15 Miles of Turn Island

Campground	Miles to Turn Island	Acres	Shoreline (linear feet)	Campsites	Mooring Buoys	Firepits	Water	Toilets	Hiking Trails	Setting
South Beach County Park (Shaw Is.)	2	60	4,610	11	-	▪	▪	▪	▪	Woods
Blind Island State Park	2	3	1,280	4	4	▪		▪		Rocky, scrub-shrub
Odlin County Park (Lopez Is.)	4	80	3,960	30	Y	▪	▪	▪	▪	Old growth forest, forest, sandy beach, steep cliffs
Griffin Bay State Park (San Juan Is.)	4	15	340	4	2	▪	▪	▪		Woods, grassy meadow
Jones Island Marine State Park	6	188	25,000	21	7	▪	▪	▪	▪	Forest, sandy beaches, rock outcrops
Spencer Spit Marine State Park (Lopez Is.)	8	138	7,800	50	12	▪	▪	▪		Saltwater marsh
San Juan County Park (San Juan Is.)	8.5	12	2,700	20	Y	▪	▪	▪		Gravel beach, rocky bluffs, woods
Posey Island Marine State Park	11	1	1,000	2	-	▪		▪		Woods, rock island
James Island Marine State Park	11	113	12,335	13	4	▪		▪	▪	Forest, rock outcrops, cliffs
Strawberry Island	11	ND	ND	3	-	▪		▪		Forest

Campground	Miles to Turn Island	Acres	Shoreline (linear feet)	Campsites	Mooring Buoys	Firepits	Water	Toilets	Hiking Trails	Setting
Pelican Beach (Cypress Is.)	12	ND	ND	3	6	▪		▪	▪	Forest
Cypress Head (Cypress Is.)	14	ND	ND	9	4	▪		▪	▪	Forest
Stuart Island Marine State Park	14	153	33,030	22	22	▪	▪	▪	▪	Forest, meadow, sandy beaches, rocky shores
TOTALS		**763**	**92,055**	**192**	**61+**					

ND = No Data
Sources: Mueller and Mueller 1995, NW Source 2007, San Juan County Parks 2007, San Juan Islands Directory 2007, TheSanJuans.com 2007, SanJuansSite.com 2007, Washington State Department of Ecology 2007, Washington State Department of Natural Resources 2007, Washington State Parks and Recreation Commission 2007b.

5.6.7 Beaches and Beach Activities

There are many public beaches throughout the San Juan Islands and along the shores of the Quimper and Miller peninsulas. Among local residents, beachcombing and other beach-related activities are popular. In a recent survey of residents of San Juan and Island counties, beachcombing was ranked third out of fourteen water activities most engaged in by survey participants (RCO 2007). In the same survey, swimming or wading at fresh or saltwater beaches was ranked second (RCO 2007). This survey is discussed in greater detail in the regional recreation rates and trends section below. Although all of the beaches on refuge islands are closed to the public, except Rolfe Cove on Matia Island and a small portion of the Turn Island shoreline, there are many open beaches near refuge islands. See the table titled Beaches in the Vicinity of Protection Island NWR and San Juan Islands NWR, Appendix D.

5.6.8 Boating

Many areas with boat access throughout the San Juan Islands, Quimper Peninsula, and Whidbey Island provide a variety of regional access options. Most of the marinas provide some guest moorage and many of the public parks and campgrounds offer mooring buoys and/or anchorages. Limited boat launches are scattered throughout the main islands. Powerboat cruising, sailing, and kayaking are all popular means of boating throughout the archipelago.

Motorized boating (including sailboats that typically have auxillary motors)
Motorized boat users visit the refuge from locations throughout the region, including the major metropolitan areas around Seattle, Washington, and Vancouver and Victoria, B.C. Popular mainland departure locations close to refuge islands include marinas, harbors, and parks in the northeast Olympic Peninsula, Anacortes and Bellingham areas. In the San Juan Islands area, motorized boat traffic concentrates at towns (e.g., Friday Harbor), harbors (e.g., West Sound), and resorts (e.g., Rosario and Lopez Islander). From these locations, motorized boaters explore a variety of campgrounds and beaches throughout the San Juan Archipelago.

Human-powered boating (including kayaks and canoes)
Human-powered boaters also visit major harbors and parks throughout the mainland and San Juan Islands, but often prefer launch sites and destinations not frequented by motorized boaters. Smaller state and county parks are popular with human-powered boaters, especially sites associated with the Cascadia Marine Trail. Short loop trips near cities are especially popular (e.g., Deception Pass and Cypress Island)

while paddlers with more time look for more remote places such as Stuart or Sucia Islands. The nature of human-powered boating allows for access to many undeveloped areas that are popular for picnicking, beachcombing, clamming, and other informal activities.

Sea kayaking in the San Juan Islands is a favorite local past time and the area is considered one of the top ten sea kayaking destinations in the United States (GORP 2008). The Islands are highlighted as a choice autumn destination for sea kayaking (Bune 2001 in GeatOutdoors.com 2008). Olinger (2008) describes the San Juan Islands as "…a plethora of jewels that touring buffs fervently take to in good and sometimes even bad weather." With islands close together, paddlers can enjoy time both on the water and the shoreline throughout a day of paddling (GORP 2008). In addition, the local marine wildlife, unsurpassed scenery, and charm of their quiet isolation and small villages make the islands a coveted destination of many paddlers (GORP 2008).

Among local residents, kayaking is a popular activity. In a recent survey of residents of San Juan and Island counties, kayaking/canoeing/rowing was ranked 4th out of 14 water activities most engaged in by survey participants (RCO 2007). In the same survey, the statewide rank for this activity category was only slightly lower, at 5th place, indicating that hand-powered boating opportunities are not just a locally preferred sport, but rather are valued across the state. This survey is discussed in greater detail in the regional recreation rates and trends section below.

Commercial outfitters
There is no shortage of commercial kayaking outfitters serving the San Juan Islands. More than 25 outfitters, most located within the immediate islands area, offer San Juan Islands paddling trips. Kayak outfitters and guides favor the west side of San Juan Island, as this is also primary whale watching territory. Many offer overnight camping trips to Stuart Island as this is (relatively) easily accessed from the west side of San Juan Island.

There is also a common paddle route from Stuart Island along Spieden Island and through the Cactus Islands en route to Jones Island. Jones Island is another common overnight camping stop for multi-day paddles. Many of these trips return to San Juan Island at Friday Harbor. Outfitters out of Anacortes tend to guide trips through the eastern islands as the outer islands are quite some distance to paddle if a mother ship is not utilized. Outfitters are reluctant to report the numbers of visitors served each year, but it is safe to say that this activity is very popular.

Cascadia Marine Trail is one of the premier water trails for human-powered boaters in the United States. Designed for kayaks, canoes, and other non-motorized beachable boats, the water trail offers unsurpassed views of Northwest scenery and wildlife while providing access to pullouts, campsites, and other public amenities along the way (WSPRC 2008c). Since 1993 thousands of state residents and visitors have traveled on the water trail that extends the length and width of the Salish Sea from the state capitol in Olympia to the Canadian border (WWTA 2008).

The Cascadia Marine Trail is an inland sea National Recreation Trail and is designated as one of 16 National Millennium Trails by the White House (WWTA 2008). There are over 50 campsites along the trail that can be accessed by boating from many public and private launch sites or shoreline trailheads (WWTA 2008). Within the San Juan Islands, there are many campgrounds along the trail, including:

- Blind Island State Park
- Griffin Bay
- James Island State Park

"The primary goal of the Cascadia Marine Trail is to secure camping areas every 5 to 8 miles for the safety of non-motorized boaters traveling on Puget Sound waters. The length of Puget Sound shoreline, according to various sources, is between 1,800 and 2,300 miles. The trail will be considered complete at a point in time when there are between 225 and 460 campsites." Washington Water Trails Association.

- Jones Island State Park
- Obstruction Pass
- Odlin County Park
- Point Doughty
- Posey Island State Park
- San Juan County Park
- Shaw County Park
- Spencer Spit State Park
- Stuart Island State Park

5.6.9 Hiking Trails

The National Park Service manages several miles of trails at San Juan Island National Historical Park. The WSPRC and WDNR manage approximately 47 miles of trails in San Juan County, including 33 miles within Moran State Park (San Juan County 2005). San Juan County manages a minimal number of walking trails at a few County parks.

5.6.10 Other Recreation

Geocaching is becoming a popular activity throughout the islands. There are several known locations throughout the area where caches are located (Geocaching 2007). Other recreation occurring on the main islands includes bicycling and visiting historic places.

5.7 Regional Recreation Rates and Trends

The Washington State Recreation and Conservation Office (RCO), formerly the Interagency Committee for Outdoor Recreation (IAC), advises the State on matters of outdoor recreation. The RCO conducts inventories of outdoor recreation sites and opportunities, conducts studies of recreational participation and preferences, and periodically releases documents related to overall state outdoor recreation. The most recent release is the 2006 Outdoor Recreation Survey (formerly, the State Comprehensive Outdoor Recreation Planning Report – SCORP Report).

5.7.1 Washington Tourism

In 2008, visitors to Washington spent $15.7 billion and travel spending accounted for 3.8% of all jobs statewide. Tourism is one of the top 5 industries in the state (VS, 2009) and continues to be a critical element for the viability of local communities. Local economies where Protection Island NWR and the San Juan Islands NWR are located rely heavily on visitors. For example, in San Juan County alone, more than 10% of all jobs were directly attributed to the travel industry (WSTC, 2008). Tourism accounted for 28% of all state and local tax dollars generated countywide in 2006, making it a key segment of the area's economy. In addition, local tourism in San Juan County continues to grow faster than almost every other county in the state (SJIVB, 2006).

5.7.2 Outdoor Recreation Participation Rates

The most recently released survey report (RCO 2007) identified 15 major categories of outdoor recreation, subdivided into 114 activity types or settings. Of these 15 major categories, walking/hiking is the number one activity with 74 percent of Washington residents participating in some type or setting of walking and/or hiking. Nature activity is the third most popular recreation, with 54 percent of residents enjoying some form of this activity. The report indicated observing/photographing nature and wildlife has a participation rate of 29 percent and that visiting interpretive centers has a participation rate of 15 percent among statewide residents.

The RCO also reported regional data for the same activity categories. "The Islands" region is comprised of Island and San Juan counties. There were 320 people surveyed in The Islands region and they engaged in a total of 94,526 outdoor activity occurrences over the course of the year 2006. The highest average participation rates were in sightseeing and nature activities, 35 and 23 percent, respectively. The next most popular category, water activities, had a 16 percent average participation rate. The other categories all ranged between 12 and 15 percent.

5.7.3 Forecast for Regional Recreation Demand and Key Recreation Needs

Note: The following information is from the Washington State Recreation and Conservation Committee (**RCO**), formerly known as the Interagency Committee for Outdoor Recreation (**IAC**).

Overall, outdoor recreation in most categories continues to increase at high growth rates. In a recent technical report (IAC 2003), IAC projected future participation in 13 of 14 major outdoor recreation use categories over periods of 10 and 20 years. Nine of these activities will experience double digit growth.

These most recent estimates of recreation trends were based on the National Survey on Recreation and the Environment Projections for the Pacific Region (NSRE), which includes Washington State. IAC adjusted the NRSE projections as necessary based on age group participation, estimates of resource and facility availability, user group organization and representation, land use and land designations; and "other factors" including the economy and social factors. Table 5.6 shows the percent change expected for Washington State by activity as reported by IAC.

The 1995 assessment identified trails and environmental education as the two highest outdoor recreation needs in the state. Many outdoor activities generally permitted on Refuges are expected to show increases of 20 to 40 percent over the next 20 years. The exception is hunting, in which participation is expected to fall at about that same rate.

Table 5.6, Projected Participation Increases for Selected Outdoor Recreation Activities

Activity	Estimated Change, 10 years (2002-2012)	Estimated Change, 20 Years (2002-2022)
Walking	23%	34%
Hiking	10%	20%
Nature Activities (outdoor photography, wildlife observation, gathering and collecting, gardening, and visiting interpretive centers)	23%	37%
Fishing	-5%	-10%
Hunting / Shooting	-15%	-21%
Sightseeing (includes driving for pleasure)	10%	20%
Camping – developed (RV style)	10%	20%
Canoeing/kayaking	21%	30%
Motor Boating	10%	No estimate
Equestrian	5%	8%
Non-pool swimming	19%	29%

Source: IAC 2003.

In addition, the newly designated San Juan Islands Scenic Byway, which includes routes on both Orcas Island and San Juan Island (San Juan Islands Visitors Bureau 2008), may draw more recreation-seeking visitors to the vicinity of the San Juan Islands National Wildlife Refuge.

5.8 Socioeconomics

5.8.1 Socio-economic Baseline Setting

The study area for estimating the economic effects of the recreational use of the refuges is defined as Island, Jefferson, San Juan, Skagit, and Whatcom counties. The Protection Island NWR is wholly contained within Jefferson County, which was established in 1852. Port Townsend is the county seat and the only incorporated city within the County.

The San Juan Islands NWR is predominantly located in San Juan County with some islands located in neighboring Island, Skagit, and Whatcom counties. San Juan County was established in 1873 and contains 176 named islands and reefs (with up to 743 at low tides). The largest islands in the County are San Juan, Orcas, Lopez, and Shaw, all of which are served by the Washington State Ferry System. The nearest major population centers are Victoria and Vancouver, B.C., and Seattle, WA. The County seat is Friday Harbor, located on San Juan Island.

Smith and Minor islands, the two most southern of the San Juan Islands NWR islands, are located in Island County. Island County was established in 1852 and consists of two large islands (Whidbey and Camano) and several smaller islands. The county seat is located on Whidbey Island at Coupeville. The largest city is Oak Harbor, also on Whidbey Island.

Eliza Rock, Viti Rocks, and Three Williamson Rocks, the eastern-most features of the San Juan Islands NWR, are located in Skagit County. Skagit County was established in 1883. Mount Vernon is the largest city and the county seat. Other incorporated cities within Skagit County include Anacortes, Burlington, Concrete, Hamilton, La Conner, Lyman, and Sedro Woolley.

The Whatcom County boundary lies at the eastern edge of the San Juan Islands NWR. The county was established in 1854. The largest city, Bellingham, is the county seat. Other major communities within the county include Lynden, Everson, Ferndale, Sumas, Nooksack, and Blaine.

5.8.2 Population Data and Trends

Growth Rate

Between 1980 and 2000, all five area counties, Island, Jefferson, San Juan, Skagit, and Whatcom, grew at a rate well above the Washington State average and substantially above the rate for the United States. The one exception is from 1990 to 2000, when Island County grew at a rate slightly less that that for the state. The other four counties experienced a higher rate of growth during the 1990 to 2000 period than in the 10 years prior (U.S. Census Bureau).

Density

Based on the 2000 census data, of the five-county area containing the refuges, Island County has the highest density at 344 people per square mile, nearly four times greater than the state density of 88.6 people per square mile. Jefferson County density is only 14.3 people per square mile, about 1/6 of the state density. Less extreme are San Juan, Skagit, and Whatcom counties with 80.4, 59.4, and 78.7 people per square mile, respectively (U.S. Census Bureau).

Age Distribution

In general, the five counties follow the state trend with the majority of the population falling between the ages of 18 and 65 years old. The next highest percentage age group in the state is persons under 18 years of age (23.6 percent). Island, Skagit, and Whatcom counties have similar percentages (22.5, 23.5, and 21.5, respectively), while Jefferson and San Juan counties differ in the trend. Jefferson and Skagit counties have a higher percentage of retiree-age population (21.5 and 21.1, respectively). In all cases, county and state, the lowest age category percentage is those under 5 years old (U.S. Census Bureau).

5.8.3 Low Income and Minority Populations

Each of the five counties has a smaller percentage of minority population (86.5 – 95.0 percent) than the overall United States percentage (75.1 percent) and the Washington State percentage (81.8 percent). The percent of people below the poverty level in the five counties varies from below to above (7.0 percent - 14.2 percent) the national and state values (12.4percent and 10.6percent, respectively) (U.S. Census Bureau).

5.8.4 Economic Base of the Surrounding Area

Employment

Among all five counties, the largest employment sectors in both 2000 and 2005 were in construction, manufacturing, retail trade, health care and social assistance, and accommodations and food services. However, business sectors experiencing the most growth between 2000 and 2005 varied by county. In Island County, the highest positive percentage change (growth) was seen in the professional, scientific, and technical services sector (29.59 percent) and the highest negative percentage change (decline) was in the unclassified establishments sector (-91.89 percent), followed by finance and insurance (-29.53percent). The most growth in Jefferson County was seen in the real estate and rental and leasing sector (55.56 percent) and the largest decline in transportation and warehousing (-28.95 percent). In San Juan County, the highest growth was seen in the finance and insurance sector (99.13 percent) and the largest decline in the transportation and warehousing sector (-21.11 percent). Between 2000 and 2005, Skagit County experienced the most employment growth in the wholesale trade sector (89.03 percent) and the most employment decline in the arts, entertainment, and recreation sector (-33.07 percent). Whatcom County saw its highest employment growth in the health care and social assistance sector (40.14 percent) and its sharpest decline in the management of companies and enterprises sector (-74.82 percent).

Overall, employment growth in Island, Skagit, San Juan, and Whatcom counties outpaced state growth from 2000 to 2005. Washington State experienced an overall 2.15 percent growth in employment between 2000 and 2005. Island, Skagit, San Juan, and Whatcom counties experienced 5.35, 13.36, 7.03, and 14.14 percent growth, respectively, during the same time period. Jefferson County experienced a 0.64 percent growth in employment from 2000 to 2005, nearly one-fourth of the state growth during that same time frame (U.S. Census Bureau).

Personal Income and Employment Earnings

In general, per capita personal incomes (PCPI) for Island, Jefferson, Skagit, and Whatcom county residents from 1979 to 1999 mirror the Washington State trend. However, San Juan County had a much higher growth rate. From 1979 to 1989, San Juan County PCPI increased more than 45 percent compared to the next highest rate of 17 percent and 13 percent for Island and Whatcom counties respectively. However, from 1989 to 1999, PCPI increases in the four other counties were similar to San Juan County. When PCPI growth is combined for both decades, San Juan County experienced a 112 percent increase while the four other counties sustained more moderate increases between 64 and 80 percent averaging 71.4 percent, just above the Washington State average of 69.82 percent and below the U.S. average of 76.6 percent for the same 20 year period (U.S. Census Bureau).

5.8.5 Recreation and Economic Uses of Refuges

The economic significance of refuge visits nationally has been estimated to be nearly $1.4 billion (2004 US dollars [2004 USD]) (Caudill and Henderson 2005). Caudill and Henderson (2005) report approximately $154,000 (2004 USD) from USFWS Region 1 (including Washington, Oregon, California, Idaho, and Nevada at the time of publication) contributed to the national economic significance figure. More localized studies and modeling of the economic impacts to local communities from the San Juan Islands and the Protection Island NWRs has not been undertaken. Some generalizations about recreation impact on the local socioeconomics can be drawn based on other readily available information.

Matia and Turn Islands are the only refuge islands which allow camping and day use. Visitation records from 1986 through 2004 indicate that each of these two islands averages between 8,000 and 11,000 day and overnight visitors each year. Over time, the two islands have consistently been used by more visitors for day use activities than for overnight camping.

In addition to Turn and Matia, all of the islands comprising the San Juan Islands and Protection Island NWRs provide vessel-based wildlife viewing opportunities for visitors to the area. Some of the most popular uses of the surrounding waters include whale and wildlife watching tours. Other regionally important recreation occurring in the waters surrounding both refuges includes recreational boating, including motorized and personal watercraft, deep-sea sport fishing, and underwater diving. Other water-dependent recreation known to occur on islands within the San Juan Archipelago, but not necessarily on those that are part of the refuges, include beach-related activities (beachcombing, picnicking, hiking, etc), waterfowl hunting, interpretation and environmental education activities, and some geocaching.

The San Juan Islands Visitors Bureau conducts occasional surveys of people visiting the islands. Tourism is a major economic base for the islands. While Washingtonians make up more than 20 percent of the visitors to the islands, nearly half the visitors surveyed are from other parts of the Unites States. A small percentage of those surveyed arrived by personal watercraft or by airplane but the vast majority of visitors to the islands rely on the Washington State Ferry system. Approximately 75 percent of the visitors surveyed were there for leisure.

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Chapter 6. Environmental Consequences

6.1 Overview of Effects Analysis

The effects analysis was developed by identifying resources associated with the physical, biological, and human environment identified in Chapters 3 through 5 of the Draft CCP/WSP/EA that may be impacted by the various alternative strategies presented in Chapter 2. The potential effects to those resources as a result of implementing the strategies described under each alternative were then assessed. Alternatives are compared within each topic area. In general, Alternatives B and C are compared to Alternative A (Current Management), which presents a baseline. However, there are cases in which continuing the current management strategies (Alternative A) may also result in impacts.

The information used in this Draft CCP/EA was obtained from relevant scientific literature, existing databases and inventories, consultations with other professionals, professional knowledge of resources based on field visits, and experience. Subheadings have been included to guide the reader in understanding which types of management strategies are likely to affect each resource as not all management strategies affect each resource. Additional details on effects are contained within the Draft CCP/EA appendices as indicated throughout this chapter.

Cumulative impacts, including impacts to refuge resources from reasonably foreseeable events and impacts resulting from interaction of refuge actions with actions taking place outside the refuge, are addressed in the final section of this chapter. That discussion includes a brief discussion on potential impacts of climate change to refuge resources.

6.1.1 Terminology

Effects were assessed for scope, scale, and intensity of impacts to resources. Effects may be identified further as beneficial or negative as well as long-term or short-term.

Beneficial and negative effects can be defined on a scale from negligible to major.

- **Negligible:** Resources would not be affected, or the effects would be at or near the lowest level of detection. Resource conditions would not change or would be so slight there would not be any measurable or perceptible consequence to a population, wildlife or plant community, recreation opportunity, visitor experience, or cultural resource.
- **Minor:** Effects would be detectable but localized, small, and of little consequence to a population, wildlife or plant community, recreation opportunity, visitor experience, or cultural resource.

Mitigation, if needed to offset negative effects, would be easily implemented and likely to be successful.

- **Intermediate:** Effects would be readily detectable and localized with consequences to a population, wildlife or plant community, recreation opportunity, visitor experience, or cultural resource. Mitigation measures would be needed to offset negative effects and would be extensive, moderately complicated to implement, and probably successful.
- **Major:** Effects would be obvious and would result in substantial consequences to a local area or regional population, wildlife or plant community, recreation opportunity, visitor experience, or cultural resource. Extensive mitigating measures may be needed to offset negative effects and would be large-scale, very complicated to implement, and may not have any guarantee of success. In some instances, major effects would include the irretrievable loss of the resource.

Time scales are defined as either short-term or long-term.

- **Short-term or Temporary:** An effect that generally would last less than a year or season.
- **Long-term:** A change in a resource or its condition that would last longer than a single year or season.

6.1.2 Integrated Pest Management

Potential effects to the biological and physical environment associated with the proposed site-, time-, and target-specific use of pesticides (Pesticide Use Proposals [PUPs]) on the refuge would be evaluated using scientific information and analyses documented in “Chemical Profiles” (see Appendix E). These profiles provide quantitative assessment/screening tools and threshold values to evaluate potential effects to species groups (birds, mammals, and fish) and environmental quality (water, soil, and air). PUPs (including appropriate Best Management Practices) would be approved where the Chemical Profiles provide scientific evidence that potential impacts to refuge biological resources and its physical environment are likely to be only minor, temporary, or localized in nature. Along with the selective use of pesticides, PUPs would also describe other appropriate IPM strategies (biological, physical, mechanical, and cultural methods) to eradicate, control, or contain pest species in order to achieve resource management objectives. The term pest species refers to both plant and animal pests (non-native rat, rabbit, red fox, domestic dogs and cats).

The effects of these non-pesticide IPM strategies to address pest species on refuge lands would be similar to those effects described elsewhere within this chapter, where they are discussed specifically as habitat management techniques to achieve resource management objectives on the refuge.

Based on scientific information and analyses documented in “Chemical Profiles”, pesticides allowed for use on refuge lands would be of relatively low risk to non-target organisms as a result of low toxicity or short persistence in the environment. Thus, potential impacts to refuge resources and neighboring natural resources from pesticide applications would be expected to be minor, temporary, or localized in nature.

6.2 Summary of Effects

A summary of the effects analysis is presented in Table 6.1 using the terms defined in section 6.1.1 above, to describe the magnitude of change from the current condition. Alternative A represents current management and therefore effects are often least for this alternative, even though there are many benefits to wildlife and habitats. Alternative A also serves as a baseline to compare the other two alternatives.

Table 6.1 Summary of Effects by Alternative.

	Alternative A	Alternative B	Alternative C
Effects to the Physical Environment			
Soils/Substrates	Minor negative impacts from continuing erosion associated with deer browsing, deer trails, and human social trails.	Minor to intermediate long-term beneficial effects from reduced soil erosion due to restoration efforts and deer removal from Protection Island. Some minor, short-term, negative effects during restoration activities.	Minor to intermediate long-term benefits but slightly less compared to Alternative B due to fewer acres restored.
Hydrology	Negligible effects.	Potential for minor to intermediate beneficial effects possible with restored wetland hydrology.	
Air Quality	Minor, beneficial effects from wildfire suppression.	Minor beneficial effects from wildfire suppression and better enforcement of no open recreational fires. Minor short-term and localized, negative effects from using prescribed fire for habitat restoration.	
Water Quality	Minor beneficial effects from oil spill prevention, marine debris clean-up, and removal of creosote pilings.	Minor to intermediate beneficial effects due to restoration efforts that would reduce erosion as well as enhanced oil and fuel spill prevention, marine debris clean-up, removal of creosote pilings, and other actions.	
Contaminant Levels	Minor beneficial effects from oil spill prevention, marine debris clean-up, and removal of creosote pilings.	Minor beneficial effects but slightly more than Alternative A due to actions that will reduce the risk of fuel spills from refuge and recreational boats.	
Effects to Habitats and Associated Species			
Shorelines	Negligible to minor beneficial effects from shoreline nourishment, wildfire suppression, and prohibition of open fires and driftwood collection.	Intermediate, long-term, beneficial effects from habitat restoration, shoreline nourishment, wildfire suppression, and better enforcement of unauthorized activities.	Minor beneficial effects due to fewer acres restored compared to Alternative B.
Sandy Bluffs	Intermediate negative effects due to deer presence, including erosion of bluff habitats.	Intermediate beneficial effects from removal of deer from Protection Island, removal of structures, modified transportation routes, habitat restoration and better enforcement of unauthorized activities.	
Savanna, Grasslands, and Balds	Minor negative and beneficial impacts from deer.	Intermediate beneficial effects from habitat restoration, rerouting the Turn Island trail, and removal of deer on Protection Island.	Similar to Alternative B however there would be minor beneficial effects due to fewer acres restored.

	Alternative A	Alternative B	Alternative C
Forests and Woodlands	Intermediate negative impacts from deer browsing woody vegetation. Minor to intermediate beneficial effects from wildfire suppression, prohibition of open fires, and prohibition on collecting downed wood.	Intermediate beneficial effects from removal of deer browsing impacts and habitat restoration of the former forest cover on Protection Island and prevention of wildfire for all forests on the Refuges.	Slightly more beneficial effects compared to Alternative B due to the removal and revegetation of some campsites on Matia Island.
Wetlands	Negligible effects.	Minor to intermediate beneficial effects likely if restoration of wetland hydrology is necessary and feasible for any of the 3 small wetlands on the refuges.	
Effects to Wildlife Resources			
Seabirds	Intermediate negative effects to glaucous-winged gulls from predation and the continued spread of invasive plant species, and to rhinoceros auklets and their nesting habitat from deer. Intermediate beneficial impacts from prohibition on collecting driftwood and marine debris clean-up.	Intermediate beneficial effects from restoration; deer removal on Protection Island; prohibition on driftwood collection; marine debris clean-up; non-native mammal predator surveys; and limiting shoreline access. Some temporary negative effects during removal of deer.	Slightly less beneficial effects compared to Alternative B due to fewer acres restored.
Bald Eagles	Minor to intermediate beneficial effects from wildfire suppression tactics.	Intermediate beneficial effects from wildfire suppression tactics, forest restoration, and reduced human-caused disturbance.	Slightly less beneficial effects compared to Alternative B due to less staff time dedicated to preventing disturbance.
Black Oystercatchers	Intermediate beneficial effects from continued prohibition on collecting driftwood.	Intermediate beneficial effects from continued prohibition on collecting driftwood and elimination of closed social trails on Matia and Turn Islands. Negative effects possible from improved predator habitat and respective breeding success.	

	Alternative A	Alternative B	Alternative C
Marine Mammals	Minor beneficial impacts from strategies that benefit water quality.	Intermediate beneficial impacts from increased marine debris cleanup activities and increased education and enforcement of shoreline access limitations.	Intermediate but slightly less beneficial effects compared to Alternative B due to less staff time dedicated to preventing disturbance.
Deer	Negligible short-term effects. Negative long-term effects from high density of deer on Protection Island leading to poor quality of health due to lack of food and/or water and disease.	Negative effects to deer on Protection Island from removal. Negligible effects on the surrounding regional deer population from the removal of deer on Protection Island.	
Effects to Wilderness, Cultural, and Paleontological Resources			
Wilderness Resources	Minor negative effect from unaddressed marine debris accumulations. Negative and beneficial effects from quantity of very large format regulatory signs.	Minor, mostly beneficial effects from decreasing campsites, eliminating illegal trails, reducing access, and strategies that restore and protect habitats. Negative and beneficial effects from very large and large format regulatory signs.	Similar to Alternative B except fewer regulatory signs would result in fewer benefits in terms of reducing human-caused wildlife disturbance and fewer negative impacts related to the visual distraction of regulatory signs.
Cultural Resources	Minor to intermediate negative effects of erosion, ground-disturbing activities, and lack of systematic surveys.	Intermediate beneficial effects as potential negative disturbances to cultural resources are minimized through surveys, research and monitoring, evaluation of known sites, and increased awareness.	
Paleontological Resources	Minor to intermediate negative effects of erosion, ground-disturbing activities, and lack of systematic surveys.	Intermediate beneficial effects as potential disturbances to paleontological resources are minimized through surveys, research and monitoring, increased awareness, and enforcement.	
Social and Economic Effects			
Research and Monitoring Program	Negligible effects.	Intermediate beneficial effects by providing more up-to-date, scientifically sound data from monitoring and assessments to guide refuge management. Additional intermediate beneficial effect from updating facilities, increased collaboration emphasizing partnerships, and additional outreach.	
Overall	Negligible effects	Overall refuge visitation	Beneficial impacts would

	Alternative A	Alternative B	Alternative C
Visitation	from refuge management actions. Overall visitation however is likely to increase due to the increasing popularity of the area.	numbers likely to increase due to the popularity of the area. Intermediate beneficial effects to the visitor experience from establishing camping reservation system, increasing interpretation and visitor contact. Minor negative effect due to reduced Turn Island access and number of campsites.	be the same as in Alternative B. There would be a minor to intermediate negative impact due to reduced Turn Island access and eliminating camping on Turn Island as well as reducing number of campsites on Matia Island.
Opportunities for Wildlife Observation and Photography	Negligible effects	Mostly minor beneficial effects from restoring and protecting habitats; decreasing human disturbance, enforcing pet regulations, and increased outreach and education.	
Opportunities for Environmental Education	Negligible effects	Intermediate, beneficial effects from strategies to foster public outreach and education. Also benefits from increased student opportunities.	Slightly less beneficial effects compared to Alternative B due to fewer staff to provide Environmental Ed. Programs.
Opportunities for Interpretation Experience	Negligible effects. Very little interpretation currently is provided.	Minor to intermediate, beneficial effects from increasing interpretive signage; developing the interpretive component on the Turn Island trail; increasing staffing commitments; and increasing public outreach and education.	Slightly less beneficial effects compared to Alternative B due to fewer interpretive signs.
Opportunities for Hunting Experience	Negligible effects.	Negligible to minor benefits from habitat enhancement that benefits sea ducks.	
Opportunities for Fishing Experience	Negligible effects.	Minor beneficial effects from enhanced actions to remove marine debris and contaminants from shorelines. Negligible to minor negative effects from increased education about voluntary boat-free zones around refuge islands.	
Opportunities for Camping Experience	Negligible effects.	Intermediate beneficial impacts from camping management strategies that include new reservation system. Intermediate negative and minor beneficial impacts from limiting camping to	Slightly less beneficial impacts compared to Alternative B due to eliminating camping on Turn Island.

	Alternative A	Alternative B	Alternative C
		visitors arriving by human powered boats and reducing the number of campsites on Turn Island.	
Human Health	Negligible effects.	Negligible effects.	Negligible effects.
Economy	Negligible effects.	Minor beneficial impacts expected from increased refuge expenditures. Negligible negative effects from reduced campsites on Turn Island.	Slightly less beneficial impacts compared to Alternative B due to fewer refuge expenditures and intermediate negative impact due to elimination of camping on Turn Island and reducing campsites on Matia Island.
Environmental Justice	Negligible effects.	Negligible effects.	Negligible effects.

6.3 Effects to the Physical Environment

Topics addressed under the physical environment section include the direct and indirect effects to soils/substrates, hydrology, air quality, water quality, and contaminant levels. None of the alternative actions are expected to have major effects to the physical environment of either Refuge.

6.3.1 Soils/Substrates

Effects from Habitat Management Strategies: Under all alternatives the continued nourishment of the Protection Island shoreline west of the marina would reduce the potential for erosion and improve shoreline conditions impacted by the marina's breakwater. This is expected to result in minor beneficial effects to the site-specific substrate for as long as the gravel source stockpiles remain. Cleaner soils and substrates are another minor beneficial effect anticipated from continued participation in oil spill prevention and preparedness planning.

Under Alternative A, allowing deer to remain on Protection Island would contribute to soil erosion from compaction, especially along deer trails and because of browsing, which reduces vegetation that can provide soil stability. Allowing unauthorized social trails to continue on Turn and Matia Islands within the San Juan Islands Refuge contributes to compaction and erosion. These are estimated to be minor negative effects to soils/substrates.

Under Alternatives B and C, native vegetation restoration actions on Protection Island are expected to decrease soil erosion in the long-term but may increase it slightly in the short-term until native plants are established. Soil quality would improve as areas are rehabilitated following structure removal and transportation route/mode adjustments. Removal of deer from Protection Island and removal of illegal social trails from Matia and Turn islands would decrease soil compaction and increase the quality and integrity of the soil. Overall, minor to intermediate long-term benefits are expected.

Under Alternative C, the beneficial effects would be similar to but slightly less than Alternative B because under Alternative C fewer acres would be restored to native vegetation.

Effects from Public Use Management Strategies: Allowing unauthorized social trails to continue on Turn and Matia Islands within the San Juan Islands Refuge contributes to compaction and erosion.

Effects to soils/substrates from implementing either Alternative B or C are expected to be predominantly beneficial because human disturbance and improper use/entry is limited under these alternatives. As access points are enforced and limited on Matia and Turn Islands, and the number of campsites is reduced, substrates and soils would be subjected to fewer and less frequent disturbances as a result of boat beaching/launching and accompanying foot traffic. Revegetation of removed campsites would also protect some soils on these two islands.

Effects from Research and Monitoring Strategies: Research strategies in both Alternatives B and C have the potential to indirectly impact soils. Initial plant inventories and studies that address vegetation restoration successes and erosion rates would inform future management decisions related to soils/substrates. The knowledge gained from these efforts would be applied for beneficial outcomes. In addition, standardized surveys for non-native herbivores such as European rabbits have the potential for intermediate, long-term, positive effects on soil stability and vegetative community health should management act quickly if rabbits are encountered. European rabbits reproduce rapidly and can denude small islands of vegetation in very little time. They are ubiquitous on San Juan and Lopez Islands and prairie habitats in San Juan Island National Historic Park have been degraded or eliminated as a result.

6.3.2 Hydrology

Effects from Habitat Management Strategies: Due to the lack of related strategies under Alternative A, it would have negligible impacts on hydrology. Alternatives B and C include potential restoration of wetland hydrology on Protection, Smith, and Matia Islands. If these alternatives are implemented, minor to intermediate beneficial effects are expected to result as flow patterns and sources are brought back to more natural hydrologic processes.

Effects from Research and Monitoring Strategies: Research strategies in both Alternatives B and C have the potential to indirectly benefit hydrology. Studies that address wetland hydrology sources would inform future management decisions related to wetland hydrology restoration.

6.3.3 Air Quality

Effects from Habitat Management Strategies: All alternatives include strategies to reduce the risk of fire. Effects from these habitat management strategies are expected to have negligible beneficial effects to air quality by reducing smoke particulates entering the local airshed. Alternatives B and C also include prescribed fire strategies for managing native grasses and forbs, invasive and non-native plants, and canopy cover. During any prescribed burning, minor short-term negative air quality effects would be experienced. It is likely that these effects would be localized and carried a relatively minimal distance on air currents. This analysis assumes small controlled burns of minor fire intensity.

Effects from Public Use Management Strategies: As described above, strategies to eliminate open fires on Matia and Turn Islands would reduce the wood-fire smoke particulates from contributing to local air quality conditions. However, liquid fuel camp stoves would be allowed; they would contribute to a negligible decrease in local air quality.

6.3.4 Water Quality

Effects from Habitat Management Strategies: Minor beneficial effects associated with all alternatives include continued involvement in local oil spill prevention and preparedness planning and marine debris clean-up activities. Involvement in these local community efforts better positions the refuge to contribute to good water quality practices and to benefit from other participants' efforts. In addition, all of the alternatives include facilitating removal and replacement of the creosote pilings at the Protection Island marina. As creosote pilings are replaced with non-polluting pilings, water quality that has been diminished by the leeching creosote would improve. These effects would be very localized and diminished in the context of the Salish Sea.

Alternatives B and C indirectly contribute to a minor to intermediate beneficial impact to water quality impacts because restoration efforts would reduce the long-term potential for soil erosion that could contribute to increased water turbidity and reduced water quality.

Effects from Public Use and Facilities Management Strategies: Under Alternatives B and C there may be slightly fewer motor boats landing directly on the beaches of Turn and Matia Islands as a result of limiting overnight camping to visitors arriving by human-powered boats only. Fewer motor boat landings decrease the chances of a fuel spill. Upgrading refuge facilities to include more solar power will reduce the need to transport liquid fuel to Protection Island and also decrease the chance of a spill from this source.

6.3.5 Contaminant Levels

Effects from Habitat Management Strategies: All alternatives include continued participation in local oil spill prevention and preparedness planning. Oil spill avoidance and immediate action when appropriate would limit the risk of oil entering refuge habitats. In addition, marine debris monitoring and clean-up would continue on Protection Island, and creosote pilings at the island marina would be replaced with non-polluting pilings. Habitat integrity would be maintained or improved as marine debris and pilings that contribute to contamination are removed. All of these measures would have minor beneficial effects due to reducing contaminant levels.

Alternatives B and C add the San Juan Islands Refuge to the marine debris monitoring and clean-up rotation would reduce contaminants especially along island shorelines. Expanded use of solar energy on Protection Island would reduce the need to transport gas, oil, and propane and thereby reduce the potential for fuel spills during transportation. Removal of structures on Smith Island will decrease levels of contaminants such as asbestos and lead paint on that island.

Short-term use of herbicides to control invasive species may have a minor negative impact by increasing contaminant levels. There would be minor to intermediate benefits to reducing contaminant levels in Alternative B and C.

Effects from Public Use Management Strategies: Increased staffing to provide visitor contacts and education is expected to reduce the risk of contaminants being transported to or left upon open and closed refuge islands. These contaminants include fuel spills, garbage/litter, and other contaminants for which humans are a vector of dispersal. Other strategies, including those that educate users about why a closer look hurts wildlife, would have indirect results of reducing the risk of contaminants entering refuge habitats as vessels keep their distance from refuge islands and the wildlife that use them. These actions would have a minor beneficial effect on contaminant levels.

Effects from Research and Monitoring Strategies: As described in the Compatibility Determination appendices, all research and monitoring activities would need to comply with measures to limit the risk of contaminants entering the refuge environments and therefore they would have a negligible effect.

6.4 Effects to Habitats

Topics addressed in this section include the direct and indirect effects to shorelines (including spits, sandy and gravel shorelines, and rocky shorelines); sandy bluffs; savanna, grasslands, and balds; forests and woodlands; and wetlands. These five habitat types and their associated species make up the priority resources of concern for the San Juan Islands and Protection Island Refuges. None of the alternative actions are expected to have major effects to these habitats. In general, the strategies contained in Alternatives B and C would provide the most benefits to refuge habitats.

6.4.1 Shoreline

Effects from Habitat Management Strategies:
All alternatives include continued nourishment of Protection Island's shoreline west of the marina with gravels from marina dredge spoils. This would benefit the integrity of the shoreline. Once the stockpiles are completely used, natural processes are likely to result in erosion of the nourished area.

All alternatives include implementing total wildfire suppression tactics for all wildfires on Protection Island and continued prohibition of open fires by all island users. Likewise, open fires, including charcoal and wood, would be prohibited on Matia and Turn Islands. As a result of these combined strategies, shoreline habitats and their associated species would benefit from protection against habitat destruction by fire.

Firewood and driftwood collecting is prohibited under all alternatives. These strategies, along with prevention and suppression of wildfire, preserve the accumulated woody debris on shorelines which has many benefits, including reducing erosion and providing habitat structure for shorebirds and seabirds that use the shoreline.

Alternative A strategies are expected to produce generally negligible to minor beneficial effects compared to Alternatives B and C as current management actions, such as those mentioned above, and opportunistic removal of marine debris from refuge islands continues.

The habitat management strategies of Alternatives B and C are generally expected to provide minor to intermediate benefits to refuge shoreline habitats and their associated species. With the addition of Smith and Minor Islands to the annual marine debris clean-up efforts and the remaining refuge islands on a five-year rotation, more shoreline habitats would experience beneficial impacts compared to Alternative A. Restoration of as much as 41 acres of Violet Spit strand vegetation under Alternative B is expected to have intermediate beneficial effects as the vegetation character is altered toward native strand habitat characteristics and, therefore, more optimum glaucous-winged gull nesting habitat. Effects for this action under Alternative C are expected to be minor as fewer acres, between 5 and 15, would be restored.

Effects from Public Use Management Strategies: Public use management strategies in Alternatives B and C are expected to result in beneficial impacts to shoreline habitats and their associated species. A reduction in campsites on Turn Island and enforcement of unauthorized camping, especially on Matia Island shoreline, and unauthorized island access may have minor to intermediate benefits to the habitat and to the wildlife species that have been displaced from the habitat due to human activities. Increased public stewardship projects that benefit shoreline would have mostly beneficial effects but some short-term increased disturbance to the habitat and associated species would occur during the project.

6.4.2 Sandy Bluffs

Effects from Habitat Management Strategies: Under Alternative A, intermediate negative impacts to sandy bluff habitat would continue from deer use. Deer trails have been formed on the bluffs, which are long and linear, unvegetated, and contain angular ruts. These conditions produce an ideal situation for larger erosion events. Other strategies from Alternative A are expected to be have negligible effects.

Habitat management strategies in Alternatives B and C are expected to result in long-term intermediate beneficial impacts to sandy bluff habitats and their associated species. As unnecessary structures are removed from Protection Island and the footprint is restored to functioning habitat, species would benefit. Strategies designed to ensure restoration success include development of small test plots to determine the best restoration techniques, viable native plant species, and methods for non-native plant removal. Implementing small test plots would ensure that the larger restoration area is not disturbed more than necessary to implement the complete restoration plan. Transportation routes would be adjusted, resulting in beneficial effects to habitats in which modifications and road rehabilitation/habitat restoration occur. Removal of deer from Protection Island would decrease erosion of sandy bluff habitats by reducing the loss of vegetation on deer trails, which will increase soil stability. Deer removal activities would occur outside the seabird breeding season and would not occur on the sandy bluffs, therefore, no negative impacts to sandy bluffs or associated species are anticipated from the deer removal activities.

Effects from Public Use Management Strategies: The two refuge islands, Protection and Smith, with sandy bluff habitat are closed to the public. There may, however, be some limited amount of unauthorized access to these islands, which would be reduced by additional education and visitor contact made possible with increased staff, volunteers, and partners under Alternatives B and C.

Effects from Research and Monitoring Strategies: As indicated above, research that augments the success of sandy bluff habitat restoration would benefit both the habitat and the wildlife species that use it. In addition, standardized, regular monitoring of wildlife and plant community composition on sandy bluff habitats is important to guiding management decisions in the future, particularly after habitat restoration.

6.4.3 Savanna, Grasslands, and Balds

Effects from Habitat Management Strategies: No new impacts to savanna, grassland, or bald habitats are expected from implementation of Alternative A. Currently, non-native plant species predominate and the large deer herd on Protection Island impacts this habitat from soil compaction and from reducing the diversity of forbs.

Alternatives B and C have similar impacts associated with these habitats and their species; the two alternatives differ in the size of habitat management project areas. Like the effects described above for sandy bluff habitats, test areas on Protection Island would be used to evaluate the best restoration techniques to apply to the larger restoration area on the island. Depending on the number of successfully restored acres, this strategy could ultimately have an intermediate beneficial effect. Other strategies include measures to promote native grasses and forbs and to remove invasive and non-native species and encroaching canopy coverage on the San Juan Refuge islands. Strategies to reintroduce rare plant species and plants that support Taylor’s checkerspot butterflies would support habitat integrity and diversity. If used for restoration, prescribed fire would have a beneficial impact on the habitat by reducing non-native vegetation, recycling of nutrients, maintaining native plant species that benefit from fire disturbance, and prevent encroachment of woody vegetation.

Removing deer from Protection Island under Alternative B and C would reduce impacts to vegetation from browsing and increase the success of native plant restoration. Deer removal is expected to lead to increased woody plants within the grasslands. There may be a negligible amount of vegetation disturbance from deer removal activities conducted outside the seabird breeding season.

Effects from Public Use Management Strategies: Impacts from strategies to increase visitor contact and education, including increased staffing, volunteers, and partnerships for stewardship projects, would be similar to those discussed for shorelines. Rerouting the trail on Turn Island to avoid the sensitive camas community would also contribute to improving habitat integrity.

Effects from Research and Monitoring Strategies: Under Alternatives B and C, identified research that augments the success of savanna and grassland habitat restoration would benefit both the habitat and the wildlife species that use it. Monitoring and research conducted on savanna, grassland, and bald habitats and their associated species would provide benefits in the form of information for future management decisions and directions.

6.4.4 Forests and Woodlands

Effects from Habitat Management Strategies: Under all alternatives, there would be beneficial effects to forests, woodlands, and associated species from total wildfire suppression tactics and prohibition of open fires and collection of down wood. Allowing downed wood to remain in forested environments contributes to wildlife habitat and nutrient cycling. Under Alternative A, continued deer browsing that limits natural regeneration of trees and shrubs would have intermediate negative impacts.

Under Alternatives B and C, the removal of deer from Protection Island would benefit forests and woodland habitats by eliminating the heavy browsing of small trees and shrub understory. Negligible negative impacts to forests and woodlands are anticipated from deer removal activities. Restoration of the former forest cover on Protection Island would join the shrub layer and two forest patches into one contiguous forest to benefit associated species.

Under Alternative C, beneficial effects are also expected as campsites removed on Matia Island are revegetated with trees and shrubs.

Effects from Public Use Management Strategies: Under Alternatives B and C, additional staff and volunteers would help reduce unauthorized activities with benefits to forests and woodlands.

Effects from Research and Monitoring Strategies: Little to no information is currently available on reptile, amphibian, or bat species occurrence on the refuges. Assessments and monitoring for these species in forests and woodlands would greatly assist management in identifying and prioritizing management needs for these species, particularly in response to climate change.

6.4.5 Wetlands

Effects from Habitat Management Strategies: Negligible effects to wetlands are expected as a result of continuing current habitat management strategies under Alternative A.

Habitat management strategies associated with Alternatives B and C that may impact wetland habitats are centered on potential wetland hydrology restoration. If the hydrologic processes can be restored to any one of the three refuge wetlands (historic wetland on Protection Island, brackish wetland on Smith Island, and forested wetland on Matia Island), it would provide opportunities for long-term beneficial effects with intensity levels commensurate with the management action(s) implemented. Wetland habitats are limited within the two refuges and have the potential to provide beneficial functions and values within the local landscapes.

Effects from Research and Monitoring Strategies: Under Alternatives B and C, research efforts aimed at understanding the feasibility of restoring natural hydrologic processes to the refuge wetlands would benefit the Refuge. If the staff has a better understanding about the natural processes and feasibility of restoration, it would inform their management decisions about that habitat type.

6.5 Effects to Wildlife

Topics addressed in this section include seabirds (including rhinoceros auklets, tufted puffins, pigeon guillemots, glaucous-winged gulls, and cormorants); bald eagles, black oystercatchers, and marine mammals (including harbor and elephant seals, Stellar and California sea lions). These are considered focal wildlife resources for Protection and San Juan Islands Refuges. Deer are also addressed in this section, however they are not considered a focal resource for these refuges because their habitat needs can be met in many other locations. Many of the effects discussed in the previous sections regarding habitats also impact focal resources, for example black oystercatchers and marine mammals are closely associated with shoreline and bald eagles are closely associated with forested habitats. None of the alternative actions are expected to have major effects to these wildlife species/groups. In general, the strategies contained in Alternatives B and C would provide the most benefits.

6.5.1 Seabirds

Effects from Habitat Management Strategies:
Under all alternatives, seabirds that use the Protection Island shoreline where marine debris and contaminated materials collect would continue to experience beneficial impacts when their habitat is maintained in a cleaner state. Seabirds and their prey species would also benefit from the decreased marine toxicity from removal of the creosote piling associated with the marina at Protection Island. Seabirds, especially pigeon guillemots, would benefit from continued prohibition of collecting driftwood and down wood from all refuge islands.

Negative impacts associated with Alternative A include continued decline in the quality of glaucous-winged gull nesting habitat on Protection Island's Violet Spit, due to the presence of dense and tall invasive plant species. This will also contribute to continued and possibly increased competition between the gulls and the rhinoceros auklets for nesting habitat on the sandy bluffs where vegetation is less dense and more desirable to the gulls. Other potential negative impacts may be experienced as the rhinoceros auklet colony expands into existing facility locations such as the caretaker's and extended users' structures and as disturbances from existing transportation routes/modes continue.

Under Alternative A, nesting rhinoceros auklets and glaucous-winged gulls will continue to experience negative impacts from the presence of deer on Protection Island. Deer use rhinoceros auklet burrow nesting habitat to browse and bed down. When deer bed down on top of rhinoceros auklet burrow entrances, they prevent the birds from leaving or entering burrows to feed their young and can startle auklets, causing them to lose a beak-load of fish for their young. In addition, deer hooves can cause the collapse of rhinoceros auklet burrows. In the case of the gulls, eggs and young would continue to be more susceptible to predation due to disturbance of adults and nests by deer browsing and walking through the colony.

Under Alternatives B and C, benefits to seabirds from marine debris collection and removal of contaminated materials would increase by including Smith and Minor Islands in annual cleanup activities and including other islands in the San Juan Islands Refuge on a five-year rotation basis. Development and implementation of the Protection Island infrastructure site plan would have beneficial effects to seabirds, especially rhinoceros auklets due to removing structures that are in the vicinity of the expanding rhinoceros auklet colony, and modification of transportation routes/modes to minimize disturbance to seabirds and other refuge wildlife.

Alternatives B and C include removing deer from Protection Island. This would benefit rhinoceros auklets and glaucous-winged gulls and their habitat by preventing disturbance of nesting colonies by deer and reduce soil erosion associated with deer trails. Negligible impacts from deer removal are anticipated because this activity will not occur directly on the sandy bluffs where rhinoceros auklet nesting burrows are found and it will occur outside of the seabird breeding season.

Alternatives B and C also include restoration of native strand vegetation on Protection Island to benefit glaucous-winged gulls and their preferred nesting habitat. Alternative B includes more acres (up to 41) of restoration and is therefore expected to have more benefits than Alternative C, which has fewer acres (5-15) of restoration. It is anticipated that improving habitat for the gulls on the spit will encourage more gulls to nest on the spit and move away from the sandy bluffs where the rhinoceros auklets nest. This would benefit both the rhinoceros auklets and the gulls by increasing habitat quality and reducing habitat competition.

Some negligible short-term negative effects to seabirds and their habitats could occur during stewardship project activities such as beach clean-up, invasive species removal, and wildlife monitoring. Some minor short-term negative effects to seabird habitat may occur during vegetation restoration, however, these would be carefully monitored and minimized.

Effects from Public Use Management Strategies: Under all alternatives, wildlife observation and photography, both priority public uses, will continue. The impact of these activities to seabirds would depend upon the distance from the animal to the disturbance and the duration of the disturbance. Because photographers are more likely to attempt close contact with their subjects, wildlife photography is likely to be more disturbing, per occurrence, than wildlife observation. The Compatibility Determination for wildlife observation, photography, and interpretation includes a detailed description of effects from wildlife observation and photography (Appendix J).

Under Alternatives B and C, it is anticipated that seabirds would benefit from more security to rest, feed, and care for their young due to a decrease in human-caused disturbances. This effect is anticipated as a result of identified strategies, including increased boater contacts and education, to promote voluntary boat-free zones around refuge islands. Other strategies are to increase awareness of the impacts of boats on wildlife; better enforcement of closed islands and closed shorelines on Matia and Turn Islands; the new prohibition of pets on Turn and Matia Islands; improved regulatory signs; increased partnerships with others to protect seabirds; and more opportunities for interpretation and stewardship projects that increase awareness of how people can minimize their impacts to wildlife. Effects would be slightly more beneficial under Alternative B due to the allocation of greater staff time.

Additional benefits to seabirds are expected from the development and distribution of a handbook containing refuge guidelines for all people authorized to be on Protection Island. The handbook would include maps of breeding areas and best management practices and/or requirements to prevent unintentional seabird disturbances or trampling.

Effects from Research and Monitoring Strategies: Under Alternatives B and C, there would be benefits to seabirds from surveys and monitoring for rats, rabbits, and mammalian predators. Surveys and monitoring of refuge island habitats and equipment brought to the islands would benefit seabirds and their habitat from the potential negative consequences of introduced rats and rabbits as well as native and non-native mammalian predators. These animals can prey on seabirds directly or cause habitat damage and breeding nest disturbances.

In addition, standardized, long-term surveys throughout the Salish Sea will benefit seabirds and oystercatchers by providing an ecosystem-wide framework from which to interpret monitoring data and implement region-wide management responses if necessary. This is particularly important for seabird habitat management as seabird colony locations can shift from year-to-year in response to environmental and disturbance factors.

As test plots for best restoration techniques, including invasive plant removal techniques, erosion control methods, and native plant establishment methods, are used to inform future management decisions, seabirds would benefit with better nesting habitat. There may be some short-term negative impacts from restoration activities due to decreased ground cover as invasive plants are removed and before native plants become well established.

6.5.2 Bald Eagles

Effects from Habitat Management Strategies: Under all alternatives, wildfire suppression efforts would continue to have direct benefits to bald eagle habitat as nesting and roosting trees are protected from potential destruction from fire.

Under Alternatives B and C, restoration of forest habitat on Protection Island would benefit bald eagles in providing a long-term source of nesting and roosting trees. Habitat improvements aimed at other wildlife species such as seabirds and marine mammals on the refuges would indirectly benefit bald eagles by enhancing conditions for their prey species. Bald eagles and their prey species would also benefit from the decreased marine toxicity from removal of the creosote piling associated with the marina at Protection Island.

Effects from Public Use Management Strategies: Under all alternatives, wildlife observation and photography would continue on open refuge islands and from boats at a distance on closed refuge islands. Bald eagles are a popular species for wildlife observation and photography. The impact of these activities to bald eagles would depend upon the distance from the animal to the disturbance and the duration of the disturbance.

Under Alternatives B and C, it is anticipated that bald eagles would benefit from more security to rest, feed, and care for their young due to a decrease in human-caused disturbances. This effect is anticipated as a result of identified strategies, including better enforcement of closed islands and closed shorelines on Matia and Turn Islands; increased education opportunities to let people know how they can minimize human-disturbance to bald eagles and other refuge wildlife, such as staying up to 200 yards away from refuge islands. The development of a handbook containing refuge guidelines for Protection Island would benefit bald eagles by reducing unintentional human disturbance to their nesting territory. Beneficial effects would be slightly greater under Alternative B compared to Alternative C due to the allocation of greater staff time.

6.5.3 Black Oystercatchers

Effects from Habitat Management Strategies: Black oystercatchers depend on driftwood for cover from predators. As driftwood is allowed to accumulate under all alternatives and shoreline habitat is enhanced and protected, black oystercatchers would experience beneficial impacts similar to those discussed for seabirds.

Beneficial impacts resulting from strategies under Alternatives B and C for development of a handbook containing refuge guidelines for Protection Island would be similar to those discussed for seabirds.

Strategies that increase boater awareness, minimize shoreline disturbance through education of voluntary boat-free zones, limit shoreline access areas on Turn and Matia Islands, and eliminate social trails would result in impacts similar to those discussed for seabirds and particularly benefit black oystercatchers.

Under Alternatives B and C, as glaucous-winged gull breeding success improves, black oystercatcher chicks are likely to experience increased predation by the gulls, however, increases in cover (accumulated driftwood) may offset potential increases in gull predation.

Effects from Public Use Management Strategies: Effects to black oystercatchers from public use management strategies would be similar to those described for seabirds. Black oystercatchers would benefit from the elimination of social trails and pets on Turn and Matia Islands and from the increased enforcement of closed islands and closed shorelines of Turn and Matia Islands.

Effects from Research and Monitoring Strategies: Coordinated, standardized monitoring efforts of oystercatchers nesting throughout the Salish Sea will provide a minor, long-term benefit to management by providing an ecosystem-wide data on abundance and distribution year-round, especially for assessing effects of climate change and sea level raise.

6.5.4 Marine Mammals

Effects from Habitat Management Strategies: Under all alternatives, marine mammals that use the Protection Island shoreline where marine debris and contaminated materials collect would continue to experience beneficial impacts when their habitat is maintained in a cleaner state. They would also benefit from the decreased marine toxicity from removal of the creosote pilings associated with the marina at Protection Island. Nourishment of the Protection Island shoreline would also benefit marine mammals that use that shoreline.

Under Alternatives B and C, benefits to marine mammals from marine debris collection and removal of contaminated materials would increase due to including Smith and Minor Islands in annual cleanup activities and including other islands in the San Juan Islands Refuge on a five-year rotation basis.

Effects from Public Use Management Strategies: Under all alternatives, wildlife observation and photography would continue on open refuge islands and from boats at a distance on closed refuge islands. Marine mammals are a popular species for wildlife observation and photography. The impact of these activities on marine mammals would depend upon the distance from the animal to the disturbance and the duration of the disturbance. Marine mammals would continue to avoid shorelines that receive substantial human activity whether authorized or not, such as on closed islands and closed shoreline areas of Matia Island.

Under Alternatives B and C, marine mammals would benefit from greater security to haul-out and rest on refuge islands while experiencing fewer human-caused disturbances as a result of increased boater awareness about the refuges and the potential impacts from boating activities; better enforcement of closed islands and closed shoreline areas on Matia Island; elimination of pets on Turn and Matia Islands; and more staff presence on refuges, on the water, and in nearby communities to encourage wildlife observation and photography at a distance that minimizes disturbance. The development of a handbook containing refuge guidelines for Protection Island would benefit marine mammals by reducing unintentional human disturbance. Beneficial effects would be slightly greater under Alternative B compared to Alternative C due to the allocation of greater staff time.

6.5.5 Deer

Effects from Habitat Management Strategies: Under Alternative A, deer removal is not proposed for Protection Island. The very high density (~124 deer/mi^2) of deer on the island noted in 2008/2009 (see Chapter 4, section 4.12.1) has already impacted island vegetation and wildlife. Water and forage resources could become depleted if the herd size increases and the deer would become malnourished. Starvation and/or disease would likely cause a reduction in deer numbers. Negligible impacts to deer on both refuges are expected from research and monitoring activities identified under Alternative A.

Under Alternatives B and C, deer removal from Protection Island in coordination with Washington Department of Fish and Wildlife is proposed. Deer removal methods would be evaluated and determined in a step-down planning process. More than one removal method may be employed, however the impacts to the deer would be similar and will typically result in the death of the deer. This would obviously have a negative impact to the deer on Protection Island. However, removal of deer from Protection Island is expected to have a negligible impact to the abundance of deer in the area. According to models developed by WDFW, the black-tailed deer population estimate has nearly doubled over the last 5 years within WDFW's Coastal Region (6) which includes the Olympic Peninsula (WDFW 2009).

6.6 Effects to Wilderness Resources

Wilderness character includes consideration of the wildlife and habitats, visual quality, noise intrusions, and the general opportunity to experience solitude in an untrammeled environment.

Effects from Habitat Management Strategies:
Under Alternative A, marine debris would sometimes be removed from wilderness islands, but there would often be debris remaining and detracting from the wilderness character of the islands since there is no regularly scheduled clean-up.

Under Alternatives B and C, there would be more regular marine debris clean-up on wilderness islands, which would benefit maintenance of the wilderness character of the islands. Short-term, minor negative effects would result from diminished visual quality due to smoke particulates during prescribed burns associated with restoration projects. There would be long-term beneficial effects from the reduction of invasive species on wilderness islands.

Effects from Public Use Management Strategies: Under all alternatives there are negative effects to the visual quality of wilderness islands due to the use of signs to identify refuge islands and reduce wildlife disturbance. Alternative A would have the most negative effects to wilderness quality because 15 islands would have very large format (4' x 6') signs compared to only 10 islands in Alternatives B and C. Alternative B would be next in terms of reduced visual quality from signs due to the use of additional medium and large signs, and Alternative C strategies use mostly small signs and therefore would have the least negative impact to visual quality from signs. Alternative B is expected to be the most effective in terms of reducing wildlife disturbance. Therefore, the benefits associated with enhanced wildlife viewing opportunities on wilderness islands would be greatest under Alternative B because wildlife are more likely to be present where there are fewer human-caused disturbances.

Under Alternatives B and C, the wilderness experience on Matia Island is expected to be enhanced by limiting the size of commercial day-use groups to not more than 20 people. This would increase opportunities for solitude or near-solitude and decrease the noise that can accompany large groups. This would, however, result in a smaller number of people being able to visit Matia Island at any given time.

Interpretive signs and education would provide knowledge about wilderness islands with the intention of enhancing the wilderness experience. The removal of unauthorized "social trails" and enforcement of no access, including no camping, on closed shorelines would enhance the wildlife values of Matia Island. Under Alternatives B and C, the use of a reservation system for camping, and limiting camping to visitors arriving by human-powered craft, is expected to enhance the wilderness experience for campers.

Under Alternative C, there would be 2 fewer campsites on Matia Island. The reduction of campsites and corresponding reduction in the number of people allowed on the island overnight would enhance the opportunity for solitude for the remaining overnight users but would limit the number of people who could camp on Matia Island and experience it overnight.

6.7 Effects to Cultural Resources

Under all alternatives, surface-disturbing activities may cause direct negative impacts to cultural resources through the damage or destruction of archaeological sites or loss of valuable scientific information by the disturbance of the stratigraphic context in which archaeological deposits are found. Due to the small percentage of the refuges' acres that have had a cultural resource survey, it is expected that new sites may be found. The probability of finding larger habitation-type sites is low due to the small size of the islands and the lack of ready resources. All alternatives assume a cultural resource survey would be conducted prior to implementing any ground-disturbing activity in order to avoid negative effects to cultural resources. Even with a survey, the presence of buried cultural deposits can never be predicted with certainty. If significant resources are discovered during management activities or at any other time, the project would be halted immediately until the site can be evaluated.

Erosion and ongoing public uses are two examples of active impacts to the stability of known sites. Allowing natural processes to occur with minimal human intervention could cause negative effects if wave action or other erosive activities occur in the vicinity of cultural deposits. Whether permitted or not, if public access to sites continues to occur, the stability and integrity of archaeological sites could be compromised.

Under Alternative A, negligible effects to cultural resources are anticipated as a result of the Service working with partners to reduce the risk of oil spills, clean up of marine debris, and education of boaters to minimize human-caused wildlife disturbance and facilities maintenance. Under this alternative there is a higher risk that erosion from wind, wave action, soil compaction, and the actions of people walking around the islands may cause some minor to intermediate negative effects to cultural resources due to lack of staff to provide erosion intervention and to control unauthorized public activities.

Under Alternatives B and C, facilitating research and monitoring studies to improve understanding of wildlife would have negligible effects to cultural resources. Habitat restoration projects that involve extensive digging or ground disturbance, including prescribed fire, could negatively impact cultural resources. Impacts would be negligible to minor assuming proper cultural resource management procedures are followed. Habitat restoration projects that increase vegetation to cover exposed sites, stabilize soils, and reduce erosion would have a beneficial effect on cultural resources. There may be some minor short-term negative effect from deer removal activities on Protection Island which would increase the chances of exposure and degradation of cultural resources. However, there would also be a long-term beneficial effect on cultural resources because soil erosion on the bluffs will likely decrease.

Implementation of a new site plan for Protection Island under Alternatives B and C could have negligible to minor negative impacts should cultural resources be present in the vicinity of activities associated with destruction and construction of structures/facilities, roads, and trails.

Other actions under Alternatives B and C that are expected to benefit cultural resources include relocating, updating the documentation, and performing NRHP evaluations for the six known prehistoric sites. Systematic efforts to survey and evaluate cultural resources in unsurveyed areas with high potential for archaeological materials would also benefit cultural resources. Enhancing the public’s understanding and appreciation of the natural and cultural resources through on-refuge and off-refuge interpretation and education programs would result in beneficial effects to cultural resources.

6.8 Effects to Paleontological Resources

Paleontological resources of Pleistocene age have been identified as eroding out along the margins of Protection Island. Erosion along the margins of Protection Island is expected to continue as a result of sea level rise and wave cut erosion processes. Given the large number (n=164) of paleontological resources, mostly unidentifiable fragments and mastodon teeth, the potential for additional paleontological resources on Protection Island is considered to be high.

No known paleontological resources have been identified within the San Juan Islands Refuge, however, the broader San Juan Islands have yielded a number of Paleozoic to Holocene age fossils (n=60 +), including mollusca, foraminifera, crinoids, conodonts and Bison remains. Given that the San Juan Islands are comprised of Paleozoic, Mesozoic and Cenozoic era sediments (i.e., limestone, sandstone, siltstone, glacial drift), the potential for paleontological resources is considered to be moderate-to-high.

Paleontological resources, like cultural resources, are found above and below the surface of the ground. Also, similar to cultural resources, they are impacted by ground-disturbing activities including erosion, digging, prescribed fire, and public uses that alter their stability and integrity. Negative effects to paleontological resources would be greatest under Alternative A. The lack of systematic surveys on Protection Island and other refuge lands to identify and document paleontological resources and under each of the CCP Alternatives are expected to be nearly identical to the effects to cultural resources described above. Negative impacts to paleontological resources would be minimized by conducting a systematic survey prior to any ground-disturbing activity and mitigating potential negative effects. Alternatives B and C include proactive systematic surveys for paleontological resources where they are most likely to be found on refuge lands and objectives for enhancing their scientific, educational, and recreational values which would benefit this non-renewable resource.

6.9 Effects to the Research and Monitoring Program

Under Alternative A, the refuge staff works with a limited number of long-term partners. Refuge facilities to house and conduct research activities are in need of updating and consolidating. The program does result in quality research aimed at improving scientific knowledge. Coordination with refuge staff is limited due to lack of refuge staff and results in fewer research topics focused on answering specific refuge management questions. Continuing the current program would allow biological studies to provide information for several years into the future.

Alternatives B and C include moving, consolidating, and updating the current facilities that house researchers in conjunction with the development and implementation of the Protection Island site plan. This would improve overall working conditions and encourage more collaboration among research groups. The refuge guidebook would contain guidelines and inform people how to engage in behaviors to reduce and minimize negative impacts to habitats and species.

Under Alternatives B and C, greater emphasis would be given to working closely with partners to design and implement cooperative research and monitoring activities. Existing cooperative efforts with state agencies would be continued and the partnerships expanded to include more activities in support of the refuges' and the Service's mission and goals. These cooperative efforts would directly contribute toward maintaining or restoring the biological integrity, diversity, and environmental health of the refuges. Specifically, the establishment of a cooperatively developed GIS-based inventory and monitoring program for seabirds; endangered, threatened, and sensitive wildlife species; and other wildlife and plant species, as well as pursuit of joint survey and monitoring opportunities and information sharing, would substantially increase understanding of wildlife, habitats, and ecosystem processes. This would allow implementation of adaptive management techniques, which would result in an expected beneficial effect on refuge resources.

An expected long-term beneficial effect on refuge resources may occur under Alternatives B and C with the increased emphasis on specific areas of wildlife and habitat research through a collaborative approach. This strategy includes cooperative interagency or collaborative efforts with universities to perform research. Examples include coordinating with NOAA Fisheries and WDFW to increase collection of abundance and distribution data for harbor and elephant seals; coordinating with partners to conduct surveys for bald eagles according to the Bald Eagle Delisting Monitoring Plan; and coordinating 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.

Staff will also focus on implementation of a comprehensive inventory and standardized monitoring program for burrow and crevice-nesting seabirds. As a result, a more accurate estimate of populations and trends would be obtained. Resource managers would have reliable seabird population census data to properly guide management of species and ecosystems. A long-term seabird monitoring program using seabirds as biological indicators of ocean conditions and effects of climate change would be established. Thus, climate change and its influence on biological processes would be better understood, allowing likely scenarios to be factored into habitat management and protection strategies.

6.10 Social and Economic Effects

6.10.1 Overall Visitation

Under Alternative A, overall visitation experiences and trends are not expected to change as a result of current management strategies. The San Juan Archipelago is a popular destination for vacations and summer homes. Under all alternatives there may be an increasing number of visitors to refuge islands if the popularity of the region continues to grow.

Under Alternatives B and C, the visitor’s experience would be enhanced from installation of interpretive signs on Turn and Matia Islands as well as off-refuge; increased education and outreach about the refuges through many different venues; and increased visitor contacts from refuge staff and volunteers. The experience would also be enhanced from the expected increase in the quality of wildlife viewing of refuge islands from boats at a distance and on Turn and Matia Islands as a result of better enforcement of wildlife sanctuary areas off limits to people.

Under Alternatives B and C, some negative impacts to the visitor’s experience is expected from closing some areas of Turn Island, including some shoreline landing sites that have previously been open to access. On Matia Island, better enforcement of the already closed shoreline areas and removal/restoration of the unauthorized social trails may also be perceived by some visitors as a negative effect.

Under Alternatives B and C, there would be a new reservation system for camping that would provide visitors with assurance that they will have a campsite. It would also discourage unauthorized camping. The new stipulation that only visitors arriving by human-powered boats would be able to camp would enhance the experience for some by providing a quieter, more primitive camping experience, but it will likely be perceived as negative by others. The number of visitors using the refuge at night would be reduced some in Alternative B with fewer campsites on Turn Island and reduced quite a bit more in Alternative C with camping eliminated on Turn Island and the number of campsites reduced on Matia Island.

6.10.2 Opportunities for Quality Wildlife Observation and Photography

Wildlife observation and photography opportunities throughout most of the refuges should occur from outside the voluntary boat-free zone (200 yards). However, it is likely that some observers and photographers do approach the islands for a closer look. Visitors to Matia and Turn islands have an opportunity for land-based viewing and photographing in the areas specifically open to access. Evidence of social trails and illegal shoreline access indicates that some of these visitors are also taking a closer look. Unfortunately, a closer look can have negative impacts on wildlife. It may cause birds to flush from nests, leaving eggs without necessary incubation attendance; marine mammals can be caused to abandon haul-out sites that may provide a necessary resting period.

With habitat improvements that are proposed under Alternatives B and C, wildlife is expected to use the restored habitat. Where those restoration projects are within the viewshed, opportunities for observation would likewise increase. Other habitat management strategies that would improve opportunities for observing/photographing wildlife in a natural setting include prohibiting firewood and driftwood collection. Wildlife is likely to be seen using these important habitat features.

Alternatives B and C also include measures for increased environmental education, interpretation, and general enforcement of public use restrictions. All of these strategies would improve visitor understanding of how wildlife use the area, how human activities can disturb wildlife, and when, where, and how to increase the likelihood of observing wildlife in their natural environment. Strategies to reduce the number of visitors to the islands at any one time and limiting overnight access to human-powered boats will decrease human disturbances during some of the most active wildlife hours and increase the opportunity to see wildlife for those visitors who are present. It is expected that the collective measures proposed to teach visitors about healthy viewing methods would have a beneficial impact on opportunities for wildlife observation and photography at the refuges.

6.10.3 Opportunities for Quality Environmental Education

The current environmental education program for both refuges is limited. Strategies proposed under Alternative B would contribute to a better developed program and are expected to have beneficial effects. Alternative B strategies include increased emphasis on enhancing the public's understanding and appreciation of the refuges' natural, cultural, paleontological, and wilderness resources. Programs would be offered both on- and off-refuge. Educational programs would also encourage a stewardship ethic toward the refuges. Many of the strategies that are described as improving opportunities to observe wildlife would be directly linked to the proposed environmental education program changes. For example, increasing passive environmental education at marinas, harbors, airports, and on ferries; actively training volunteers and ecotourism operators; and increasing interpretation opportunities (see discussion below for more details on interpretation) would all have far reaching effects when the public is more informed about the refuges and their importance to the ecosystem and its species. Programs that specifically reach out to local schools would help to foster local pride in the refuges.

Similar impacts from Alternative C strategies are expected at a reduced scale.

6.10.4 Opportunities for Quality Interpretation Experience

The current interpretive program for both refuges is limited. Strategies proposed under Alternative B would contribute to a better developed program and are expected to have beneficial effects. Alternative B strategies are very similar to those described above for environmental education. They emphasize enhancing public understanding and appreciation of the refuges' resources and characters, how wildlife can be disturbed by human activity, and how the refuges are an important part of the greater San Juan Islands Archipelago. The interpretation program would include adding informative panels along trails, training volunteers and hosts/caretakers to provide interpretive information to visitors, providing materials to be posted or viewed at local harbors, airports, marinas, and on ferries.

Similar impacts from Alternative C strategies are expected at a reduced scale.

6.10.5 Opportunities for Quality Hunting Experience

Under Alternative A, no hunting is allowed on any of the refuge islands. Some deer hunting and waterfowl hunting does occur on nearby islands and mainland areas. Negligible impact to hunting in the area is anticipated under Alternative A.

Under Alternatives B and C, it is possible that hunting may be one of the chosen methods to remove deer from Protection Island. Possible methods would be evaluated and selected in a step-down planning process. If hunting is selected, there would be a short-term and limited increase in opportunities for deer hunting on Protection Island. There may also be an indirect benefit to off-refuge waterfowl hunting in the area from enhancing waterfowl foraging habitat through refuge restoration projects; enhanced shoreline protection and marine debris removal; and reducing the risk of contaminants.

6.10.6 Opportunities for Quality Fishing Experience

There are no fish-bearing water resources on any of the refuge islands. However, there are fishing opportunities in the marine waters that surround refuge islands. Under Alternatives B and C, increased staffing levels compared to Alternative A would permit more interpretation and education activities both on- and off-refuge lands and increase contacts with boaters, including those who are fishing in the area. The anticipated increase in knowledge and enjoyment of the Salish Sea would indirectly benefit the quality of the fishing experience. Increased education about the voluntary boat-free zone around refuge islands in the San Juans is expected to reduce the number of people who fish close to refuge islands. This would have a negligible to minor negative effect on fishing because the boat-free zones are voluntary and represent a minimal reduction in the area available for fishing in the Salish Sea. Under Alternatives B and C, increased involvement in marine debris and contaminants clean-up compared to Alternative A would contribute to an improved fishing experience.

6.10.7 Opportunities for Quality Camping Experience

Changes to camping proposed under Alternatives B and C are designed to create a camping experience that does a better job of supporting the Service’s priority wildlife-dependant recreational activities including wildlife observation and photography. The Refuge System Improvement Act of 1997 and the Service’s recent Compatibility and Appropriate Refuge Uses policies indicate that camping on a national wildlife refuge is not appropriate unless it is needed to support a priority wildlife-dependent recreational activity. Because of the speed of motor-boats, visitors using them can observe and photograph wildlife on Turn and Matia Islands as well as throughout the Salish Sea and can easily reach an off-refuge campsite before dark. This is much more difficult for visitors using human-powered boats, and thus Alternatives B and C allow camping only for visitors arriving by human-powered boats in order to support wildlife observation from Turn and Matia Islands as well as to support wildlife observation from a distance on closed refuge islands throughout the Salish Sea. For additional information see Appendix I.

Under current management Alternative A, the number of campsites provided remains the same on Turn and Matia Islands within the San Juan Islands NWR, and visitors arriving by both motorized and human-powered boats are able to use authorized campsites. Due to staff limitations, some unauthorized camping would likely continue on closed shoreline areas of Matia Island and on closed refuge islands in the Salish Sea. The lack of a camping reservation system means that boaters would continue to have no assurance that an authorized campsite will be available for them when they arrive. This likely contributes to unauthorized camping, especially among human-powered boaters who, due to boat speed limitations, have less flexibility to find another campsite before dark. The quality of the camping experience in terms of opportunities to observe wildlife or experience nature in a peaceful atmosphere would be negative, especially during busy summer weekends due to the number of authorized and unauthorized campers, as well as the limited staff available to enforce camping, noise, and disorderly behavior regulations.

Under Alternative B, fewer people would be able to camp on Turn Island due to eliminating 5 campsites (8 campsites would remain). This reduction in campsites is negligible because it represents a loss of less than one percent of available campsites in the local area. There are more than 800 public and private campsites within 15 miles of Turn and Matia Islands (See Chapter 5 Tables 5.4 and 5.5). The loss of campsites is greater for visitors arriving by motor-boat because they would not be allowed to camp on either refuge island; however, that is offset by their greater ability to get to alternate campsites compared to visitors arriving by human-powered boats. Unauthorized camping activities would decrease due to creation of the reservation system which would allow people to reserve campsites before they arrive and from increased staff capacity to patrol refuge islands. Opportunities for wildlife observation and the ability to experience nature in a peaceful atmosphere would be enhanced due to fewer overall numbers of campers at one time, less noise, and fewer unauthorized activities. These changes would result in an intermediate benefit to the quality of the camping experience.

Alternative C would remove all campsites on Turn Island and two on Matia Island (leaving four Matia Island campsites). This would result in fewer campsites being available but still represents a minor reduction in the quantity of available campsites found in the local area. It would, however, eliminate a popular camping area. The impact would be greatest on individuals, families, organizations, and commercial kayak outfitters who have enjoyed the accessibility and convenience of the Turn Island campground within a short distance of Friday Harbor, the social and economic center of San Juan County.

6.10.8 Effects to Human Health

In addition to the effects described in the air quality section (Section 6.3.3); use of herbicides and/or pesticides in Alternatives B and C management strategies could have the potential to impact human health. However, it is expected that all people performing applications of these chemicals would follow instructions and wear appropriate protection to avoid dangerous contact with or respiration of the materials. Because most of the refuges are closed to public access, there would be little risk of the public coming into contact with herbicides or pesticides used in refuge management (also see Appendix E). Replacement of the marina creosote pilings would reduce the toxin and contaminant contributions to the food chain. Therefore, no negative impacts to human health are expected as a result of any of the management alternatives.

6.10.9 Effects to Economy

Local communities benefit economically from having a national wildlife refuge in the area (Carver and Caudill 2007). In the lower 48 states recreational visits to national wildlife refuges in Fiscal Year 2006 generated $1.7 billion of sales in regional economies; almost 27,000 people were employed; and $542.8 million in employment income was generated. In the state of Washington, the average for the six refuges that were sampled that year (Dungeness and Nisqually were the closest in proximity) indicates $2.05 million in sales, 30.5 people employed, and $830,000 in employment income (Carver and Caudill 2007).

Implementation of Alternative A would be expected to result in negligible increases in expenditures in the local economy because staff levels and visitor programs would remain similar to current conditions.

Implementation of Alternative B is expected to result in minor beneficial impacts to local economies. This alternative would have the greatest economic benefits because expenditures are expected to increase in order to implement additional and/or improved educational and interpretive programs and resource restoration projects. Refuge visitation and money spent in the community is also expected to increase in part from increased knowledge of the refuges and also from the overall increasing popularity of travel to the Salish Sea area. The additional volunteer, host/caretaker, and staffing positions would also add slightly to the local economy and employment. Under Alternative B, removal of 5 of the 13 campsites on

Turn Island in Alternative A would decrease State Parks revenue in campground fee collections to the degree that would-be campers did not find alternate campsites within the State Park system. The change in State Parks revenue is expected to be negligible and there may be increases for county and private campgrounds in the area.

Since Alternative C includes fewer acres of restoration, there will likely be slightly fewer expenditures and less economic benefits to the local area associated with restoration projects. Alternative C public use strategies include enhancing environmental education and interpretation opportunities, which would be expected to have minor economic benefits similar to Alternative B. The elimination of camping on Turn Island under Alternative C would have an intermediate negative economic impact to the local area as it is popular campground for local residents, visitors, and commercial kayak outfitters. The refuge would also incur greater staffing costs as a result of State Parks no longer handling maintenance and law enforcement on the island.

6.10.10 Environmental Justice

The concept of environmental justice has been around since the early 1990s and arose from a need to ensure that negative environmental activities from industry or government projects would not endanger local communities. The U.S. Environmental Protection Agency (USEPA) oversees environmental justice compliance and defines environmental justice as: "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies" (USEPA 2010).

Since CCP implementation of any of the alternatives is expected to result in generally positive effects on the human environment, there would be little risk of disproportionate negative effects to low income or minority groups. Therefore, negligible effects related to environmental justice are anticipated under all CCP alternatives.

6.11 Cumulative Effects

The Council of Environmental Quality defines "cumulative effects" as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR Part 1508.7). Within the previous discussions, the direct and indirect effects associated with implementing the various alternatives have been evaluated in a comprehensive manner. Therefore, the cumulative effects analysis is largely complete. Following a brief summary of past actions, the analysis in the following discussion primarily focuses on effects associated with reasonably foreseeable future events and/or actions both on- and off-refuge.

As described in Chapters 3, 4, and 5, there has been very little change to the small uninhabited refuge islands, rocks, and reefs within the San Juan Islands. However, there have been some modifications to Matia, Turn, Smith, and Minor islands. A few human-made structures were developed on these islands and limited habitation has occurred in the past. Substantial habitat alterations have occurred in the past on Protection Island and many areas of the larger, nearby, inhabited islands within the San Juan Archipelago; the mainland areas that surround the Salish Sea have also experienced substantial changes. Many of these modifications have resulted in the loss of important habitats including dry Douglas-fir forest and the Willamette Valley grasslands, two habitats which exist in limited acreage within these two refuges. A variety of government and non-government agencies, including the National Park Service, The Nature Conservancy, Bureau of Land Management, U.S. Forest Service, State of Washington, Tribes, and the

Service have protected a large number of natural areas along and within the Salish Sea. However, alterations and loss of native habitats along with human pressures on protected areas continue at a regional scale due to a growing population and the increase in tourism. Loss of old-growth forest structure and the introduction of non-native species into these habitats have altered the ecosystem processes within the archipelago and the surrounding mainland.

6.11.1 Reasonably Foreseeable Future Refuge Activities

As protected areas, Protection Island and San Juan Islands NWRs, though relatively small in size, are extremely important to the persistence of island wildlife. Under both action alternatives, the Service would protect and maintain its island habitats and their associated wildlife and plant species. Invasive species are likely to become more prevalent on surrounding lands, but on the refuges, active efforts would be made to reduce their populations, especially under the Preferred Alternative.

Under Alternative B, the Complex would emphasize working closely with partners to research, design, and implement cooperative studies that would directly contribute toward understanding and maintaining or restoring the biological integrity, diversity, and environmental health of the refuges. The Complex would improve the availability of off-refuge education and interpretation under Alternative B.

Under both action alternatives, the Complex would continue to promote and preserve the wilderness characteristics of designated San Juan Islands Wilderness areas. Under Alternative B, there would be a greater emphasis placed on partnerships focused on reducing the effects of human disturbance to wildlife, increasing awareness of the refuges, and appreciation for natural resources of the area.

Because it is anticipated that human population growth within the Salish Sea region will result in continuing loss and degradation of wildlife habitats and open space, refuge habitats will become increasingly important over the life of the CCP. In concert with other protected lands, the refuges have an important role to conserve resident, threatened, and rare species, as well as migratory wildlife species, and to provide places where the public can enjoy and appreciate nature. Implementing the CCP would have overall beneficial effects to habitats and species. In the context of all of the factors (both natural and human-caused) that negatively affect habitats and species (e.g., food availability, marine currents, marine debris, human disturbance, and ocean pollution) the positive contributions associated with CCP implementation do not represent a major (significant) effect.

6.11.2 Reasonably Foreseeable Future off-Refuge Activities

Aquatic Reserves

In 2008, the State of Washington Department of Natural Resources (DNR) received nominations for several aquatic reserves; the agency selected three for full proposal development and review. Two of the current aquatic reserve proposals are for aquatic lands adjacent to the refuges: Protection Island Aquatic Reserve and Smith and Minor Islands Aquatic Reserve.

The Planning Advisory Committee is in the process of reviewing proposed goals and objectives for the Smith and Minor Islands reserve and the Protection Island reserve and is developing a list of management actions in which DNR and the local community will engage. A draft management plan for these reserves is due soon (summer 2010). Once these draft plans are developed, they will include allowed uses as well as strategies for monitoring, research, and restoration actions and management of existing authorized uses. The Service is participating in the planning process for both proposed reserves. It is expected that the management actions for each reserve will support the objectives of the refuges and result in overall beneficial and synergistic effects.

6.11.3 Potential Effects from Global Climate Change

Global climate change and associated changes to the marine environment will have additional impacts on island and reef habitats. These changes could have significant negative effects on these refuges; however, due to the complexity and unknown elements associated with the severity of change (e.g., sea level rise), the magnitude of effects of climate change on the refuges cannot be predicted. Climate change may further exacerbate some of the influences affecting environmental consequences that have already been described because they are likely to be additive. For instance, increases in the severity and incidences of storm events due to climate change will increase the threat of oil spills in this area.

Signs of climate change can currently be seen in the Salish Sea with total annual temperatures increasing by 13 percent and annual inflow of fresh water from precipitation and snow melt decreasing. These changes have lead to increased instances of harmful algal blooms and areas of low dissolved oxygen. This in turn is expected to reduce plankton, the foundation of the food web in the Salish Sea (Snover et al. 2005). Reduced abundance of plankton will likely reduce forage fish for wildlife that depend on fish for nourishment.

Organisms such as seabirds that require specific habitat types face an increased threat from climate change because they have a very restricted range of breeding habitats. For instance, terns and gulls that typically nest on low-elevation sand spits, beaches, or rocky shorelines are vulnerable to nest flooding and loss of habitat due to sea level rise and increased incidences of storm events. Increased El Niño event frequency, sea surface warming, and ocean acidification, all partly due to climate change, are already affecting seabird species by altering forage fish distribution (Walther et al. 2002; Wormworth and Mallon 2009). Because seabirds, especially cormorants, will not nest if the right habitat is not available and colonies will fail in years of low food resources, climate change has the potential to greatly reduce seabird productivity and adult survival.

Long-term climate change is expected to result in local sea level rise, an increase in winter precipitation, and increased storm strength and frequency (Huppert et al. 2009; Mote et al. 2008). These factors may lead to increased bluff erosion and sand spit degeneration depending on prevailing currents and storm tracks. In fact, inundation of low-lying refuge islands is very likely. With an increase in major storm events combined with high tides or elevated sea levels, seabird nests placed low on the shoreline will be vulnerable to flooding.

The warming trends within the Salish Sea leading to higher summer temperatures and anticipated minor precipitation increases (Mote and Salathé 2009) will likely increase water stress on native vegetation. Such stressors increase vulnerability to competition from invasive species. Additionally, warmer temperatures and summer drought may lead to increases in fire frequency and severity.

Species distributions are likely to change. Cool, coniferous forests in the western part of the Pacific Northwest will contract and be replaced by mixed temperate forests over substantial areas (Mote et al. 2003). For example, Douglas-fir appears relatively sensitive to low soil moisture, especially on drier sites (Case 2004; Hessl and Peterson 2004; Holman 2004 citations in CIG 2004).

Warmer temperatures could lead to a change in the timing of reproduction, which may lead to different timing between flowering and pollinator activity, fruit ripening and foraging by fruit consumers, or predator behavior by pest-eating species. Other examples include the freshwater and precipitation changes described above that ultimately may affect the availability of forage fish.

Warmer temperatures could also increase development of insect and pathogen outbreaks and extend their growing season. It would be expected that increases in the frequency and extent of outbreaks would accompany such changes. Rising ocean temperatures and increased El Niño event frequency may increase the potential for bacterial infections as disease vectors change.

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Appendix A. Lands

A.1 Introduction

This appendix includes information about refuge establishment authorities, acquisition history, refuge purposes, and land status for Protection Island and San Juan Islands Refuges. It documents research that was done early in the planning process. Findings from many sources are summarized in this appendix. Research included the following:

- The Service's national refuge purposes database was consulted.
- The Service's Land Record System was reviewed.
- Realty hardcopy files were searched extensively.
- The Tract Record spreadsheet prepared by the GIS branch was consulted.
- Additional documents related to the establishment history of the San Juan Islands NWR which were not found in the Service's files were obtained from Bonneville Power Administration Library in Portland, Oregon, and from the DOI national library.

This appendix also includes information about navigation aids that are on or near refuge lands, and a section on habitat protection needs.

Protection Island National Wildlife Refuge

Refuge 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 apply 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 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)). Also see Table A.1.

Table A.1. Protection Island Acquisition History and Land Status Summary

Date acquired	# of tracts	Interest	Acquisition authority	Funding authority
12/22/82	6	Fee	Public law 97-333	donation
6/20/83	1	Fee	Public law 97-333	Land and Water Conservation Fund (LWCF)
7/25/83	4	Fee	Public law 97-333	LWCF
8/10/83	1	Fee	Public law 97-333	LWCF
8/19/83	1	Fee	Public law 97-333	LWCF
9/8/83	1	Fee	Public law 97-333	LWCF
9/19/83	1	Fee	Public law 97-333	LWCF
1/17/85	1	Fee	Public law 97-333	LWCF
4/12/85	10	Fee	Public law 97-333	LWCF
4/18/85	15	Fee	Public law 97-333	LWCF
4/19/85	12	Fee	Public law 97-333	LWCF
4/26/85	4	Fee	Public law 97-333	LWCF
4/29/85	5	Fee	Public law 97-333	LWCF
5/6/85	4	Fee	Public law 97-333	LWCF
5/7/85	2	Fee	Public law 97-333	LWCF
5/8/85	4	Fee	Public law 97-333	LWCF
5/10/85	7	Fee	Public law 97-333	LWCF
5/13/85	11	Fee	Public law 97-333	LWCF
5/14/85	2	Fee	Public law 97-333	LWCF
5/15/85	9	Fee	Public law 97-333	LWCF
5/17/85	11	Fee	Public law 97-333	LWCF
5/20/85	4	Fee	Public law 97-333	LWCF

Date acquired	# of tracts	Interest	Acquisition authority	Funding authority
5/21/85	7	Fee	Public law 97-333	LWCF
5/22/85	4	Fee	Public law 97-333	LWCF
5/24/85	7	Fee	Public law 97-333	LWCF
5/28/85	11	Fee	Public law 97-333	LWCF
5/29/85	8	Fee	Public law 97-333	LWCF
5/30/85	6	Fee	Public law 97-333	LWCF
5/31/85	4	Fee	Public law 97-333	LWCF
6/4/85	4	Fee	Public law 97-333	LWCF
6/7/85	1	Fee	Public law 97-333	LWCF
6/13/85	2	Fee	Public law 97-333	LWCF
6/18/85	11	Fee	Public law 97-333	LWCF
6/25/85	2	Fee	Public law 97-333	LWCF
6/26/85	1	Fee	Public law 97-333	LWCF
7/15/85	2	Fee	Public law 97-333	LWCF
7/19/85	4	Fee	Public law 97-333	LWCF
7/30/85	3	Fee	Public law 97-333	LWCF
8/13/85	1	Fee	Public law 97-333	LWCF
8/26/85	2	Fee	Public law 97-333	LWCF
9/30/85	2	Fee	Public law 97-333	LWCF
1/13/86	4	Fee	Public law 97-333	LWCF
1/15/86	2	Fee	Public law 97-333	LWCF
1/21/86	4	Fee	Public law 97-333	LWCF
1/23/86	2	Fee	Public law 97-333	LWCF
2/11/86	3	Fee	Public law 97-333	LWCF
2/13/86	2	Fee	Public law 97-333	LWCF
4/3/86	2	Fee	Public law 97-333	LWCF
4/11/86	616	Fee	Public law 97-333	LWCF
4/22/86	2	Fee	Public law 97-333	LWCF
4/25/86	3	Fee	Public law 97-333	LWCF
5/28/86	1	Fee	Public law 97-333	LWCF
6/2/87	1	Fee	Public law 97-333	LWCF
1/12/93	1	Lease from Washington State (No. 20-013245 expires Dec. 31, 2013)	Fish and Wildlife Act of 1956	Donation

Sources: Excel tract report by GIS branch, Land Record System, Georgia Shirilla verified acquisition and funding authorities on 2/27/07.

Land Status

Protection Island NWR is entirely on an island by the same name in Jefferson County, Washington. There are 316 acres of fee title lands within the refuge and an additional 340-acre aquatic lands lease from WDNR. The refuge establishment date is reported as December 22, 1982, concurrent with a donation to the Service of the first 1.42 acres by Admiralty Audubon Society. As of June 2, 1987, all lands identified as within the Protection Island NWR boundary have been acquired.

Aquatic Lands
The 340-acre tideland lease is due to expire on December 31, 2013. There is also a bedland reservation and withdrawal "from conflicting uses for an indefinite term from November 22, 1988" of " . . . the bedlands of navigable water owned by the state of Washington, surrounding Protection Island extending waterward 600 feet from the line of extreme low water . . .(WDNR 1988, Withdrawal Order 88 017)." This withdrawal order further states that public access may be permitted under conditions mutually agreed upon by the DNR and DOI. The Service has maintained both the lease area and the withdrawal area as closed to the public to protect refuge wildlife.

Zella Schultz Seabird Sanctuary
Protection Island NWR boundary does not include 48-acres on the west end of the island known as the Zella M. Schultz Seabird Sanctuary, which was protected prior to refuge establishment first through purchase by The Nature Conservancy in 1972, then by Washington Department of Game (now WDFW) acquisition in 1974. This sanctuary bisects the rhinocerous auklet colony. There is an MOU between the Service and WDFW for cooperation between the two agency owners and managers of Protection Island.

Protection Island Extended Users
A number of people with interest in tracts of land on Protection Island prior to establishment of the NWR were given extended use of the tracts and access to Protection Island under a variety of terms. Many of these terms have already expired and most of the rest will expire in 2011. All current extended users have unimproved lots that receive occasional use with the exception of one lifetime user who has a residence on the island. See Table A.2 for additional information.

Extended users reserved a number of rights when the refuge was established. These include the right to use their lots for picnicking and overnight camping; the right for pedestrian (or motor vehicle use for lifetime user) use of a road system designated by the United States; the right to use, without expense, water of the same quality, as presently available from the existing water system, from a central source designated by the United States; the right to use the existing marina and associated facilities for entry/exit and boat moorage subject to the right of the United States to provide equivalent substitute facilities; the right to fish and crab from the dock and from boats in a portion of the marina and the right to walk the beach in designated areas from October through February.

The use of the lot and designated island facilities is limited to the immediate family of the reservation holder. In addition personal guests may be allowed to use the reserved premises and designated island facilities only when the reservation holder is present. The only lifetime user has the additional right to maintain the grounds, have a dog on the premises, to have gardens, and to store firewood on the lot.

Table A.2. Protection Island NWR Extended Users

Tract #	Acre	Term of Use
1241	.26	25 years expires 2011
2042	.21	25 years expires 2011
2069	.26 with home	life use
2101	.21	25 years expires 2011 25 years expires 2011 25 years expires 2011 25 years expires 2011
2170	.29	25 years expires 2011

San Juan Islands National Wildlife Refuge

Refuge 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."*** In October of 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, 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. Also see Table A.3.

Table A.3. San Juan Islands NWR Establishment Authorities, Acquisition History, and Refuge Purposes.

Date	Legal document	Refuge Lands	Relevant action and refuge purposes (*bold and italicized*)
9/11/1854	Order	Smith Island Minor Island	Reserved certain islands for ***lighthouse purposes***.
7/15/1875	E.O. (un-numbered series)	Matia Island Puffin Island Sister's Is. N Peapod Is. Turn Island Jones Island Flattop Is. Skipjack Is.	Reserved 23 tracts of land in the waters north of Puget Sound for ***lighthouse purposes.***

Date	Legal document	Refuge Lands	Relevant action and refuge purposes (*bold and italicized*)
6/6/1914	E.O. 1959	Smith Island Minor Island	Reserved Smith and Minor Islands for use of the USDA "***as a preserve, breeding ground and winter sanctuary for native birds.***" The reserve to be known as Smith Island Reservation (65 ac). ***"This order is not intended to abrogate the order of September 11, 1854, reserving these islands for lighthouse purposes, . . . in addition to such use, shall insure the protection of the native birds thereon."***
3/30/1937 4/2/1937	E.O. 7594 2 FR 739	Jones Island	Established Jones Island Migratory Bird Refuge, 179.07 ac in San Juan county.
3/30/1937 4/2/ 1937	E.O. 7595 2 FR 741	Matia Island	Reserved Matia Island and established Matia Island Migratory Bird Refuge ***". . . as a refuge and breeding ground for migratory birds and other wildlife." "The Executive order of July 15, 1875, reserving certain public lands for lighthouse purposes, is hereby revoked in so far as it applies to the above-described land.*** Matia Island is 145 ac in San Juan County.
7/25/1940 7/30/1940	Proc. 2416 5 FR 147	Jones Island Matia Island Smith Island Minor Island	Changed the names of various reserves and migratory bird refuges to National Wildlife Refuges.
12/24/1960 1/10/1961	PLO 2249 26 FR 165	Williamson Rocks Colville Is. Bird Rocks Turn Island Bare Island Jones Island	Established San Juan Islands NWR 1960 to ***be ". . . reserved under jurisdiction of the Bureau of Sport Fisheries and Wildlife, United States Fish and Wildlife Service. . ."*** for a total of 52 acres in San Juan and Skagit Counties. Added 9.02 acres to Jones Island NWR for a total of 188.09 in San Juan County. ***Partly revoked Executive Order of July 15, 1875 reserving certain lands for lighthouse purposes, as far as they affect Turn Island and Jones Island.***
1/6/67 1/12/1967	PLO 4148 32 FR 320	Buck Island	Added Buck Island (1ac) to San Juan Islands NWR.

Date	Legal document	Refuge Lands	Relevant action and refuge purposes (***bold and italicized***)
7/3/1969	Letter	Puffin Is.	Travis S. Roberts, Acting Regional Director, requested concurrence from U.S. Coast Guard on FWS secondary withdrawal for wildlife management of Puffin Island ***". . . to insure protection and maintenance of natural nesting habitat for numerous sea birds.*** The only development proposed is posting the island as a National Wildlife Refuge, ***no public use will be permitted during the nesting season."***
11/6/1969	43 FR 17972	Puffin Island	Notice of Proposed withdrawal of Puffin Island " as an addition to Matia Island National Wildlife Refuge ***for the management of migratory birds and other wildlife."***
9/3/1970	PLO 4889 35 FR 14317	Puffin Island	Added Puffin Island, 10 ac (tract 1a) to Matia Island NWR, secondary to U.S. Coast Guard jurisdiction for lighthouse purposes.
10/18/1973 10/19/1973	Notice 38 FR 29831	All units	Proposed withdrawal of lands and consolidation of national wildlife refuges into the San Juan Islands National Wildlife Refuge which will ***". . .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."***
8/27/1975 9/4/1975	PLO 5515 40 FR 40811	All units	Reserved lands for the San Juan Islands NWR 388.32 acres in Island, San Juan, Skagit, and Whatcom Counties. Revoked EOs 1959, 7594, 7595, PLO's 2249 and 4148 and 4889 insofar as they affect any of the islands described in this PLO but does not alter jurisdiction for ***lighthouse purposes*** provided for by EO of July 15, 1975.
7/22/1976 7/29/1976	PLO 5594 41 FR 31535		Corrected PLO 5515 to delete all reference to EO 1959 and PLO 2249. Amended PLO 5515 to include an additional 69.5 acres of San Juan County islands in the San Juan Islands NWR. Total Refuge acres 457.82
10/19/1976	P.L. 94-557	All units except Smith, Minor, Turn, Jones, and part of Matia	***Designates as wilderness:*** "(p) certain lands in the San Juan Islands National Wildlife Refuge, Washington, which comprises approximately three hundred and fifty five acres, which are depicted on a map entitled "San Juan Islands Wilderness Proposal", dated August 1971 (revised July 1976), and which shall be known as the San Juan Wilderness."

Date	**Legal document**	**Refuge Lands**	**Relevant action and refuge purposes (*bold and italicized*)**
10/15/1982	P.L. 97-333 (96 Stat 1623)	Jones Island	In consideration of the prior transfer of certain properties now in the San Juan NWR by Washington State Parks and Recreation Commission to DOI, transfers ownership, jurisdiction, and control of Jones Island NWR to the State of Washington for use as a public recreation area.
10/14/1983 10/24/1983	PLO 6483 48 FR 49022	Dot Island	Eliminated Dot Island from SJNWR by correcting the land description in PLO 5515 to delete No. 67, Dot Island which consists of one large island with a small islet immediately to the southwest.
10/27/1983 11/4/1983	PLO 6489 48 FR 50895	Jones Island	Revoked executive order 7594 and in part PLO 2249 which had established and added to Jones Island NWR.

Land Status

The San Juan Islands NWR consists of mostly small islands, islets, rocks, and reefs scattered across a large area in Puget Sound. Refuge units are located in four Washington State counties: Island, San Juan, Skagit, and Whatcom. As far as we can tell all units currently within the San Juan NWR were always under federal ownership ever since they became part of the United States. The Service has primary interest on all refuge units except for those withdrawn for lighthouse purposes prior to refuge establishment. In those cases the Service is presumably secondary to the U.S. Coast Guard who maintains navigation aids on these islands. An estimated nineteen of the 83 refuge units have navigation aids, however, we do not have a record of when each of the navigation aids was authorizing and therefore we cannot determine if we are primary or secondary in all cases. Also see Table A.4. Determining acreage of small islands above the mean high tide is inherently difficult. Total refuge acreage is reported as 448.53 and wilderness acres as 353.0 in the Annual Report of Lands Under the Control of the USFWS (2008).

United States Coast Guard Navigation Aids

The U.S. Coast Guard (USCG) operates and maintains a number of aids to navigation structures on or immediately adjacent to refuge islands in the San Juan Islands and Protection Island (see Table A.4). Nineteen of these are covered under a 2005/2006 Memorandum of Understanding between the Service and the USCG.

Table A.4 USCG Navigation Aids on or immediately adjacent to San Juan Islands NWR and Protection Island NWR.

FWS #	Navigation Aid Name	LLNR[1]	Position	Year Established	Original Authority[2]
6	Boulder Reef Lighted Bell Buoy "2"	19500	48 38 17N 122 41 42W		
7	Davidson Rock Light "1"	19325	48 24 48 N 122 48 43 W	1933	EO 1875, tidal zone
24	Harbor Rock	19680	48 28 18 N 122 58 23 W		
25	North Pacific Rock[3]				
29	Pole Pass Light "2"	19655	48 36 06N 122 59 24W		
33	Center Island Reef Daybeacon	19385	48 29 04N 122 50 11W		
39	Flattop Island[4]				EO 1875
42	Skipjack Island Light	19805	48 43 58 N 123 02 21 W	1933	EO 1875
44	Clements Reef Danger Buoy	19860	48 45 46N 122 52 07W		
46	Parker Reef Light	19840	48 43 33 N 122 53 40 W	1957	tidal zone
47	The Sisters Light "17"	19515	48 41 40 N 122 45 25 W	1972	EO 1875
49	Wasp Passage Light "5"	19660	48 35 71 N 122 58 60 W	1948	tidal zone
52	Turn Rock Light "3"	19590	48 32 06 N 122 57 54 W	1957	EO 1875?, tidal zone
53	Shag Rock Daybeacon	19445	48 35 30 N 122 52 31 W	1959	tidal zone
56	Lawson Rock Danger Daybeacon	19410	48 31 48N 122 47 18W	1937	tidal zone
58	Black Rock Light "9"	19455	48 32 45 N 122 45 57 W	1960	tidal zone
59	Peavine Pass Rocks Daybeacon	19460	48 35 19 N 122 48 04 W	1960	tidal zone
64	Peapod Rocks Light "15"	19490	48 38 32 N 122 44 37 W	1933	EO 1875?

FWS #	Navigation Aid Name	LLNR[1]	Position	Year Established	Original Authority[2]
65	Eliza Rocks Junction Light	19215	48 38 60 N 122 34 70 W	1940	
66	Viti Rocks Light	19200	48 38 00 N 122 37 22 W	1939	
66	Viti Rocks Lighted Bell Buoy "9"	19205	48 37 48 N 122 37 08 W		
68	Bird Rocks Light	19645	48 35 52 N 123 00 53 W	1958	
75	Smith Island Light	16375	48 19 06 N 122 50 38 W	1961	EO 1854
76	Minor Island Light	16380	48 19 27 N 122 49 09 W	1931	EO 1854
78	Puffin Island Shoal Light "19"	19530	48 44 36 N 122 49 00 W	1933	EO 1875
80	Belle Rock Sector Light	19395	48 29 35 N 122 45 10 W		
81	Williamson Rocks Lighted Gong Buoy "4"	19335	48 26 50 N 122 42 25 W		
NA	Protection Island Southwest Spit Buoy "1"	16460	48 06 52N 122 57 54W		

[1] USCG Light List Number
[2] According to the USCG, special authority is not needed to establish a navigation aid in tidal areas.
[3] There are no navigation aids at this location however this location is included in the 2005/2006 MOU between the Service and the USCG.
[4] There are no navigation aids at this location however the authority for one was included in E.O. 1875 which to our knowledge has not been revoked.

Habitat Protection Needs

Some habitat protection needs have already been identified in Chapter 2 of the Draft CCP. These include extending refuge law enforcement authority to WDFW lands on Protection Island and working with WDNR and other partners to enhance buffers around refuge islands. These actions are needed to prevent habitat damage and reduce human-caused wildlife disturbance. The Service is also participating in meetings and plans are underway for establishment of aquatic reserves that would include the waters around Protection Island and around Smith/Minor Islands.

Additional habitat protection above and beyond that identified in Chapter 2 of this CCP is needed to ensure the long-term viability of wildlife associated with Protection Island and the San Juan Islands NWR in the face of climate change and human population growth.

The future condition of refuge shorelines is anticipated to be adversely affected by sea level rise associated with climate change. Likely effects due to sea level rise and other climate-related factors include increased inundation, erosion, and overwash during storm events, leading to losses of shoreline habitats (Mote et al. 2008, Huppert et al. 2009). Habitat specialists, such as black oystercatchers, face increased threats from climate change since they have a very restricted range during the breeding season. Oystercatchers, marine mammals, terns, and gulls are particularly vulnerable to loss of habitat and reproductive failure due to sea level raise because they typically nest on low-laying spits or sandy shorelines. Identification and protection of alternative shorelines would help protect these species. Habitats of interest would include spits, sandy or rocky shoreline.

Due to the scarcity of small islands suitable for nesting seabirds and other marine wildlife, their protection is warranted whenever possible. If other islands within the Salish Sea become available they would be evaluated for their conservation potential and considered for inclusion into the Refuge System or another form of habitat protection.

Appendix B. Rocks, Reefs, and Islands within San Juan Islands National Wildlife Refuge

B. Introduction

This appendix provides information on the locations, habitat types, wildlife, wilderness status, and physical attributes of the various rocks, reefs, and islands contained within San Juan Islands National Wildlife Refuge. Aerial photographs provide an additional identification aid. The numbering system of the 83 rocks, reefs, and islands contained within the refuge was first established in the San Juan Islands Wilderness Proposal of August 28, 1971, and has been retained and used in several subsequent publications and research databases. All units of the refuge lie within the San Juan archipelago, with the exception of Smith and Minor Islands, which are located approximately seven miles south of Lopez Island. Because of the limited availability of the habitat preserved and the intent to provide an undisturbed haven for wildlife, all but Turn and Matia Islands are closed to public use.

The San Juan Islands Wilderness was established on October 19, 1976, by public law 94-577. All the islands within the refuge, except for Smith, Minor, Turn, and five acres of Matia Island, are designated wilderness.

The information within this appendix was gathered from several sources and has been narrowed to provide a few of the most vital statistics. Physical descriptions of the islands were obtained from the San Juan Islands Wilderness Proposal of August 28, 1971. Data pertaining to wildlife species, plant species, and overall habitat types found on the islands were collected through a series of surveys conducted by refuge staff between 2000 and 2009. Observations collected by the Whale Museum's Soundwatch program in 1997 were also consulted on these topics. Latitude and longitude coordinates and island acreages were provided by the Region 1 Realty and Information Branch of the USFWS. Information on navigational aids was compiled from the U.S. Coast Guard 13th District Management Branch 2009 Aid Assignment List and verified using National Oceanic and Atmospheric Administration Electronic Navigational Charts from 2008-2009 and the observations of refuge staff. Although much of the provided information is dynamic and may fluctuate with time, this document was compiled to provide a brief reference to the resources managed within the refuge.

01. Small Island

48° 29' 43" N, 122° 51' 48" W

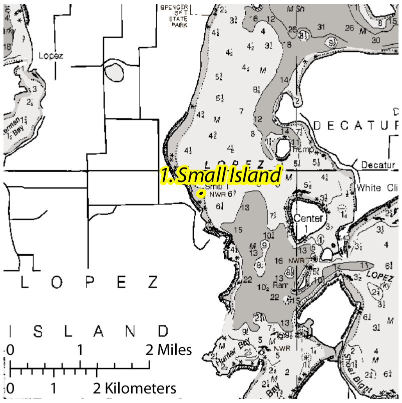


Photo by Khem So/USFWS (2007)

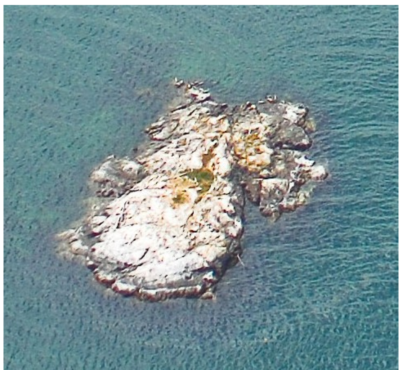
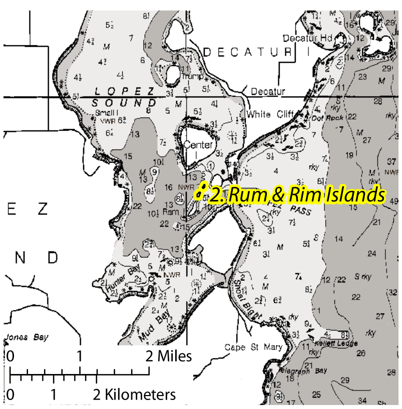


Photo by WA Dept. of Ecology (2006)

This is a very low, flat, rocky 0.329 acre wilderness island approximately 200 to 300 yards offshore of Lopez Island. The habitat structure primarily consists of consolidated rock with very sparse vegetation bordered by a sandy and gravelly shoreline. Wildlife present on this island in 2009 included swallows, black turnstones, black oystercatchers, and double-crested cormorant. Wildlife with young present on the island in 2009 included harbor seals and glaucous-winged gulls. From 2000-2004 black oystercatchers, double crested cormorants, and harbor seals were recorded here.

02. Rum and Rim Islands

48° 28' 49" N, 122° 49' 44" W



Rum Island Photo by Khem So/USFWS (2007)

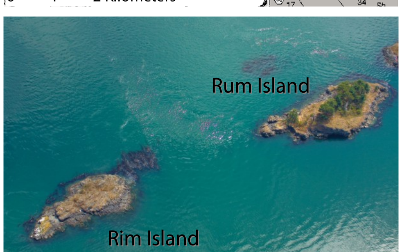


Photo by WA Dept. of Ecology (2006)

These are the northern two islands in the Ram Island group, which is located near the west entrance to Lopez Pass. The northernmost island, Rim Island, has a low-profile. The second island, Rum Island, is separated from the first by about 50 yards of water, although they may be connected by a submerged reef. Together they total 1.777 acres. Rum and Rim Islands are designated wilderness. The third island in the group is privately owned. Habitat consists of rocky shoreline surrounding an herbaceous bald interior. Tree species occurring in a limited woodland on Rum Island include Garry oak, madrone, and Douglas fir. Wildlife present on the islands in 2009 included pelagic cormorant, harbor seals, and black oystercatchers. Between 2000 and 2004 black oystercatchers and harbor seals were present on these islands

03. Fortress Island

48° 27' 55" N, 122° 50' 18" W

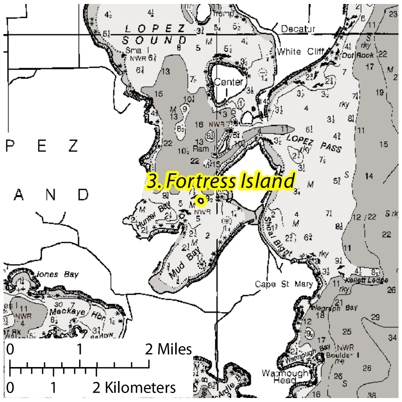


Photo by Khem So/USFWS (2007)

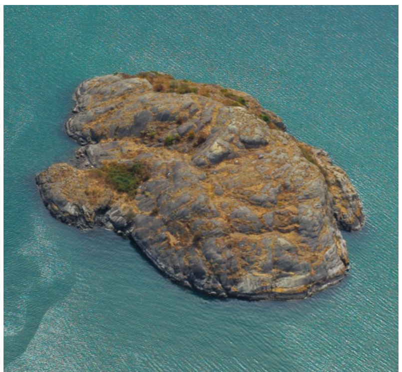


Photo by WA Dept. of Ecology (2006)

This somewhat dome-shaped wilderness island located in Lopez Sound about a half mile to the northeast of Crab Rocks is 2.324 acres. It rises to an elevation of about 100 feet above sea level, has precipitous slopes on all sides, and is surrounded by deep water. The habitat structure is mainly rocky shoreline and herbaceous bald. Willow, wild rose, ocean-spray, snowberry, reindeer moss, stonecrop, and prickly pear cactus have been recorded on this island. In 2009 no wildlife were observed on this island. However harbor seals were found here between 2000 and 2004.

04. Skull Island

48° 27' 57" N, 122° 49' 59" W

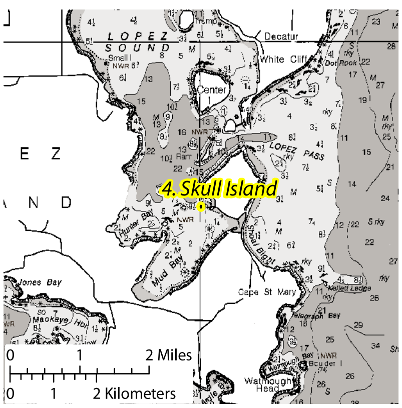


Photo by USFWS (2003)

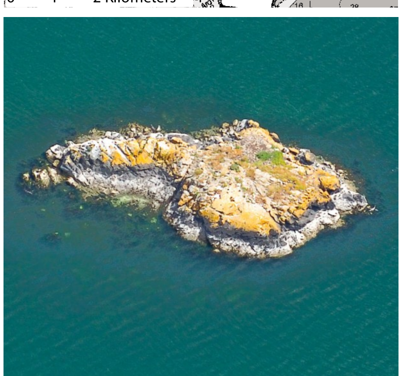
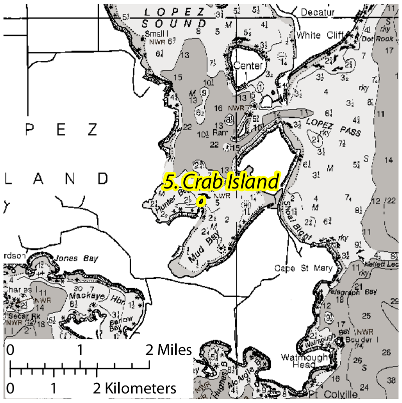


Photo by WA Dept. of Ecology (2006)

Skull Island is a low profile wilderness island about 200 yards off Lopez Island and 300 yards to the northeast of Fortress Island. It is 0.194 acres in size. The habitat consists of rocky shoreline with some grasses and sedum. Wildlife present on the island in 2009 included harbor seals and great blue heron. In 2000 through 2004 black oystercatchers and harbor seals were present.

05. Crab Island 48° 27' 43" N, 122° 50' 40" W



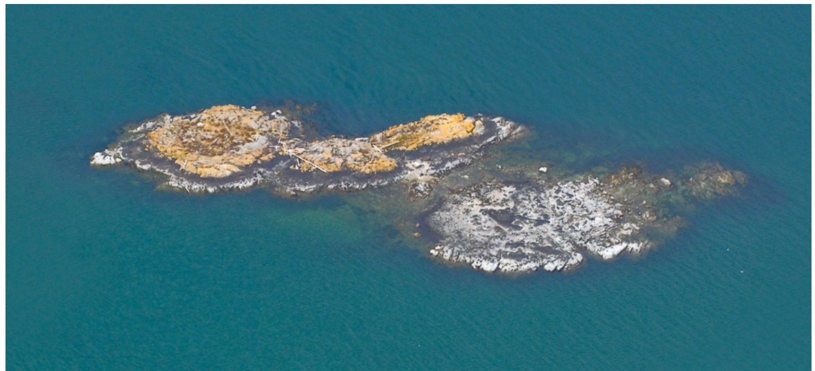


Photo by WA Dept. of Ecology (2006)

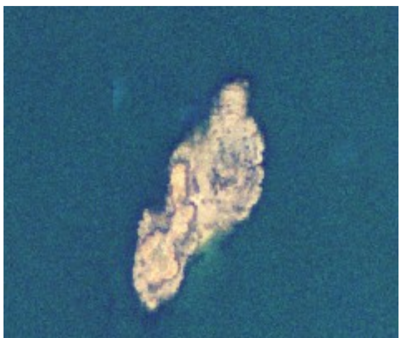


Photo by WA Dept. of Natural Resources (2004)

Crab Island is a very low and rocky wilderness island extending just a few feet above water. It is 0.717 acres in size and separated from Lopez Island by about 100 yards of deep water. The habitat structure is primarily rocky shoreline excepting areas where pockets of soil enable the limited growth of gumweed and some grasses. In 2009 wildlife surveys found double-crested cormorant, great blue heron, and glaucous-winged gulls. Wildlife with young in 2009 included harbor seals and black oystercatchers. Harbor seals and black oystercatchers were recorded in surveys between 2000 and 2004.

06. Boulder Island 48° 25' 57" N, 122° 48' 7" W

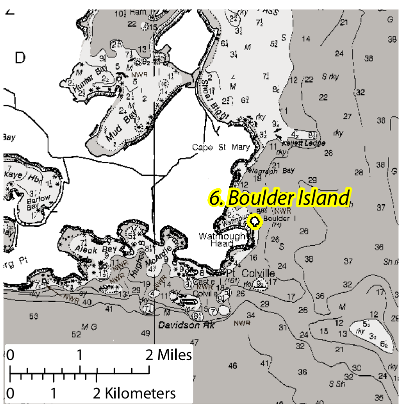


Photo by WA Dept. of Ecology (2006)

Photo by Khem So/USFWS (2007)

This wilderness island is a circular, dome-shaped island, with a narrow, rocky point projecting from its south end. A small, gravelly pocket beach exists adjacent to the narrow rocky point. It is located at the south entrance to Watmough Bay, separated from Lopez Island by about 100 yards of deep water, and is 6.558 acres. Its habitat structure is made up of rocky shoreline, sandy and gravelly shoreline, and herbaceous bald. Some scattered Douglas fir occur, mixed with wild rose, ocean-spray, gumweed, yarrow, goose tongue, sea thrift, and grasses. Glaucous-winged gulls were present on Boulder Island in 2009. From 2000 to 2004 glaucous-winged gulls, harbor seals, and pigeon guillemots were present.

07. Davidson Rock

48° 24' 48" N, 122° 48' 43" W

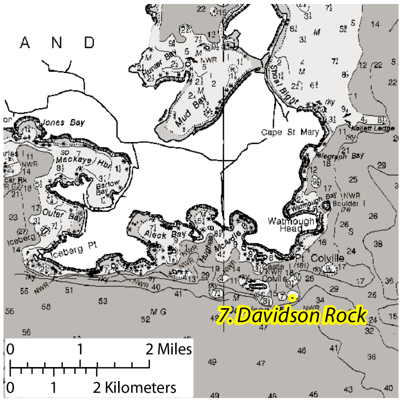


Photo by Khem So/USFWS (2007)

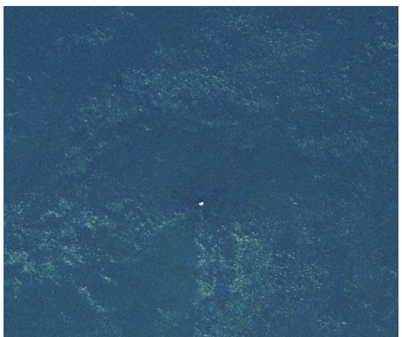


Photo by WA Dept. of Natural Resources (2004)

At high tide this wilderness island nearly submerges completely beneath water. It is located 600 yards east of Colville Island and is 0.006 acres. The island's habitat is reef. The navigational aid Davidson Rock Light "1" is located here. 2005 surveys found glaucous-winged gulls, double-crested cormorants, and harbor seals present on the rock. In the years 2000 to 2004 double-crested cormorants, pelagic cormorants, and harbor seals were found here.

08. Castle Island

48° 25' 17" N, 122° 49' 20" W

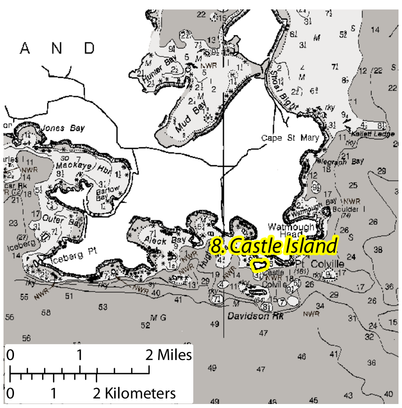


Photo by Khem So/USFWS (2007)

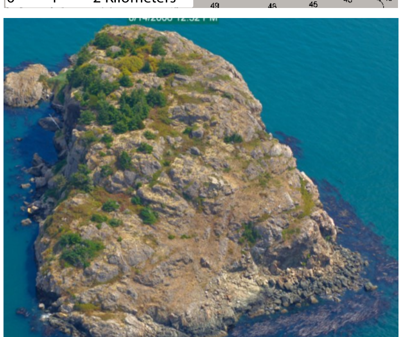
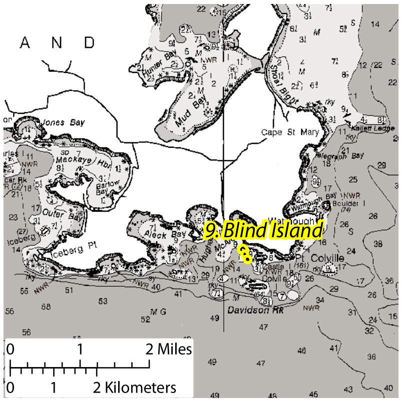


Photo by WA Dept. of Ecology (2006)

Castle Island is an 8.130 acre wilderness island situated north of Colville Island and near the shore of Lopez Island. It is roughly triangular in shape with its north and southeast sides almost vertical cliffs. The west side, though less steeply inclined, can be climbed only with difficulty. The habitat on this island includes rocky shoreline, cliffs, and herbaceous bald. Douglas fir, shore pine, elderberry, salal, and grasses growing in the shallow soil were recorded here. In 2009, wildlife present on the island included turkey vultures, bald eagles, and black oystercatchers. Wildlife with young in 2009 included pigeon guillemots. Between 2000 and 2004, harbor seals, pelagic cormorants, and pigeon guillemots were present.

09. 3 Unnamed Islands (Blind Island) 48° 25' 23" N, 122° 49' 37" W



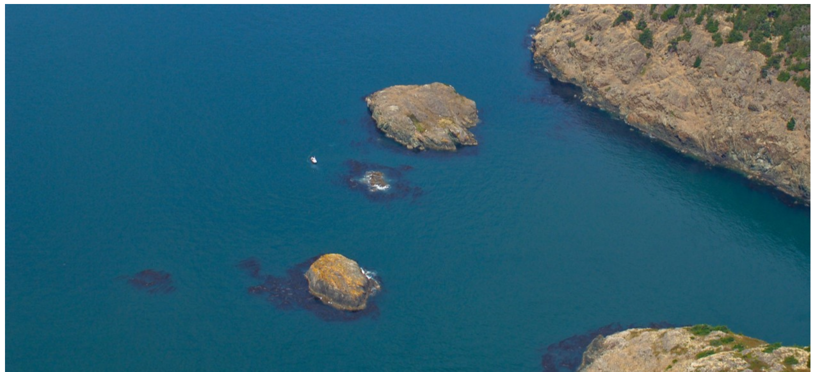


Photo by WA Dept. of Ecology (2006)


Photo by WA Dept. of Ecology (2006)

This group consists of three wilderness islets located immediately west of Castle Island. Blind Island, the northernmost island, is the largest and circular in shape. The middle island is 20 to 30 yards to the southeast. The southern-most island is about 60 to 70 yards southeast of the middle one and is somewhat higher; it has rather precipitous sides and is fairly level on top. Together the acreage for this group is 2.126. The habitat structure of these islets consists of rocky shoreline and herbaceous bald. The middle rock is devoid of vegetation while the other two have low-growing vegetation. In 2009 pigeon guillemot, marbled murrelets, glaucous-winged gulls, and harbor seals were present on the islands. Black oystercatchers and harbor seals were present here from 2000 to 2004.

10. Aleck Rocks 48° 25' 22" N, 122° 50' 60" W

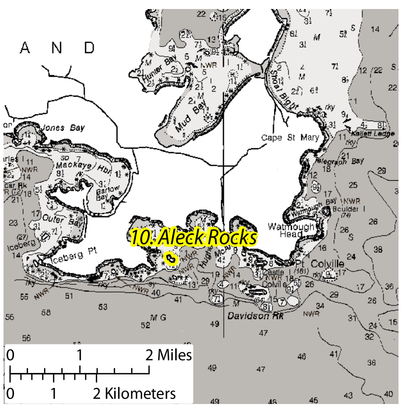



Photo by WA Dept. of Ecology (2006)

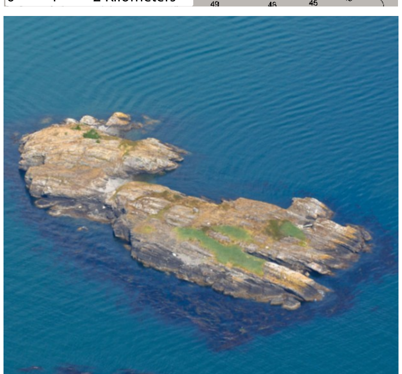


Photo by WA Dept. of Ecology (2006)

This includes two groups of rocky wilderness islets situated in the south side of the entrance to Aleck Bay. The islets appear as a low-profile 3.673 acre island extending about 20 feet above water. It is dissected roughly north to south by a low, craggy depression which is underwater at high tides. Small pocket beaches exist at lower tides. Herbaceous bald, rocky shoreline, and sandy, gravelly shoreline comprise the habitats found here. In 2009 no wildlife were observed on this island, but between 2000 and 2004 both black oystercatchers and harbor seals were observed.

11. Swirl Island

48° 25' 6" N, 122° 50' 54" W

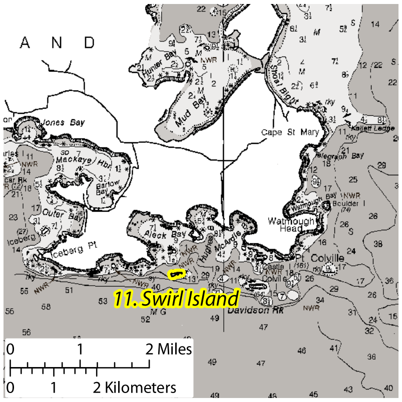


Photo by Khem So/USFWS (2007)

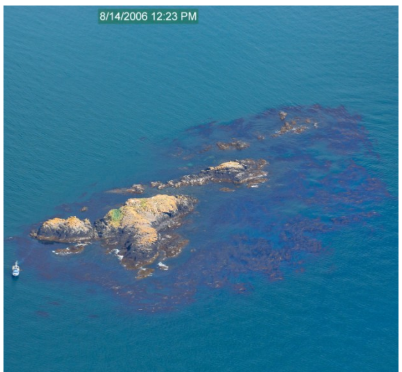


Photo by WA Dept. of Ecology (2006)

Swirl Island is the visible portion of a long wilderness reef which trends northwest to southeast. It is located about 450 yards south of Aleck Rocks. Its habitat structure is rocky shoreline with very sparse vegetation. The area exposed at high tide totals 2.303 acres. Wildlife present on the island in 2009 included Heermann's gulls, glaucous-winged gulls, black oystercatchers, bald eagles, and harbor seals. Black oystercatchers, harlequin ducks, and harbor seals were counted in surveys conducted between 2000 and 2004.

12. Unnamed Rock

48° 25' 38" N, 122° 50' 24" W

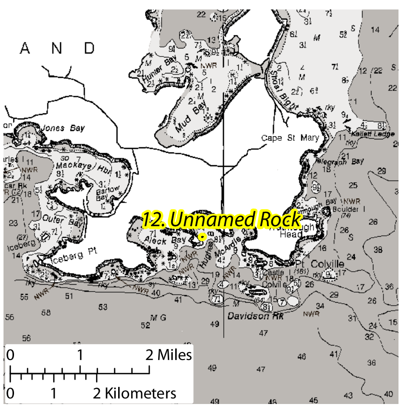


Photo by Khem So/USFWS (2007)

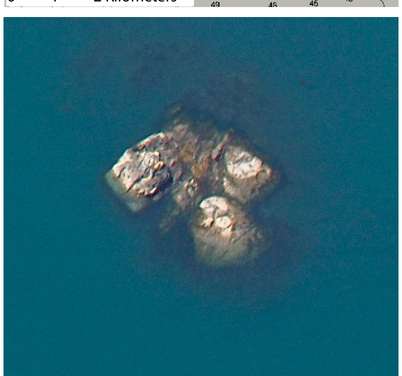


Photo by WA Dept. of Ecology (2006)

This is a single, unvegetated, 0.064 acre wilderness rock with a habitat described as rocky shoreline. It is located offshore a short distance in Hughes Bay at the southeast end of Lopez Island. Wildlife have not been observed here during survey efforts.

13. 4 Unnamed Islands

48° 25' 11" N, 122° 52' 5" W

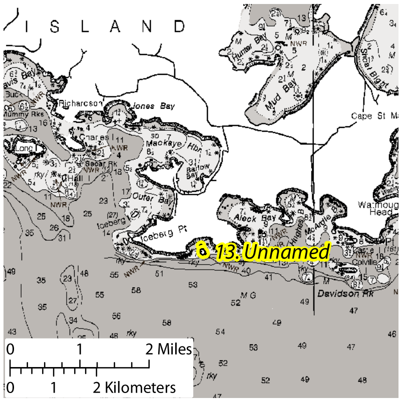


Photo by Khem So/USFWS (2007)

Photo by WA Dept. of Ecology (2006)

This is a circular, low-profile wilderness island with two or three small bare rocks nearby. The total acreage is 3.407 acres. It is separated from Lopez Island by about 200 yards of deep water. The habitat structure of this island includes herbaceous bald, rocky shoreline, and sandy, gravelly shoreline. There is a small Douglas fir stand on the north island. In 2009 harbor seals and glaucous-winged gulls were present. From 2000 to 2004 harbor seals and black oystercatchers were recorded.

14. 3 Unnamed Islands

48° 25' 6" N, 122° 53' 10" W

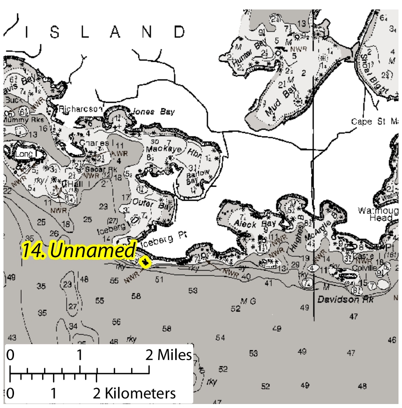


Photo by Khem So/USFWS (2007)

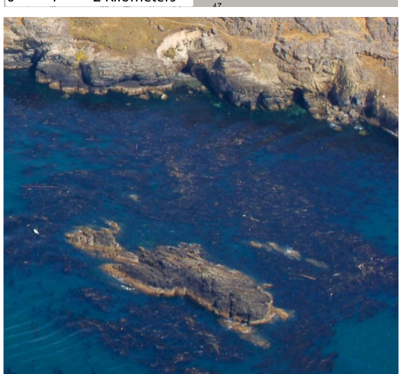


Photo by WA Dept. of Ecology (2006)

These are rocky wilderness islets that are obviously part of a submerged reef extending off the south end of a small point along the shoreline of Lopez Island. They are 0.591 acres in size. The habitat structure here is rocky shoreline. The 2009 survey found Heermann's gulls, glaucous-winged gulls, great blue herons, greater yellowlegs, and black oystercatchers present. Harbor seals were recorded here from 2000 to 2004.

15. Hall Island

48° 26' 6" N, 122° 54' 43" W

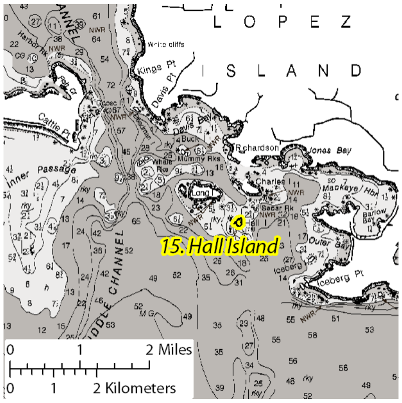


Photo by Khem So/USFWS (2007)

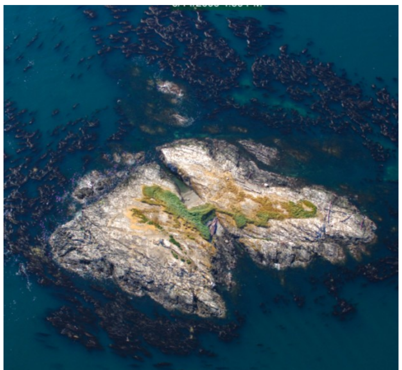


Photo by WA Dept. of Ecology (2006)

Hall Island is a low-profile wilderness island rising about 25 feet above sea level. It is located about 605 yards south of Charles Island and is 4.701 acres. The island's habitat consists of rocky shoreline, sandy, gravelly shoreline, and herbaceous bald. In 2009 wildlife present on the island included rock sandpipers, Heermann's gulls, harlequin ducks, and black oystercatchers. Wildlife found with young in 2009 includes harbor seals and glaucous-winged gulls. Black oystercatchers, double-created cormorants, glaucous-winged gulls, harlequin ducks, and harbor seals were present for surveys from 2000 to 2004.

16. Unnamed Island

48° 26' 8" N, 122° 54' 54" W

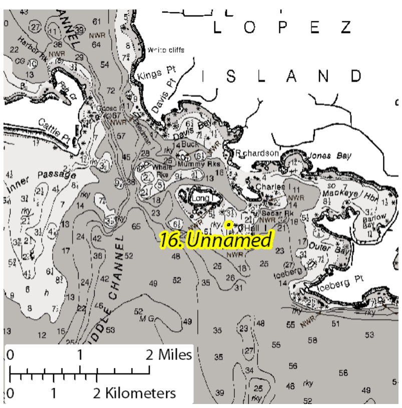


Photo by Khem So/USFWS (2007)

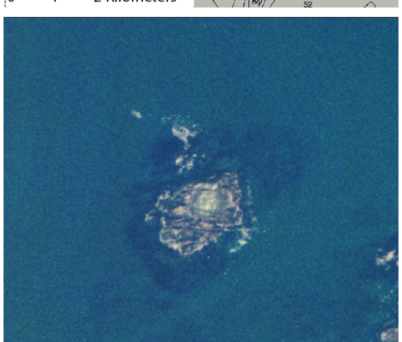


Photo by WA Dept. of Natural Resources (2004)

This low-profile wilderness island rises only a few feet above high tide. It is located about 205 yards west of Hall Island and is 0.467 acres. Its habitat is primarily rocky shoreline. In 2009 Heermann's gulls, harlequin ducks, glaucous-winged gulls, black turnstones, black oystercatchers, and harbor seals were present on the island. Between 2000 and 2004 black oystercatchers and harbor seals were recorded here.

17. Secar Rock — 48° 26' 16" N, 122° 54' 25" W

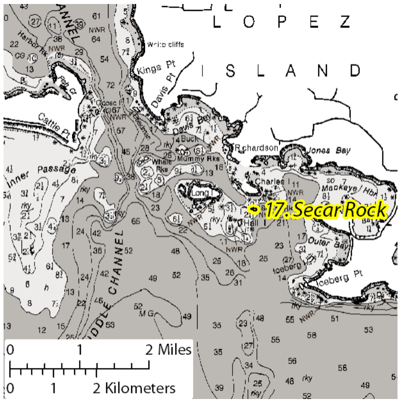


Photo by USFWS (2003)

Photo by WA Dept. of Ecology (2006)

Secar Rock is a low-profile wilderness island rising 15 feet above high tide. It is located midway between Charles and Hall Islands. The majority of this 1.302 acre island is comprised of rocky shoreline habitat. In 2009 no wildlife were observed on the island. However between 2000 and 2004 black oystercatchers, double-crested cormorants, glaucous-winged gulls, harlequin ducks, harbors seals, and pigeon guillemots were observed.

18. Unnamed Island (Round Rock) — 48° 26' 24" N, 122° 54' 10" W

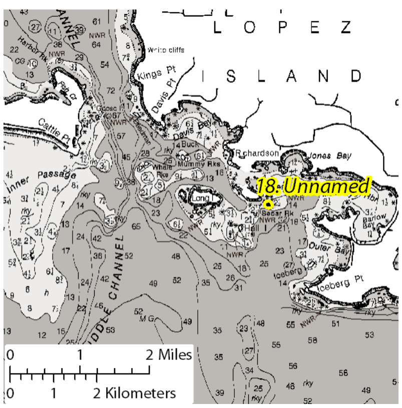


Photo by USFWS (2003)

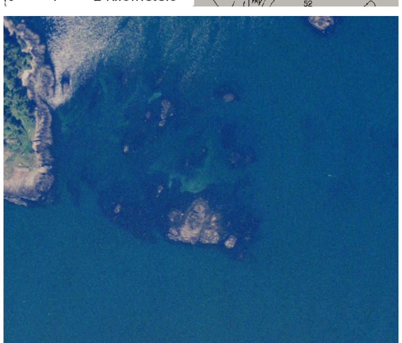


Photo by WA Dept. of Natural Resources (2004)

The exposed portion of this wilderness island rises 12 feet above sea level and is located about 375 yards east of Charles Island and immediately northeast of Secar Rock. The habitat structure of this 0.616 acre island is rocky shoreline. In 2009 harbor seals and black oystercatchers were present on the island. From 2000 to 2004 black oystercatchers, double-crested cormorants, harlequin ducks, harbor seals, pelagic cormorants, and rhinoceros auklets were observed.

19. 3 Unnamed Islats

48° 26' 22" N, 122° 55' 9" W

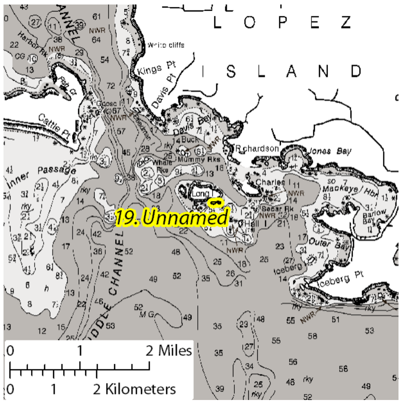


Photo by WA Dept. of Ecology (2006)


Photo by WA Dept. of Ecology (2006)

This group consists of three rocky wilderness islets located just offshore and to the southeast of Long Island, to which they are connected by a submerged reef. The total acreage of this group is 2.082 acres. The primary habitat is rocky shoreline. Grasses occur on the largest islet while the other two islets have no vegetation. In 2009, black oystercatchers were present on these islets. Harbor seals were present between 2000 and 2004.

20. 13 Unnamed Islets

48° 26' 17" N, 122° 55' 34" W

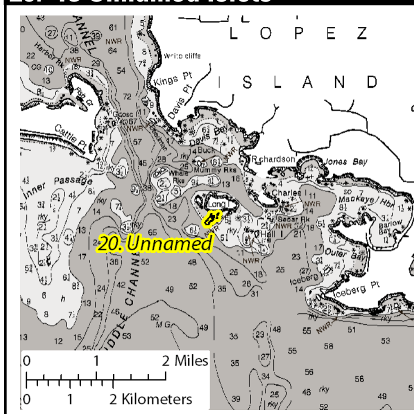



Photo by WA Dept. of Ecology (2006)


Photo by WA Dept. of Ecology (2006)

This is a large group of small low-profile wilderness islets and rocks. They are located off the south shore of Long Island just west of the group described in number 19. Collectively they are 5.085 acres. Rocky shoreline makes up the primary habitat for this group although some grasses grow on the larger islets. Bald eagles were present on this group in 2009. Also in 2009 harbor seals were present with pups. Wildlife recorded between 2000 and 2004 included black oystercatchers, double-crested cormorants, glaucous-winged gulls, harlequin ducks, harbor seals, and rhinoceros auklets.

21. Mummy Rocks 48° 26' 57" N, 122° 55' 47" W

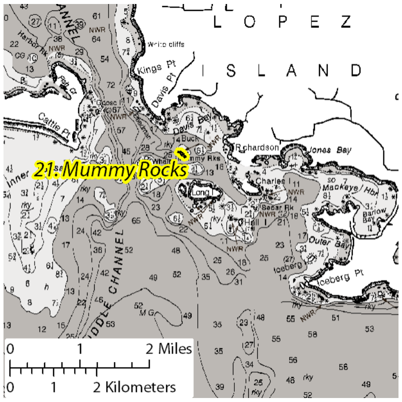



Photo by Khem So/USFWS (2007)

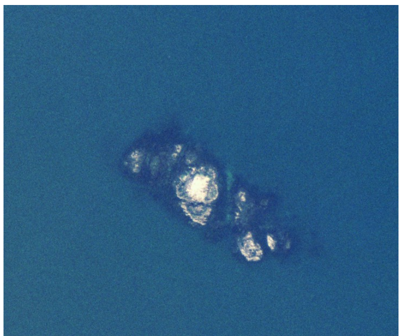


Photo by WA Dept. of Natural Resources (2004)

Mummy Rocks, located midway between Long Island and Point Davis on Lopez Island, consists of two low-profile wilderness islets with a habitat structure of rocky shoreline. They total 1.325 acres. In 2009 harlequin ducks, glaucous-winged gulls, and American crows were present on the islets. Also, harbor seals with pups were present in 2009. Between 2000 and 2004 black oystercatchers, double-crested cormorants, glaucous-winged gulls, harlequin ducks, and harbor seals were observed.

22. Islets and Rocks associated with Deadman Island 48° 27' 33" N, 122° 56' 35" W

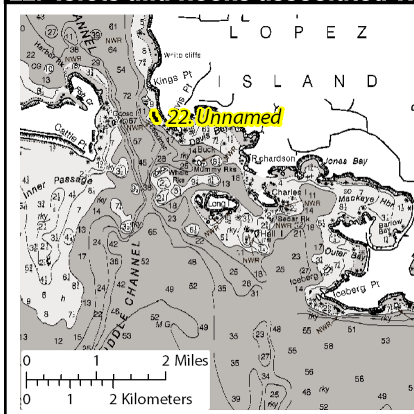


Photo by WA Dept. of Ecology (2006)

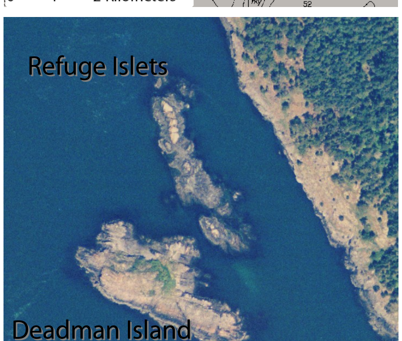


Photo by WA Dept. of Natural Resources (2004)

This is a grouping of several wilderness islets and rocks northeast of Deadman Island. They are about 300 to 400 yards offshore from Lopez Island and separated from Deadman Island by 50 to 100 yards of deep water. They trend roughly north to south and together they total 1.822 acres. The habitat of this group is rocky shoreline. Harbor seals and glaucous-winged gulls were found here in 2009. From 2000 to 2004 black oystercatchers and harbor seals were found.

23. Shark Reef — 48° 28' 34" N, 122° 56' 52" W

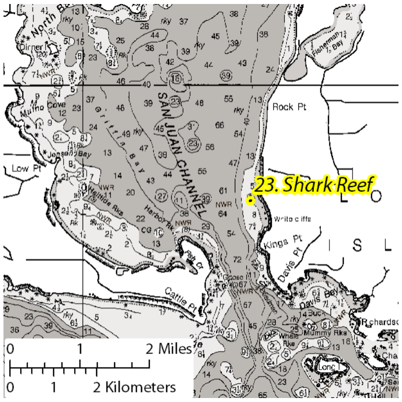



Photo by Khem So/USFWS (2007)


Photo by WA Dept. of Natural Resources (2004)

This is a wilderness reef formation with two rocky tips exposed at high tide. It is situated 200 to 300 yards off of the west shore of Lopez Island, about 1.5 miles north of Point Davis, and is 0.160 acres. Harbor seal young were present in 2009. Harbor seals were also present between 2000 and 2004.

24. Harbor Rock — 48° 28' 11" N, 122° 58' 13" W

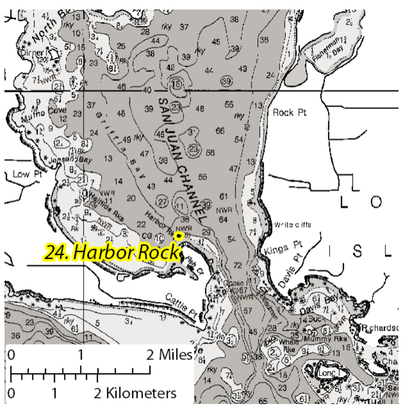



Photo by Khem So/USFWS (2007)

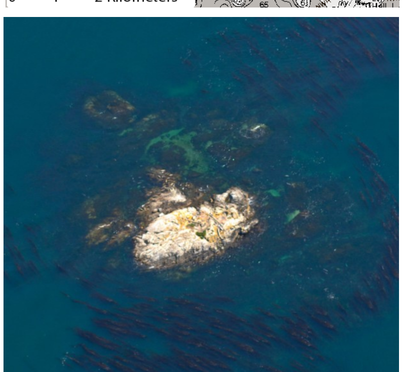


Photo by WA Dept. of Ecology (2006)

This is a low-profile wilderness rock with a habitat structure of rocky shoreline. It is located about 200 yards offshore of San Juan Island at the south side of Griffin Bay and is 0.558 acres. Black oystercatchers were present in 2009 along with harbor seals and their young. In 2000 through 2004 black oystercatchers, harlequin ducks, and harbor seals were present.

25. Unnamed Rock (North Pacific Rock) 48° 28' 17" N, 122° 59' 48" W

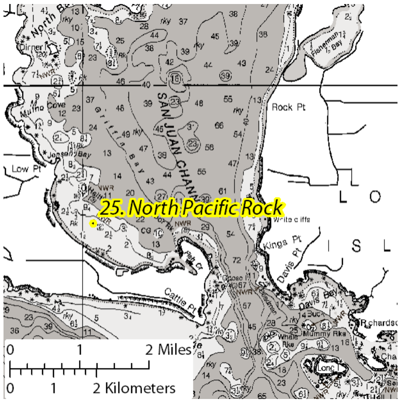


Photo by USFWS (1978)

Photo by Khem So/USFWS (2007)

This is a low wilderness reef located off the east shore of San Juan Island in Griffin Bay that is submerged at maximum high tide. The habitat structure is classified as reef with an acreage of 0.022. In 2009 pelagic cormorants, glaucous-winged gulls, and double-crested cormorants were present on this reef. Harbor seals were observed from 2000 to 2004.

26. Halftide Rocks 48° 28' 43" N, 123° 0' 0" W

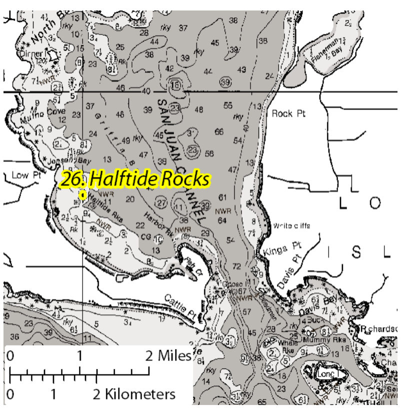
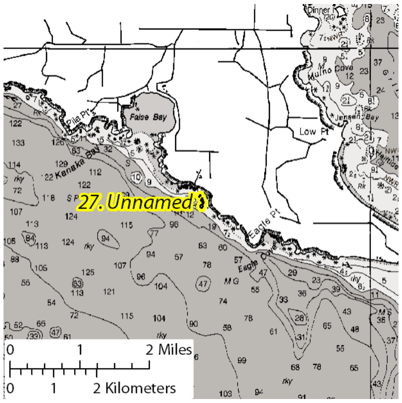


Photo by Khem So/USFWS (2007)

Photo by Khem So/USFWS (2007)

These wilderness rocks are awash at high tide, thus leading to a habitat classification of reef. They are located about three quarters of a mile north of North Pacific Rock in Griffin Bay and total 0.133 acres in size. In 2009 Heermann's gulls and glaucous-winged gulls were present on the island. Harbor seals with pups were also present in 2009. Double-crested cormorants and harbor seals were observed from 2000 to 2004.

27. 7 Unnamed islands — 48° 28' 4" N, 123° 3' 10" W



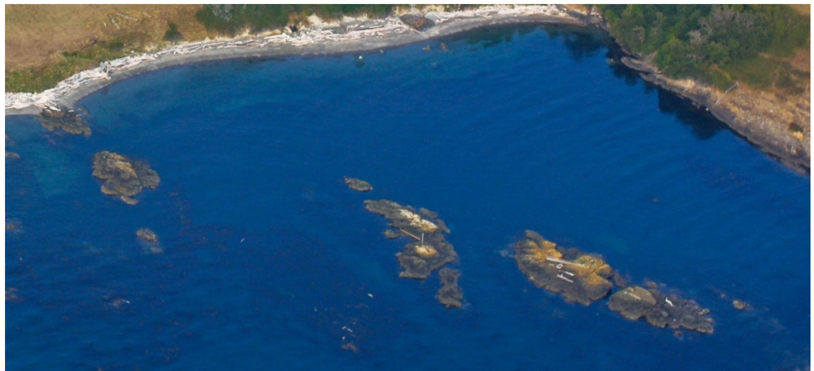


Photo by WA Dept. of Ecology (2006)

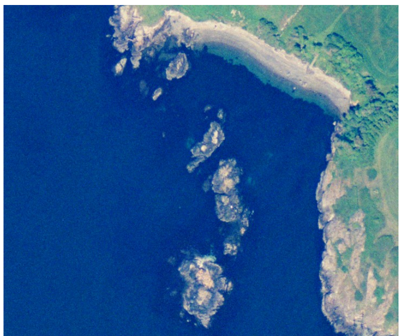


Photo by WA Dept. of Natural Resources (2004)

These are a series of wilderness islets which extend out from San Juan Island. They are midway between False Bay and Eagle Point. Collectively they total 2.177 acres. The habitat structure is rocky shoreline. Surveys in 2009 found Heermann's gulls and glaucous-winged gulls present along with harbor seals and their pups. Black oystercatchers, glaucous-winged gulls, and harbor seals were present between 2000 and 2004.

28. Low Island — 48° 32' 36" N, 123° 9' 53" W

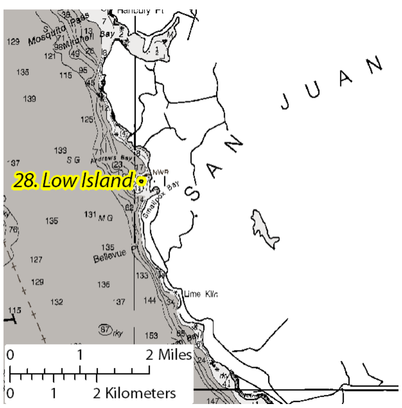


Photo by Khem So/USFWS (2007)

Photo by WA Dept. of Ecology (2006)

Low Island is a small, rocky bench designated as wilderness and with a habitat structure of rocky shoreline. It is located about 200 yards off San Juan State Park on San Juan Island and is 0.825 acres in size. Surveys in 2009 found black oystercatchers and great blue herons present on the island. In 2009 harbor seals with their young were also present on the island. Between 2000 and 2004 black oystercatchers, harbor seals, and pelagic cormorants were found.

29. Pole Island

48° 36' 3" N, 123° 10' 5" W

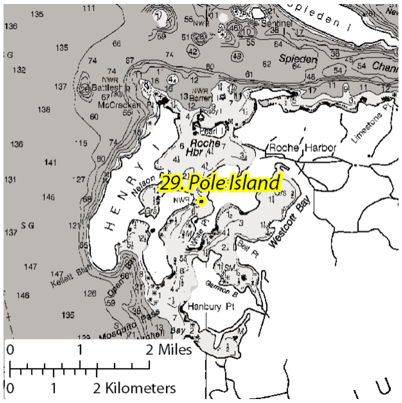


Photo by Khem So/USFWS (2007)

Photo by WA Dept. of Natural Resources (2004)

Pole Island is a circular shaped, low-profile, wilderness island 0.721 acres in size. It is situated between San Juan and Henry Islands. Its habitat consists of sandy, gravelly shoreline, rocky shoreline, and herbaceous bald. Plant species noted on this island include wild rose, ocean spray, yarrow, gumweed, plantain, Oregon grape, and grasses. No wildlife have been observed on Pole Island during recent surveys.

30. Barren Island

48° 37' 22" N, 123° 9' 39" W

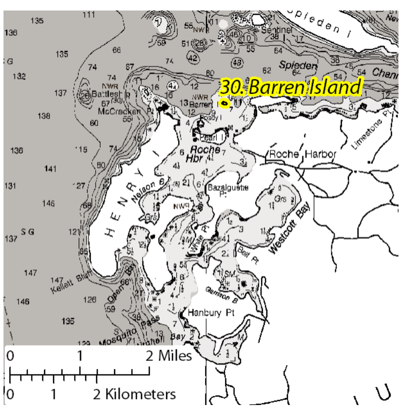


Photo by USFWS (2003)

Photo by WA Dept. of Ecology (2006)

This is a low-profile, dome-shaped wilderness island located about one-half mile off San Juan Island. The habitat of this sparsely vegetated island is comprised of herbaceous bald and rocky shoreline. It is 0.721 acres in size. Wildlife present on this island in 2009 included pelagic cormorants, double-crested cormorants, and harbor seals. In surveys taken between 2000 and 2004 black oystercatchers, double-crested cormorants, harbor seals, pelagic cormorants, and pigeon guillemots were present.

31. Battleship Island
48° 37' 29" N, 123° 11' 7" W

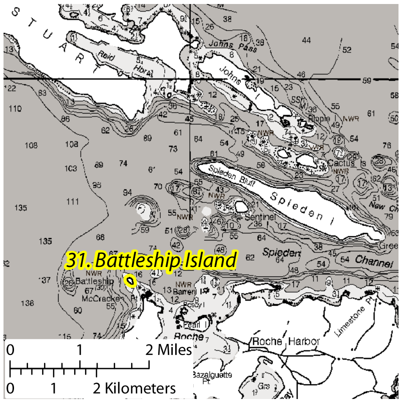



Photo by USFWS (2003)

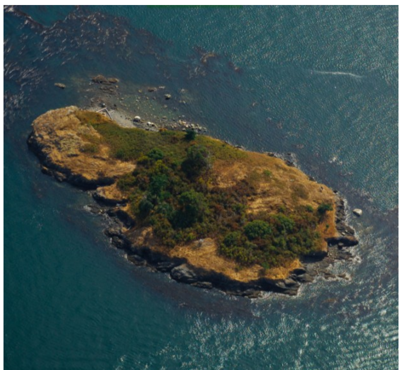
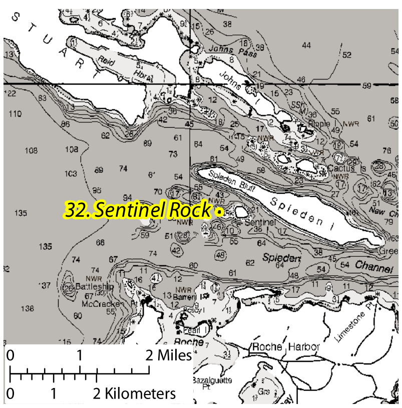


Photo by WA Dept. of Ecology (2006)

This is a circular-shaped wilderness island 2.887 acres in size with maximum elevation of 40 feet. It is located northwest of McCracken Point on the north end of Henry Island. Its habitat structure is classified as rocky shoreline with cliffs, woodland, and herbaceous bald. Trees growing on the island include Douglas fir, madrone, and willow. Understory components include ocean spray and grasses. Wildlife found on this island in 2009 included pigeon guillemot and harbor seal. Harbor seals were recorded between 2000 and 2004.

32. Sentinel Rock
48° 38' 24" N, 123° 9' 26" W



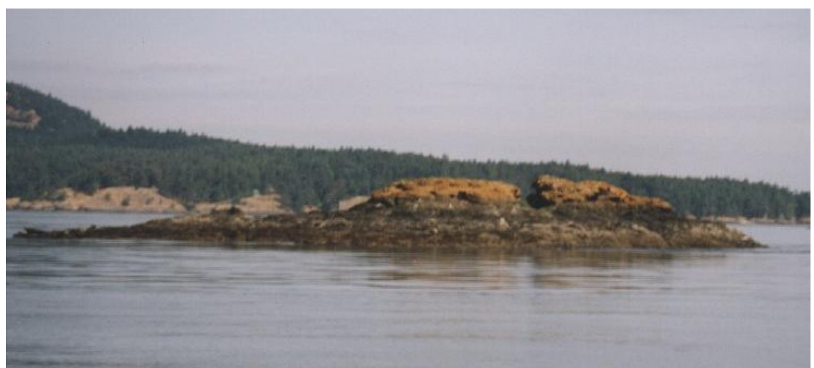


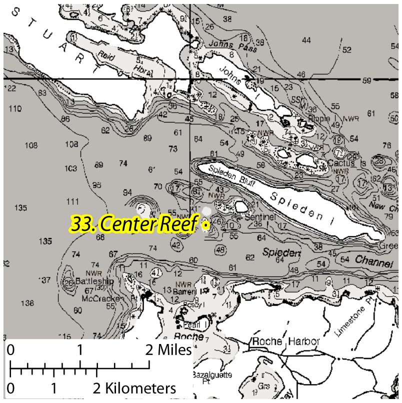
Photo by USFWS (2003)


Photo by WA Dept. of Natural Resources (2004)

Sentinel Rock is a low-profile wilderness island with an elevation of five feet. It is about 350 yards west of Sentinel Island and is 0.329 acres in size. The habitat of this island is rocky shoreline. Lichens and mosses primarily cover the rock's surface. Wildlife present in 2009 include pelagic cormorants, also harbor seals were present with their young. From 2000 to 2004 black oystercatchers, glaucous-winged gulls, harlequin ducks, harbor seals, and pelagic cormorants were found.

33. Center Reef

48° 38' 11" N, 123° 9' 42" W



Spieden Channel Buoy 3 to the left of Center Reef Photo by Khem So/USFWS (2007)

This is an extensive submerged wilderness reef, visible just beneath the surface. It is located in Spieden Channel, about 600 yards to the southwest of Sentinel Rock. It is 0.054 acres in size. It is classified as a reef habitat. Wildlife have not been observed here during survey efforts.

34. Gull Reef

48° 39' 17" N, 123° 8' 49" W

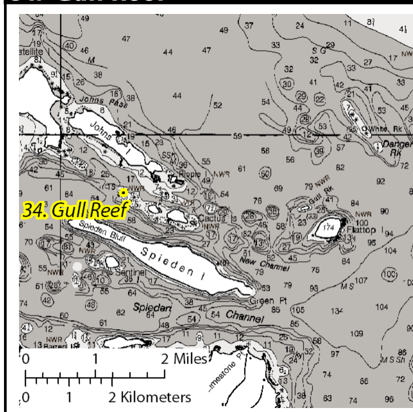


Photo by Khem So/USFWS (2007)

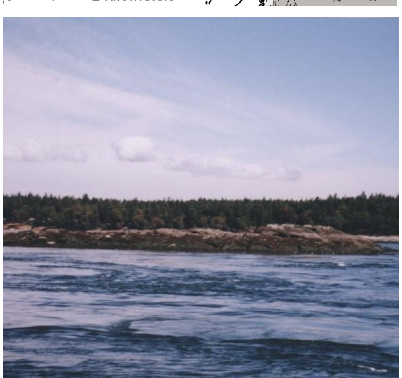


Photo by USFWS (2003)

This wilderness reef rises about two feet above high tide and is classified as a reef habitat. It is located about 1,000 yards west of Shag Reef and is 0.251 acres. The 2009 survey found pigeon guillemots and double-crested cormorants present on this reef along with harbor seals and their young. Black oystercatchers, double-crested cormorants, harlequin ducks, harbor seals, and pelagic cormorants were observed between 2004 and 2009.

35. Ripple Island — 48° 39' 25" N, 123° 7' 51" W

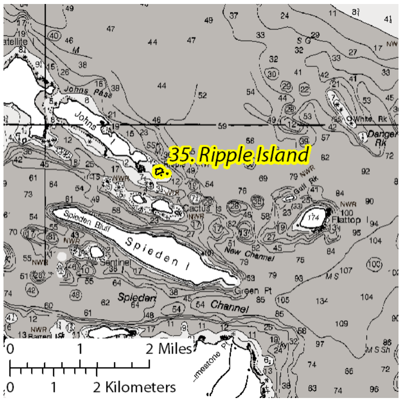


Photo by USFWS (2003)

Photo by WA Dept. of Ecology (2006)

Ripple Island is a low, flat wilderness island with a maximum elevation of about 20 feet and a size of 4.151 acres. It is separated from Johns Island by a narrow, relatively shallow channel about 100 yards wide. Its habitat is made up of rocky shoreline and sandy, gravelly shoreline along with herbaceous bald and woodland. The low vegetation includes sea birch, wild rose, gumweed, and grasses. Wildlife present on the island in 2009 included surfbirds, black oystercatchers, bald eagles, and American crows. In 2009 harbor seals were present with young. From 2000 to 2004 black oystercatchers, harlequin ducks, and harbor seals were present.

36. Unnamed Reef (Shag Reef) — 48° 39' 15" N, 123° 8' 2" W

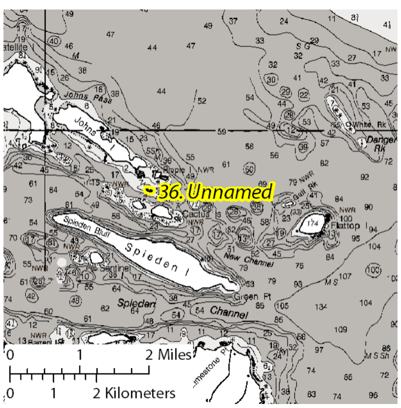


Photo by USFWS (2003)

Photo by WA Dept. of Natural Resources (2004)

Shag Reef is essentially a flat wilderness reef with the highest point rising to about a foot above high tide. The exposed portion of the reef is divided into two parts by a deep depression that extends across the central portion. It is situated between Ripple Island and the Cactus Islands and is 0.766 acres. Wildlife present on this island in 2009 were pigeon guillemots, pelagic cormorants, glaucous-winged gulls, and black oystercatchers. Harbor seals with young were also present in 2009. Between 2000 and 2004 black oystercatchers, harlequin ducks, and harbor seals were present.

37. Unnamed Island (Little Cactus Island) 48° 38' 52" N, 123° 7' 30" W

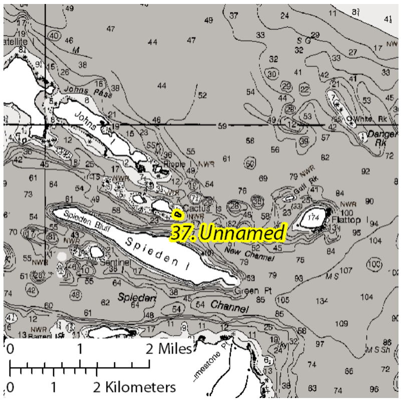



Photo by USFWS (2003)


Photo by WA Dept. of Ecology (2006)

Little Cactus Island is the smallest of the Cactus Island group at 2.103 acres. It is located 50 yards to the east of the two largest islands. It is a low-profile wilderness island. Its habitat consists of rocky shoreline and herbaceous bald. In 2009 harbor seals with pups were found on this island. From 2000 to 2004 black oystercatchers, harlequin ducks, and harbor seals were found.

38. Gull Rock 48° 39' 4" N, 123° 5' 23" W

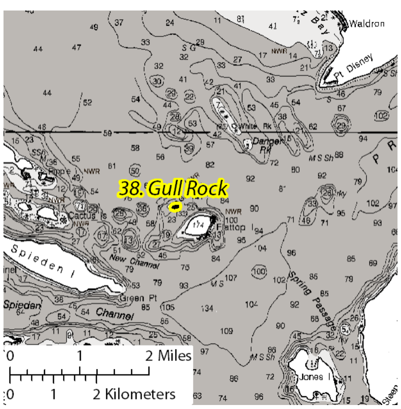



Photo by USFWS (2003)

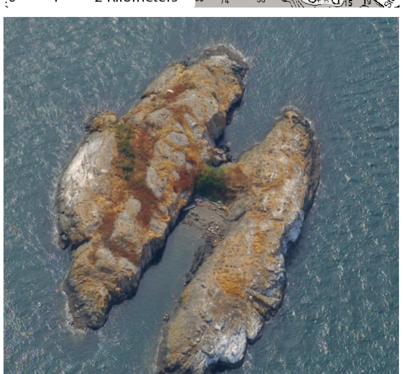
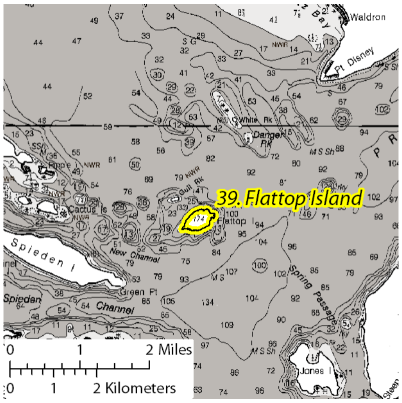


Photo by WA Dept. of Ecology (2006)

Gull Rock has a flat profile with a maximum elevation of about 30 feet and a size of 1.804 acres. It is located 500 yards northwest of Flattop Island. This wilderness island is divided almost in two by differential erosion along a stratum of soft materials that is bound in each side by hard layers of conglomerate. The habitat structure is herbaceous bald, rocky shoreline, and sandy, gravelly shoreline. Wildlife present on the island in 2009 included pigeon guillemots and glaucous-winged gulls. Harbor seals were present with pups in 2009. Between 2000 and 2004 black oystercatchers, double-crested cormorants, glaucous-winged gulls, harbor seals, pelagic cormorants, and pigeon guillemots were observed.

39. Flattop Island

48° 38' 49" N, 123° 4' 57" W



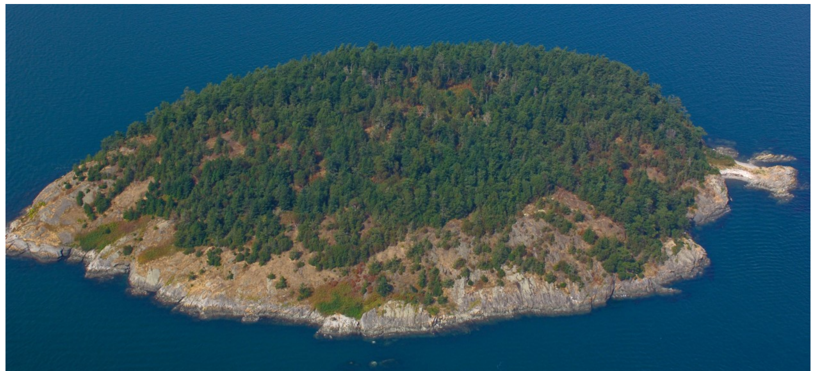


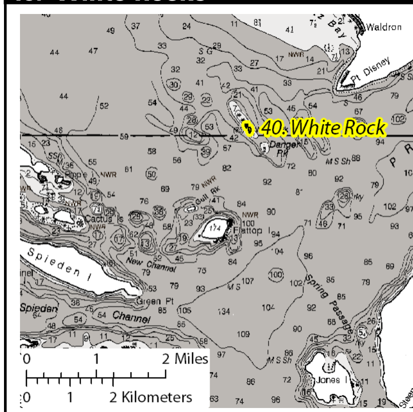
Photo by WA Dept. of Ecology (2006)

Photo by WA Dept. of Ecology (2006)

Flattop Island is located about one mile northeast of Green Point on Spieden Island. This 57.612 acre wilderness island appears slightly elliptical in shape, with a rocky, irregular surface. The highest point on the island is 174 feet above sea level. The entire surface of the island slopes toward the southeast at a 25° angle . The variety of habitats here includes woodland, herbaceous bald, cliffs, rocky shoreline, and sandy, gravelly shoreline. Tree species include Douglas fir, madrone, shore pine, Garry oak, and willow. Wildlife present in 2009 included river otters, pigeon guillemots, and black oystercatchers. In 2009 both bald eagles and harbor seals were present with young. Between 2000 and 2004 bald eagles, black oystercatchers, harbor seals, and pigeon guillemots were present.

40. White Rocks

48° 40' 6" N, 123° 4' 19" W



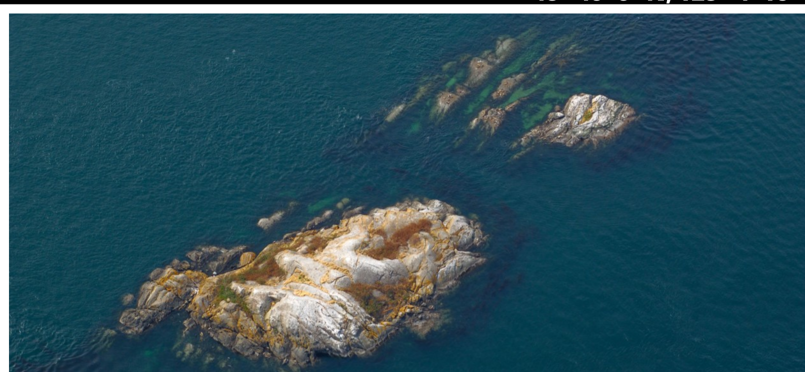


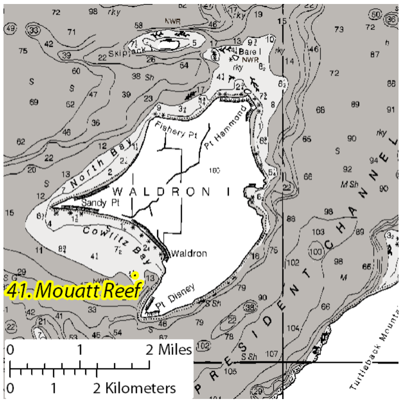
Photo by WA Dept. of Ecology (2006)

Photo by Khem So/USFWS (2007)

White Rocks is a wilderness area consisting of one large island and one very small islet. They are located approximately midway between Flattop Island and Point Disney on Waldron Island. Maximum elevation is 35 feet and size is 2.118 acres. The habitat is rocky shoreline and herbaceous bald. Wildlife present on the island in 2009 were pigeon guillemot and glaucous-winged gulls. Wildlife with young present in 2009 were bald eagles and harbor seals. From 2000 to 2004 black oystercatchers, double-crested cormorants, harbor seals, pelagic cormorants, and pigeon guillemots were found.

41. Mouatt Reef

48° 41' 5" N, 123° 2' 47" W



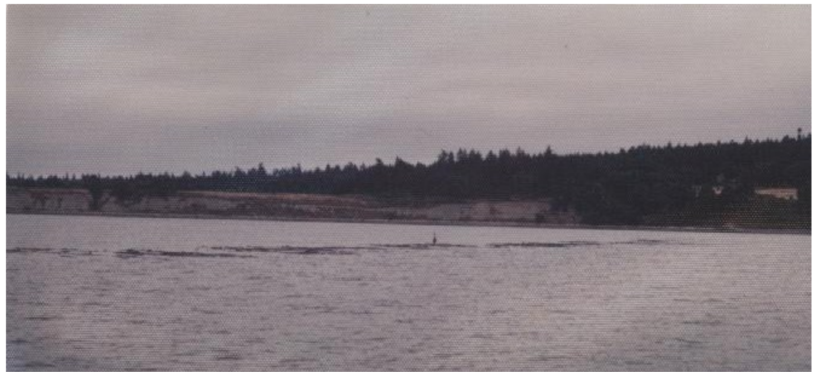
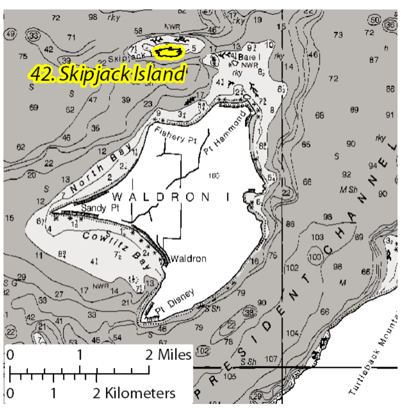


Photo by USFWS (1978)

This is an extensive wilderness reef, trending northwest to southeast, which is awash at high tide. The 0.023 acre reef is located in Cowlitz Bay, on the west side of Waldron Island. Wildlife have not been observed here during survey efforts.

42. Skipjack Island

48° 43' 56" N, 123° 2' 9" W



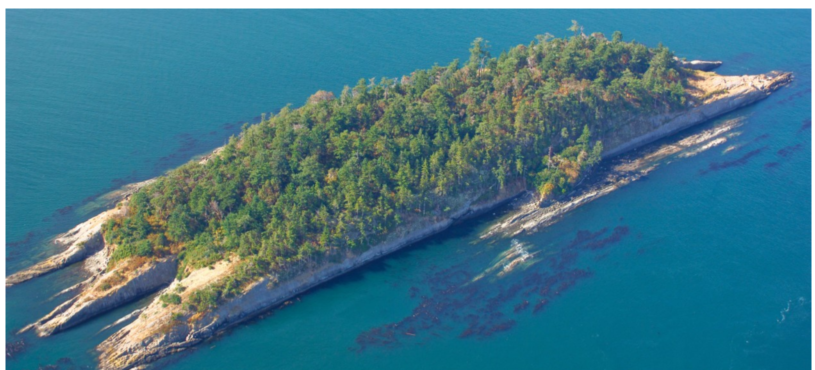


Photo by WA Dept. of Ecology (2006)

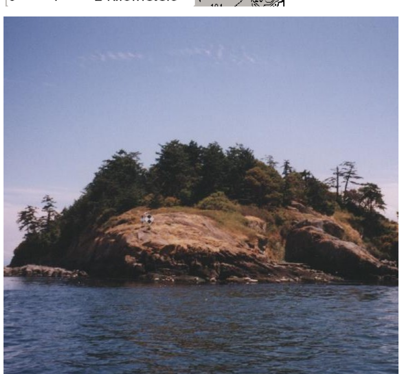


Photo by USFWS (2003)

Skipjack Island, with an area of 19.866 acres, is located north of Waldron Island. The north side of this wilderness island is very precipitous, with sheer cliffs extending nearly the full length of the north shoreline. The maximum elevation is about 120 feet. Skipjack Island Light, a navigational aid, is located in the northwest corner of the island. Habitats here include forest, herbaceous bald, cliffs, rocky shoreline, and sandy, gravelly shoreline. Tree species include Douglas fir, madrone, willow, Rocky Mountain juniper, and willow. Surveys found turkey vultures, pigeon guillemots, black oystercatchers, bald eagles, and American crows present on the island in 2009. Also, harbor seals with pups were present in 2009. Bald eagles, black oystercatchers, harbor seals, pigeon guillemots, and rhinoceros auklets were observed between 2000 and 2004.

43. Unnamed Island

48° 43' 59" N, 123° 1' 47" W

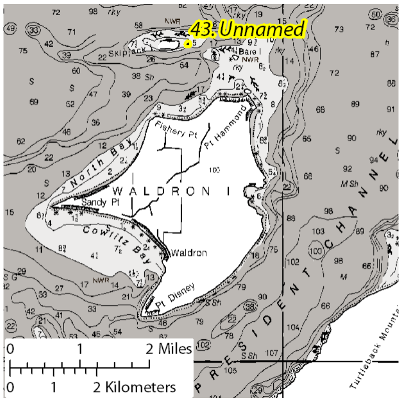



Photo by Khem So/USFWS (2007)


Photo by WA Dept. of Ecology (2006)

This is a small wilderness islet connected to the east end of Skipjack Island by a submerged reef. It is 0.077 acres. The habitat consists of rocky shoreline. Harbor seals with pups were present on the island in 2009. Harbor seals were present between 2000 and 2004.

44. Clements Reef

48° 46' 34" N, 122° 53' 20" W

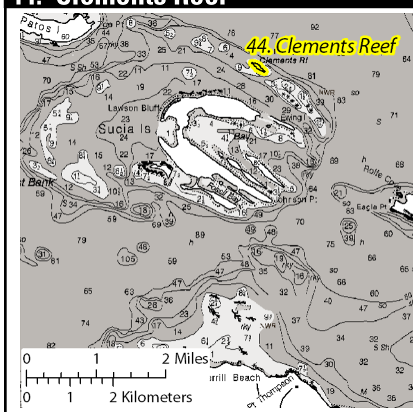



Photo by USFWS (2003)

Clements Reef is comprised of three small elongated reefs, which are located north of Sucia Island. This wilderness reef is completely submerged. It is listed as having a habitat structure of reef and a size of 4.747 acres, when exposed. The Clements Reef Buoy 2, a navigational aid, is located to the northwest of the reef. Wildlife noted as present in the area in 2009 included pigeon guillemots, Heermann's gulls, glaucous-winged gulls, and black oystercatchers. Harbor seals with pups were also present in 2009. Between 2000 and 2004 harbor seals were present.

45. Unnamed Island 48° 46' 11" N, 122° 52' 46" W

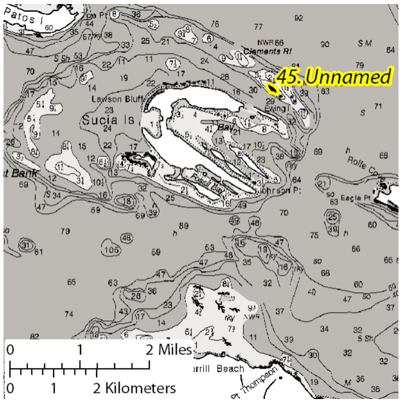



Photo by Khem So/USFWS (2007)

The habitat structure for this wilderness island is reef and its size is 0.971 acres. It is almost always submerged or nearly submerged. The Clements Reef Danger Buoy, a navigational aid, is located to the southeast of the reef. Wildlife present here in 2009 included pigeon guillemots, Heermann's gulls, glaucous-winged gulls, and black oystercatchers. In 2009 harbor seals with pups were present. Wildlife present between 2000 and 2004 included black oystercatchers, elephant seals, harbor seals, pelagic cormorants, and pigeon guillemots.

46. Parker Reef 48° 43' 33" N, 122° 53' 39" W

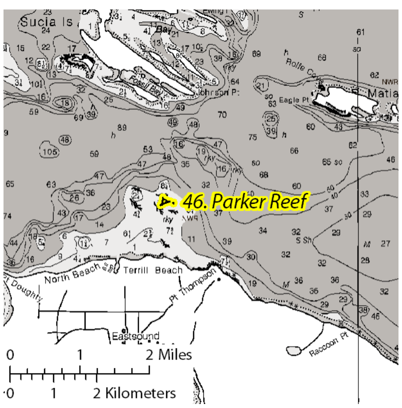



Photo by WA Dept. of Ecology (2006)

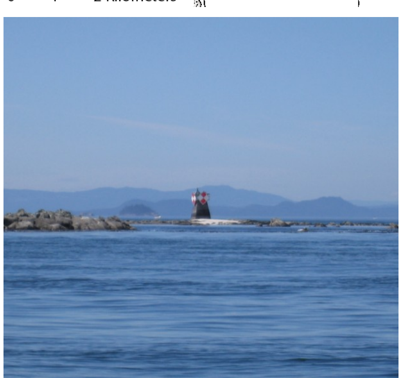


Photo by Khem So/USFWS (2007)

This is a broad, flat, largely submerged, rocky, wilderness shelf which extends northward from the north shore of Orcas Island. About five acres are exposed at extreme low tide at a distance of about one mile from shore. Except for a small, narrow, rocky ridge, it is completely covered at high tide. The habitat is classified as reef. The navigational aid on this island is the Parker Reef Light. In 2009 wildlife species found on the reef included scoter species, glaucous-winged gulls, and great blue herons. Harbor seals with pups were present in 2009 also. Wildlife found here from 2000 to 2004 included Brandt's cormorants, double-crested cormorants, harlequin ducks, harbor seals, and pelagic cormorants.

47. The Sisters (Lone Tree Island) 48° 41' 37" N, 122° 45' 28" W

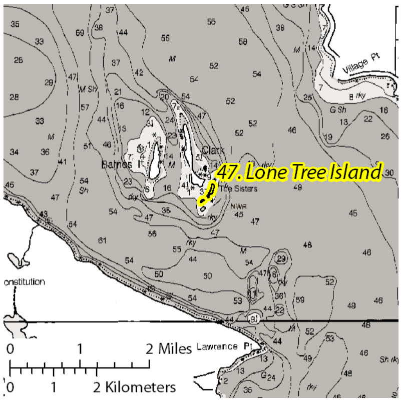



Photo by WA Dept. of Ecology (2006)

The Sisters Islands consist of four wilderness islands or islet groups situated to the south and southeast of Clark Island. The northern three are identified collectively as The Sisters. The acreage is listed as 4.994. The southern-most island is identified separately as Little Sister and is discussed under Number 48 below. The Sisters (47) consist of two major islands, with a group of small islets and rocks in between. The largest and most northern of the group is referred to as Lone Tree Island, as it had a single conifer on it at one time. This island is about 20 feet in elevation. The second largest, or most southern of this group, has an elevation of about 15 feet. The islands have a rather low profile. The Sisters Light "17" navigational aid is located here. The habitat is rocky shoreline, herbaceous bald, and sandy, gravelly shoreline. Wildlife present on this island in 2009 were glaucous-winged gulls, turkey vultures, pigeon guillemots, and black turnstones. Wildlife with young on the island in 2009 included harbor seals and black oystercatchers. From 2000 to 2004 black oystercatchers, harbor seals, pelagic cormorants, and pigeon guillemots were located here.

48. The Sisters (Little Sister Island) 48° 41' 23" N, 122° 45' 35" W

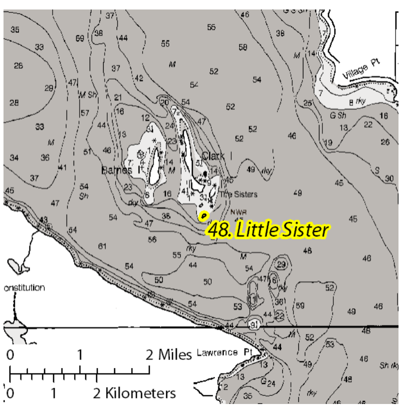



Photo by Khem So/USFWS (2007)

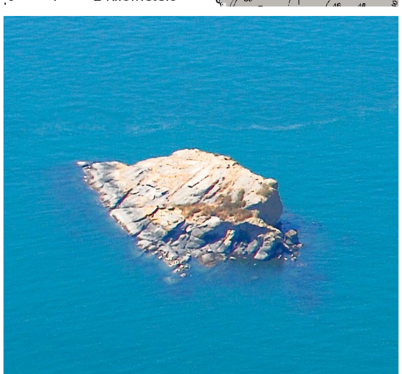


Photo by WA Dept. of Ecology (2006)

This is the southern-most island in the Sisters Island group. It is 0.929 acres. The habitat on this wilderness island is identified as rocky shoreline, cliffs, and herbaceous bald. Wildlife found here in 2009 included pigeon guillemots and glaucous-winged gulls. Harbor seals were present in 2009 with pups. Black oystercatchers, harbor seals, pelagic cormorants, and pigeon guillemots were found here between 2000 and 2004.

49. Unnamed Island

48° 35' 43" N, 122° 58' 36" W

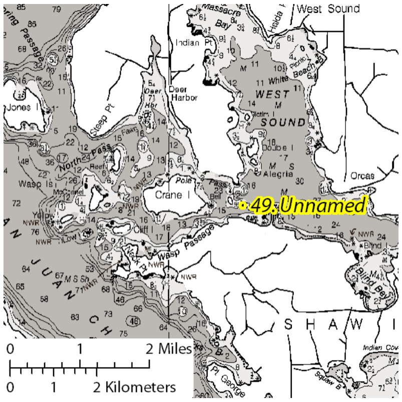


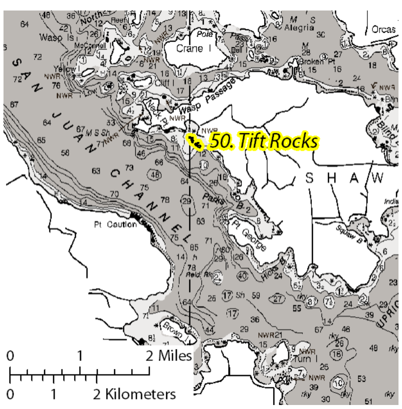
Photo by Khem So/USFWS (2007)

Photo by USFWS (1978)

This is a 0.049 acre rocky islet located immediately east of Bell Island. The Wasp Passage Light "5" navigational aid is located here. The habitat on this wilderness island is identified as reef. During the 2009 survey, surfbirds were found present. Surveys from 2000 to 2004 did not find wildlife here.

50. Tift Rocks

48° 34' 40" N, 122° 59' 54" W



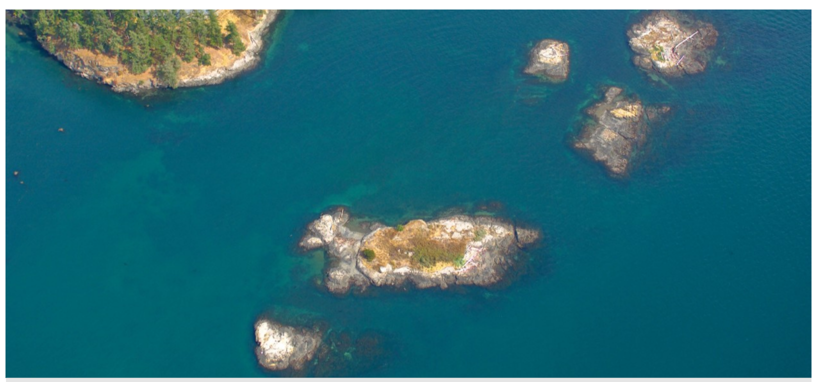


Photo by Khem So/USFWS (2007)

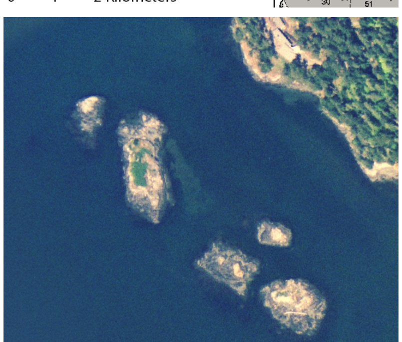


Photo by WA Dept. of Natural Resources (2004)

Tift Rocks is a group of five wilderness rock clusters extending only a few feet above water about 150 to 200 yards off the south shore of Shaw Island. This group is 2.465 acres. The habitat found here is herbaceous bald, rocky shoreline, and sandy, gravelly shoreline. Tree species growing on the largest island include Douglas fir, shore pine, and Rocky Mountain juniper. Herbaceous vegetation includes wild rose, gumweed, yarrow, and grasses. Mink, harbor seals, and glaucous-winged gulls were present on the islands in 2009. Between 2000 and 2004 double-crested cormorants and harbor seals were identified here.

51. Unnamed Rock (Reef Point) — 48° 31' 41" N, 122° 58' 5" W

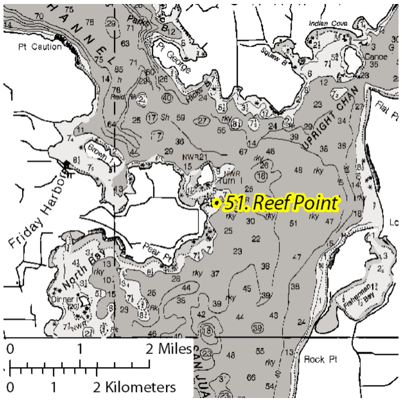
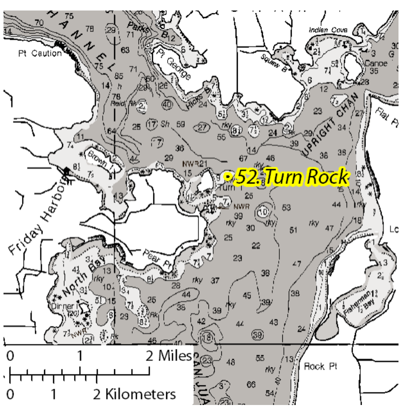


Photo by Khem So/USFWS (2007)

Photo by WA Dept. of Ecology (2006)

This is a barren, rocky wilderness islet which is part of a submerged extension of San Juan Island near Reef Point. It is separated from nearby shoreline by 50 to 80 yards of deep water and is 0.608 acres in size. The habitat of this rock is rocky shoreline. In 2009 Bonaparte's gulls, black oystercatchers, American crows, and Heermann's gulls were present. Also harbor seals were present with pups. From 2000 to 2004 black oystercatchers, double-crested cormorants, harlequin ducks, harbor seals, and pelagic cormorants were present.

52. Turn Rocks — 48° 32' 6" N, 122° 57' 52" W



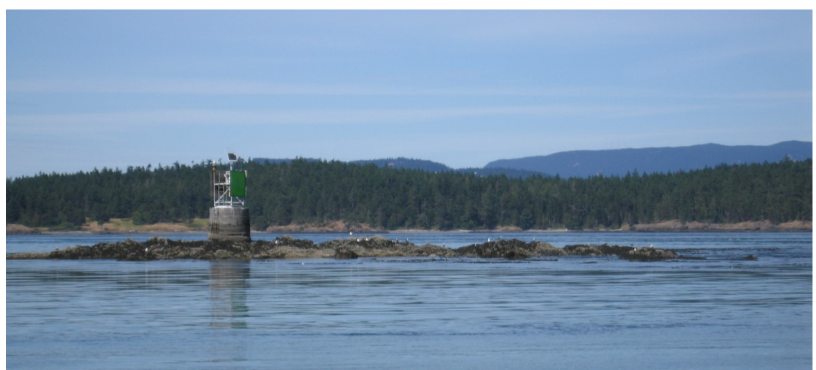


Photo by Khem So/USFWS (2007)

This wilderness rock is located immediately east of Turn Island and is awash at high tide. It is listed at 0.197 acres. Turn Rock Light "3" is the navigational aid on this rock. The habitat is identified as reef. Heermann's gulls, harbor seals, harlequin ducks, and glaucous-winged gull chicks were present in 2009. Double-crested cormorants and harbor seals were present between 2000 and 2004.

53. Shag Rock

48° 35' 30" N, 122° 52' 31" W

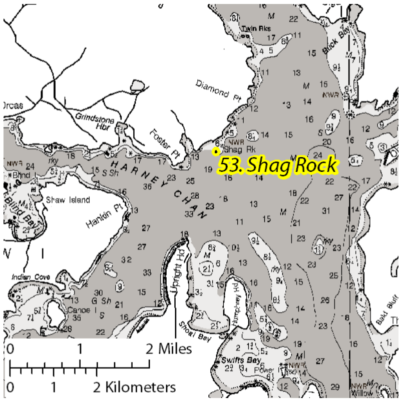


Photo by Khem So/USFWS (2007)

Shag Rock is located about 275 yards off the south shore of Orcas Island, rising about two feet above high tide level. The navigational aid on this wilderness island is the Shag Rock Daybeacon. Size is 0.049 acres. Rocky shoreline and sandy, gravelly shoreline make up the habitat of this rock. No wildlife was found on the island in the 2005 survey. From 2000 to 2004 harbor seals were recorded here.

54. Flower Island

48° 32' 43" N, 122° 51' 15" W

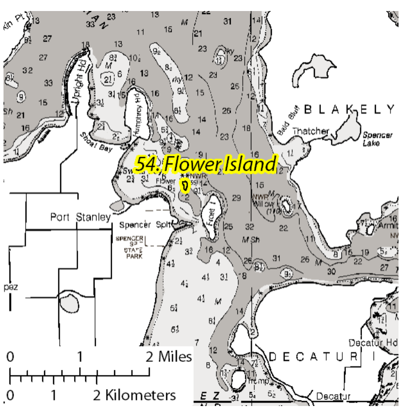



Photo by Khem So/USFWS (2007)

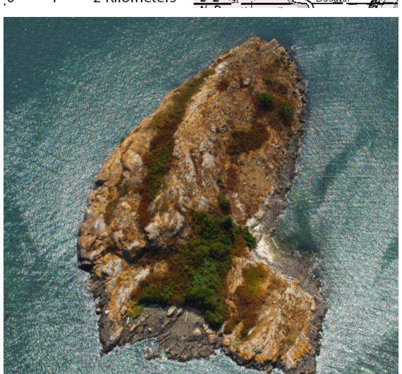


Photo by WA Dept. of Ecology (2006)

Flower Island is located near the northeast corner of Lopez Island. It slopes up to a near vertical cliff on the eastern side, which reaches a maximum elevation of 74 feet. It is 3.541 acres in size. The habitats on this wilderness island are herbaceous bald, rocky shoreline, and sandy, gravelly shoreline. Tree species observed include Douglas fir, madrone, alder, and willow. Shrubs include wild rose, snowberry, oceanspray and Himalayan blackberry. No wildlife was observed on this island during the 2009 survey. From 2000 to 2004 black oystercatchers, harbor seals, and pigeon guillemots were observed.

55. Willow Island 48° 32' 26" N, 122° 49' 21" W

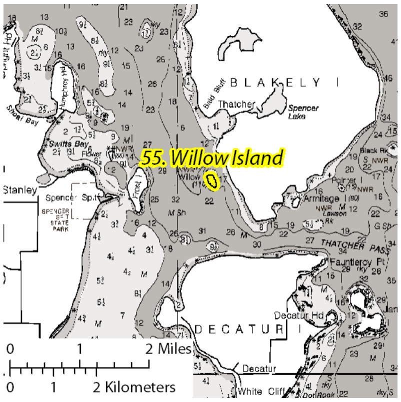



Photo by Khem So/USFWS (2007)


Photo by WA Dept. of Ecology (2006)

This is a dome-shaped, elongated wilderness island located near the southwest side of Blakely Island with a precipitous, rocky shoreline on all sides. It is 10.214 acres. Habitats on this island are rocky shoreline, cliffs, woodland, and herbaceous bald. Tree species found here include Douglas fir, willow, and madrone. Harbor seals with pups were observed on this island in 2009. Between 2000 and 2004 harbor seals and pigeon guillemots were found here.

56. Lawson Rock 48° 31' 51" N, 122° 47' 20" W

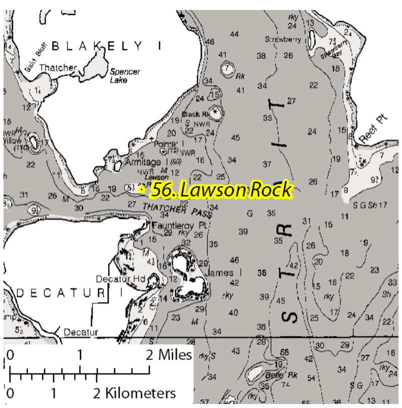



Photo by Khem So/USFWS (2007)

Lawson Rock, located at the east entrance of Thatcher Pass between Blakeley and Decatur Islands, is exposed only at low tide and is 0.005 acres in size. This wilderness rock is marked by Lawson Rock Light 2 navigational aid. The habitat is reef. Recent wildlife surveys have not found wildlife present here.

57. Pointer Island — 48° 32' 18" N, 122° 46' 56" W

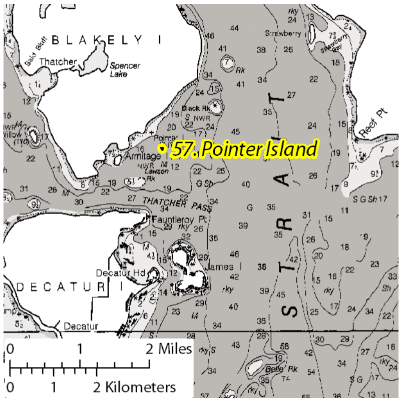



Photo by Khem So/USFWS (2007)


Photo by WA Dept. of Ecology (2006)

This is a low, flat-topped wilderness islet situated about 600 yards from the southeast corner of Blakely Island. It extends about 16 feet above high tide and is 0.591 acres. It consists of a rocky shoreline habitat. In 2009 swallow species, pigeon guillemots, and black oystercatchers were found on the island. Glaucous-winged gulls and harbor seals both with young were also present in 2009. Black oystercatchers, double-crested cormorants, glaucous-winged gulls, harbor seals, pelagic cormorants, and pigeon guillemots were present between 2000 and 2004.

58. Black Rock — 48° 32' 45" N, 122° 45' 57" W

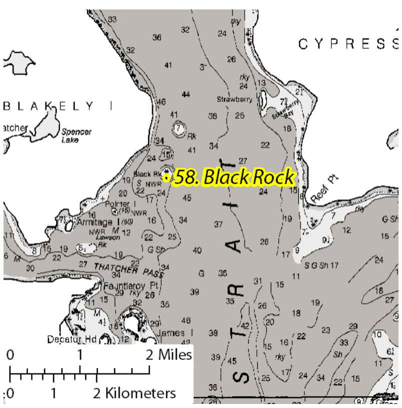



Photo by Khem So/USFWS (2007)


Photo by Khem So/USFWS (2007)

This is a low-profile wilderness island, rising about 20 feet above high tide, located about one-half mile east of Blakely Island, and 0.061 acres in size. Black Rock Light “9” navigational aid is located here. Its habitat is identified as rocky shoreline. In 2009 harbor seals were present. Between 2000 and 2004 double-crested cormorants and harbor seals were present.

59. 3 Unnamed Rocks (Spindle Rock) 48° 35' 13" N, 122° 48' 7" W

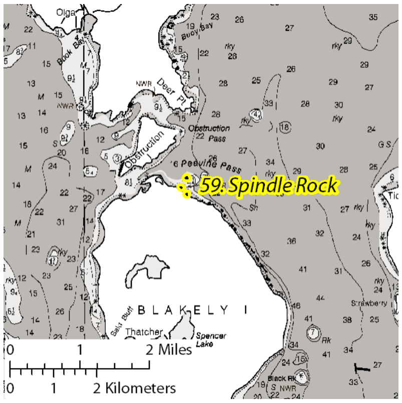



Photo by Khem So/USFWS (2007)


Photo by WA Dept. of Natural Resources (2004)

This is a group of three rocky wilderness islets off the northwest shore of Blakely Island. The farthest islet out is about 400 yards from shore and is known as Spindle Rock. It rises about 20 feet above high tide. The other two rocks are 30 to 40 yards from shore and rise only a few feet above high tide. Collectively they are 0.653 acres. The navigational aid found on the northernmost islet is Peavine Pass Rocks Daybeacon. The habitat of these islets is rocky shoreline. In 2009 raccoons, surfbirds, glaucous-winged gulls, black oystercatchers, and American crows were present on the islets. Harbors seals with pups were present in 2009 also. Harbor seals and pigeon guillemots were found here from 2000 to 2004.

60. Brown Rock 48° 36' 16" N, 122° 48' 41" W

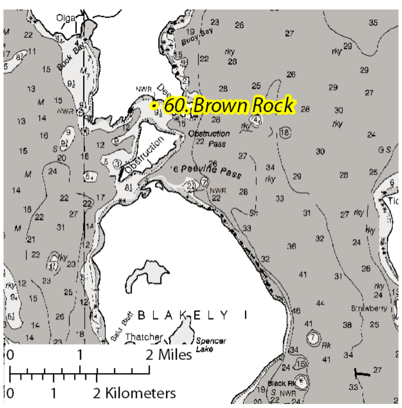



Photo by Khem So/USFWS (2007)


Photo by WA Dept. of Natural Resources (2004)

This is a single wilderness rock about 200 yards off the south shore of Orcas Island. It is surrounded by deep water and is 0.199 acres. Habitat found here is rocky shoreline. In 2009 black oystercatchers were present on this rock. Black oystercatchers were also present from 2000 to 2004.

61. Unnamed Rock

48° 36' 8" N, 122° 49' 56" W

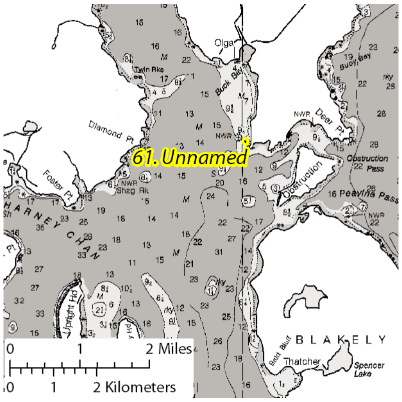



Photo by Khem So/USFWS (2007)

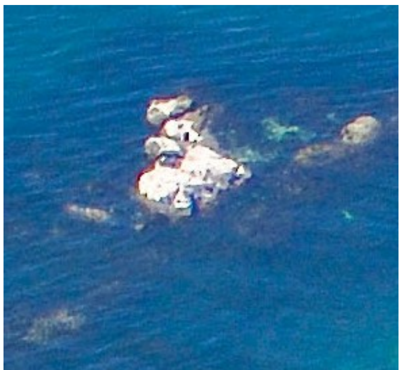


Photo by WA Dept. of Ecology (2006)

This is a bare wilderness islet, surrounded by deep water, located 200 to 300 yards off the south shore of Orcas Island. It is 0.076 acres in size. The habitat of this rock is rocky shoreline. Glaucous-winged gulls were found on this island in 2009. Other recent surveys did not find wildlife here.

62. South Peapod Rock

48° 38' 2" N, 122° 45' 32" W

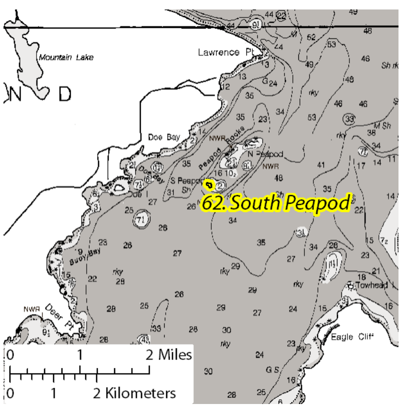



Photo by WA Dept. of Ecology (2006)

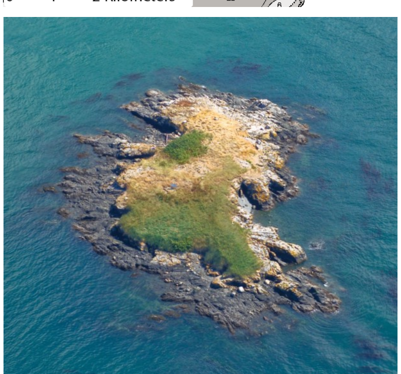
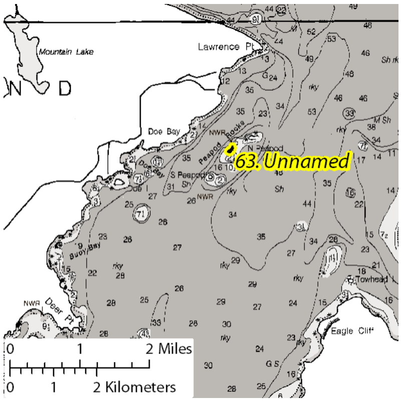


Photo by WA Dept. of Ecology (2006)

South Peapod Rock is located about a mile to the southwest of North Peapod Rock in Rosario Strait. This is a low profile wilderness island 2.014 acres in size. Habitats found on here include cliffs, herbaceous bald, rocky shoreline, and sandy, gravelly shoreline. In 2009 pigeon guillemots, pelagic cormorants, Heermann's gulls, harlequin ducks, and black oystercatchers were present on the island. Harbor seals and glaucous-winged gulls were present with young in 2009. Between 2000 and 2004 black oystercatchers, glaucous-winged gulls, harlequin ducks, harbor seals, pelagic cormorants, and pigeon guillemots were identified here.

63. Peapod Rocks 48° 38' 24" N, 122° 45' 7" W



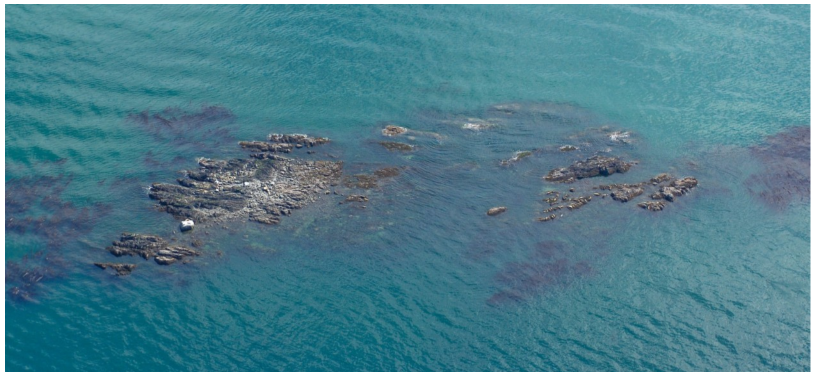


Photo by WA Dept. of Ecology (2006)

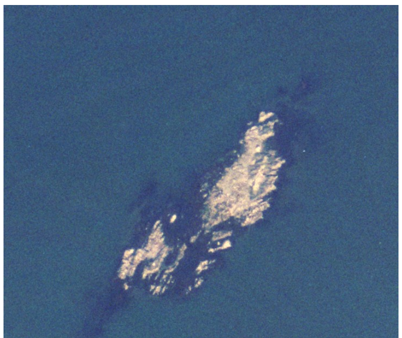


Photo by WA Dept. of Natural Resources (2004)

Peapod Rocks are a grouping of three wilderness islets situated between North and South Peapod Rocks in Rosario Strait. They are 1.130 acres in size. The habitat of these rocks is rocky shoreline. Black turnstones, black oystercatchers, belted kingfishers, and bald eagles were present on these rocks in 2009. Also harbor seals with pups were present in 2009. From 2000 to 2004 black oystercatchers, harlequin ducks, and harbor seals were observed.

64. North Peapod Rock 48° 38' 32" N, 122° 44' 42" W

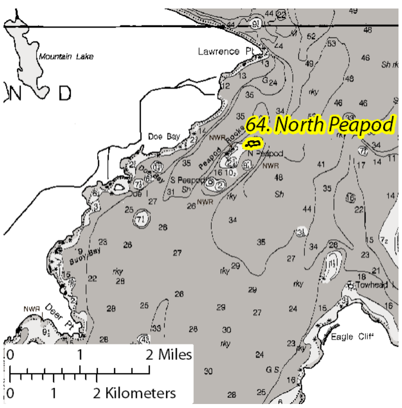



Photo by WA Dept. of Ecology (2006)


Photo by WA Dept. of Ecology (2006)

North Peapod Rock is located in Rosario Strait about a mile from the southeast shore of Orcas Island. This is a low-profile wilderness island with a maximum elevation of 28 feet and a size of 5.2 acres. The Peapod Rocks Light "15" navigational aid is found on the eastern end of this island. The habitats found here include herbaceous bald, rocky shoreline, and sandy, gravelly shoreline. In 2009 pigeon guillemots, glaucous-winged gulls, and bald eagles were present. Harbor seals with pups were also present in 2009. Between 2000 and 2004 black oystercatchers, harbor seals, harlequin ducks, and pigeon guillemots were located here.

65. Eliza Rock — 48° 38' 37" N, 122° 34' 42" W

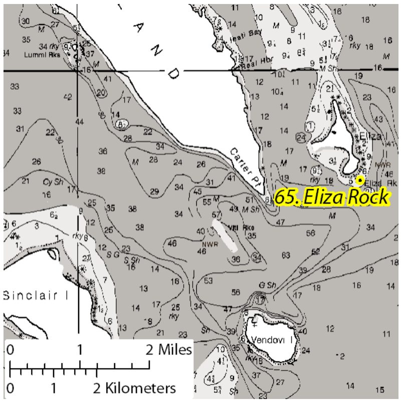



Photo by Khem So/USFWS (2007)


Photo by Khem So/USFWS (2007)

Eliza Rock is a circular, flat wilderness rock located about 100 to 150 yards off the south end of Eliza Island. It is 0.343 acres. The navigational aid on this rock is the Eliza Rocks Junction Light. The habitat here is rocky shoreline. Wildlife found during the 2009 survey included pigeon guillemots. Both harbor seals and black oystercatchers were present with young in 2009. Black oystercatchers, harbor seals, pelagic cormorants, pigeon guillemots, and Steller sea lions were present.

66. Viti Rocks — 48° 37' 60" N, 122° 37' 22" W

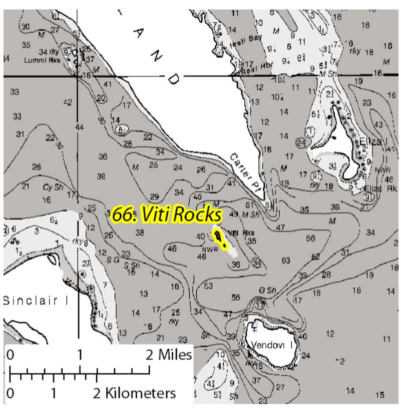



Photo by Khem So/USFWS (2007)


Photo by Khem So/USFWS (2007)

This group, located about .75 miles southwest of Carter Point on Lummi Island, consists of one large wilderness island and a small wilderness islet to the southeast. It is 2.72 acres. The larger island rises to an elevation of 35 feet. The smaller islet is the exposed portion of a reef which extends only a few feet above water at high tide. The Viti Rocks Light is located here. The habitats are identified as rocky shoreline, cliffs, and herbaceous bald. Pigeon guillemots were present in 2009. Birds with nests in 2009 included pelagic cormorants, glaucous-winged gulls, and double-crested cormorants. Also, harbor seals were present with pups in 2009. Between 2000 and 2004 black oystercatchers, double-crested cormorants, glaucous-winged gulls, harlequin ducks, harbor seals, pelagic cormorants, and pigeon guillemots were identified here.

68. Unnamed Rock (Bird Rocks)

48° 35' 52" N, 123° 0' 55" W

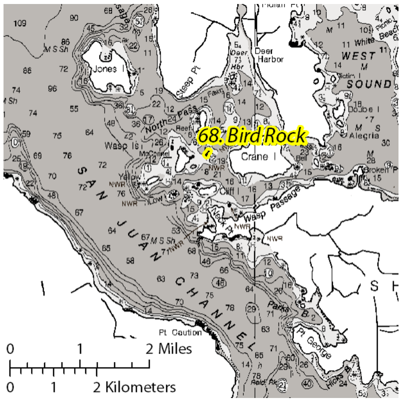


Photo by Khem So/USFWS (2007)

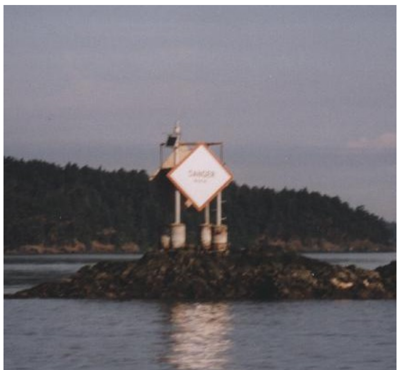


Photo by USFWS (2003)

This 0.111 acre wilderness rock located midway between Crane and McConnell Islands is awash at high tide. This is the location of Bird Rocks Light, a navigational aid. The habitat is classified as rocky shoreline. Harbor seals with pups were present in 2009. From 2000 to 2004 harbor seals were also present.

69. Unnamed Island

48° 35' 25" N, 123° 2' 3" W

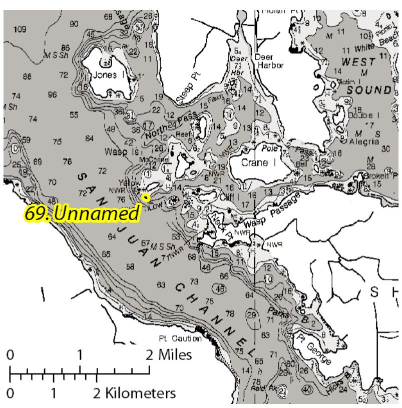


Photo by USFWS (1978)

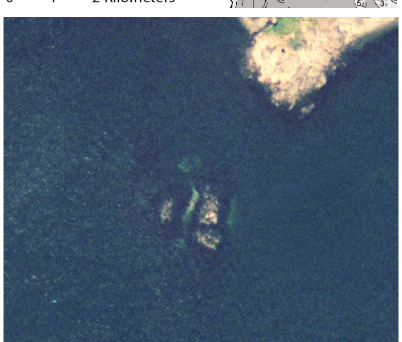


Photo by WA Dept. of Natural Resources (2004)

This consists of a group of bare wilderness rocks which are exposed portions of a submerged reef that extends out from Yellow Island, they are awash at high tide. They are 0.203 acres. The habitat is identified as rocky shoreline. The 2009 survey found glaucous-winged gulls and harbor seals with pups present here. Surveys between 2000 and 2004 found double-crested cormorants and harbor seals present here.

70. Low Island

48° 35' 21" N, 123° 1' 33" W

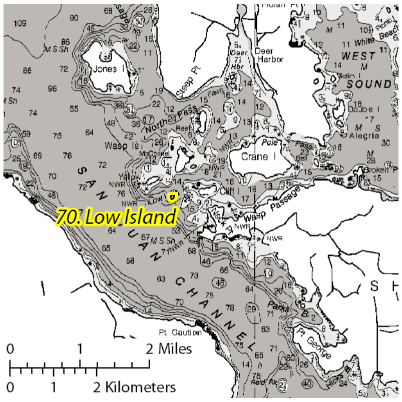


Photo by USFWS (2003)

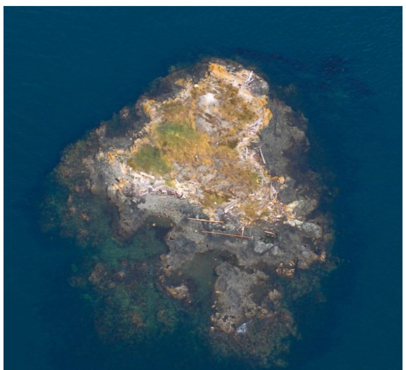
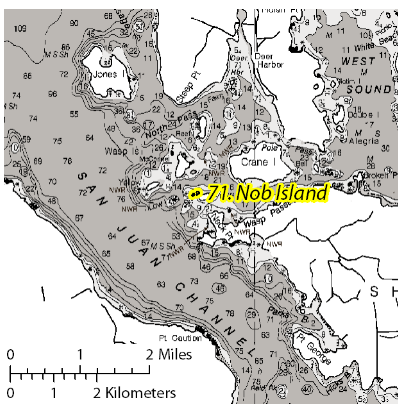


Photo by WA Dept. of Ecology (2006)

Low Island is a low-profile wilderness island located about one-third mile south of McConnell Island and 1.391 acres in size. Habitats found here include herbaceous bald, rocky shoreline, and sandy, gravelly shoreline. Black oystercatchers, bald eagles, and American crows along with harbor seals with pups were present here in 2009. Black oystercatchers, harbor seals, and pigeon guillemots were recorded between 2000 and 2009.

71. Nob Island

48° 35' 27" N, 123° 1' 6" W



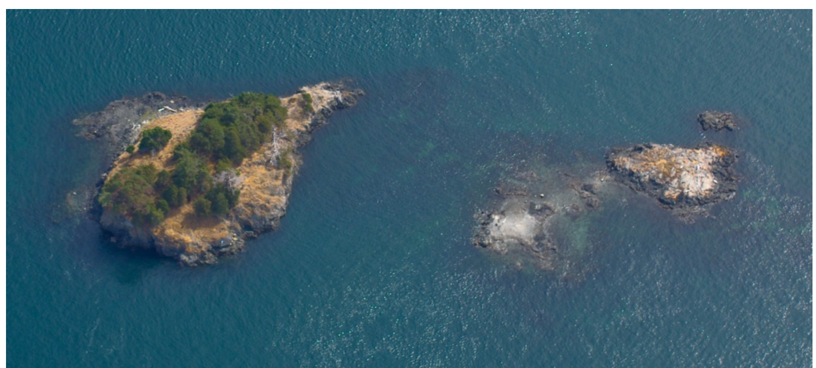


Photo by WA Dept. of Ecology (2006)

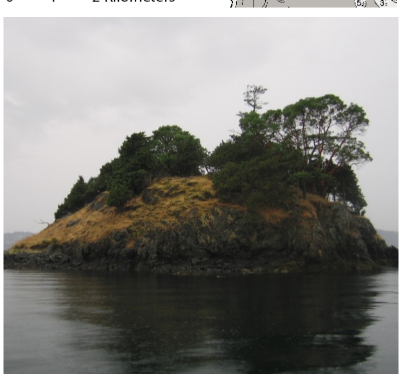


Photo by Khem So/USFWS (2007)

Located near the west side of Cliff Island in the Wasp Passage, Nob Island is a round, cone-shaped wilderness island rising to an elevation of 20 feet with a group of small rocks and islets located immediately to the southwest. The combined acreage is 1.393 acres. The habitat consists of herbaceous bald, rocky shoreline, and sandy gravelly shoreline. Tree species include Rocky Mountain juniper, Douglas fir, madrone, and immature Garry oaks. In 2009 harbor seals with pups were present. Between 2000 and 2004 black oystercatchers and harbor seals were found.

72. Unnamed Island
48° 35' 12" N, 123° 0' 28" W

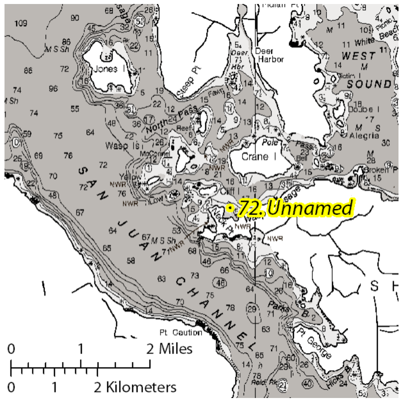



Photo by Khem So/USFWS (2007)

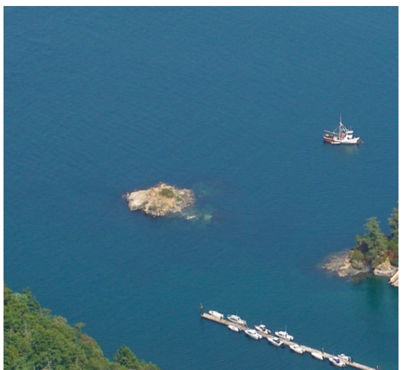


Photo by WA Dept. of Ecology (2006)

This is a small, circular wilderness island located off Shaw Island, from which it is separated by deep water. It is 0.210 acres. The habitat structure is rocky shoreline and herbaceous bald. Vegetation observed here includes Rocky Mountain juniper and grasses. Wildlife present on this island in 2009 included harbor seals with pups. Other recent surveys did not record wildlife.

73. Unnamed Island
48° 34' 60" N, 123° 0' 49" W

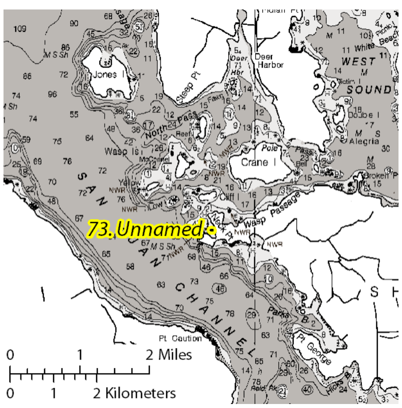



Photo by Khem So/USFWS (2007)

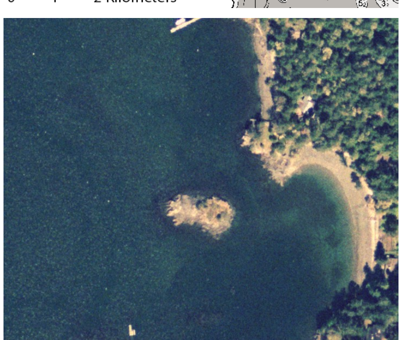


Photo by WA Dept. of Natural Resources (2004)

This is a small wilderness islet located 150 yards off Shaw Island and 0.303 acres in size. Its habitat consists of herbaceous bald, rocky shoreline, and sandy, gravelly shoreline. Tree species noted here include Garry oak and Rocky Mountain juniper. No recent surveys have recorded the presence of wildlife.

74. Unnamed Rocks

48° 30' 17" N, 123° 0' 30" W

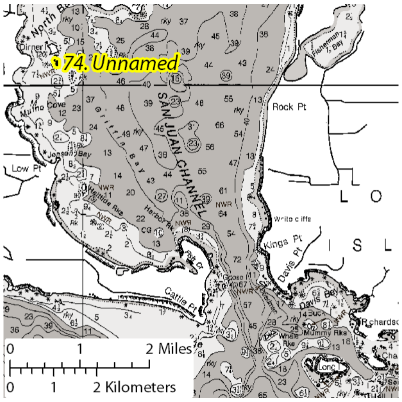


Photo by USFWS (2003)

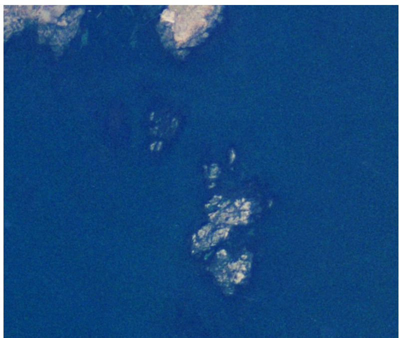


Photo by WA Dept. of Natural Resources (2004)

This is a group of wilderness islets located in Griffin Bay off of the east shore of San Juan Island. The rocks are just south of Dinner Island and total 0.615 acres in size. Its habitat is rocky shoreline. In 2009 pigeon guillemots and harbor seals with pups were present. Between 2000 and 2004 black oystercatchers, double-crested cormorants, harlequin ducks, and harbor seals were observed here.

75. Smith Island

48° 19' 9" N, 122° 50' 32" W

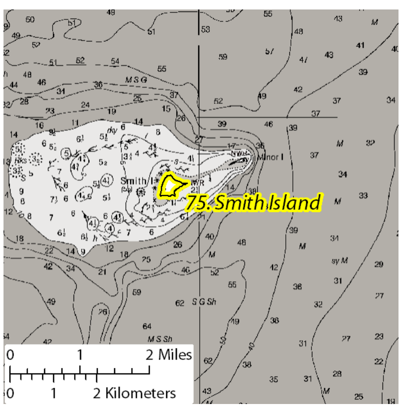
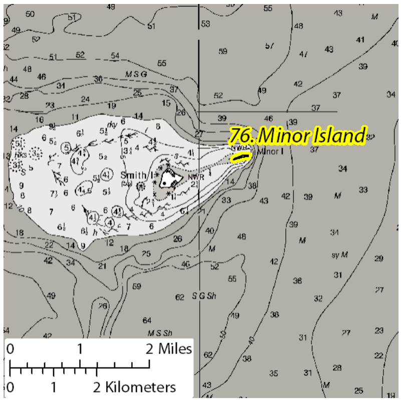


Photo by WA Dept. of Ecology (2006)

Photo by WA Dept. of Ecology (2006)

Smith Island is a 37.883 acre non-wilderness island located midway between the Admiralty Inlet and Lopez Island. Its habitat consists of bluffs, wetlands, grasslands, herbaceous bald, rocky shoreline, and sandy, gravelly shoreline. The Smith Island Light is located here. In the 2009 survey, a wide variety of wildlife was found on Smith Island including white-winged scoters, tufted puffins, swallows, surf scoters, rhinoceros auklets, pigeon guillemots, unidentified small shore birds, pelagic cormorants, marbled godwits, Heermann's gulls, harlequin ducks, double-crested cormorants, black turnstones, black oystercatchers, and American crows. Wildlife with young present in 2009 included harbor seals, glaucous-winged gulls, and bald eagles. Bald eagles have been identified here from 2000 to the most recent survey in 2009.

76. Minor Island 48° 19' 26" N, 122° 49' 11" W



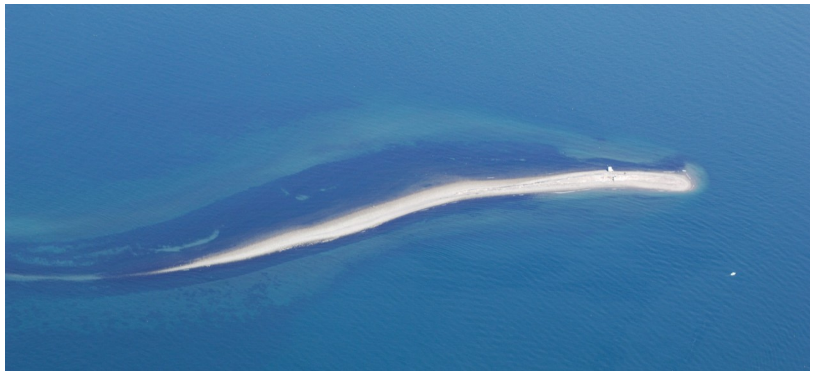
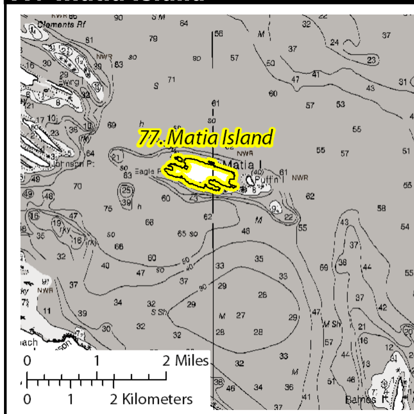


Photo by WA Dept. of Ecology (2006)

Photo by USFWS (2008)

Minor Island is a 2.483 acre non-wilderness island located in the eastern Strait of Juan de Fuca, midway between Admiralty Inlet and Lopez Island. The island is connected to Smith Island, which lies to the southwest, by a low sandy/gravelly spit. The Minor Island Light navigational aid is located here. Its habitat is classified as coastal spit, rocky shoreline, and sandy, gravelly shoreline. In 2009 wildlife found here included scoters, rhinoceros auklets, pigeon guillemots, Heermann's gulls, double-crested cormorants, black oystercatchers, and black-bellied plovers. An immature bald eagle was also present in 2009 along with glaucous-winged gulls with chicks and harbor seals with pups. Between 2000 and 2004 bald eagles were noted here.

77. Matia Island 48° 44' 47" N, 122° 50' 13" W



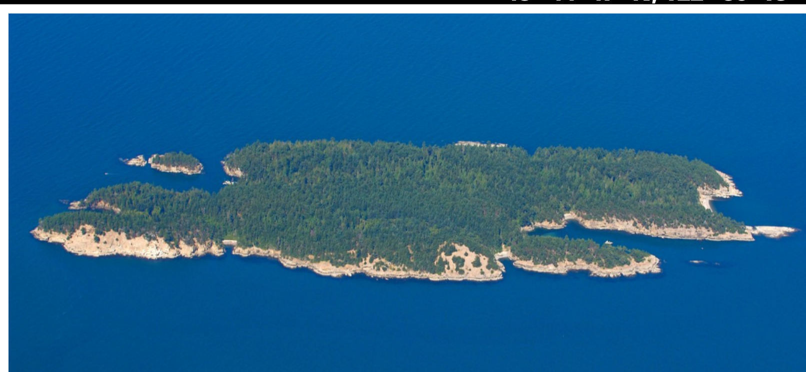


Photo by WA Dept. of Ecology (2006)

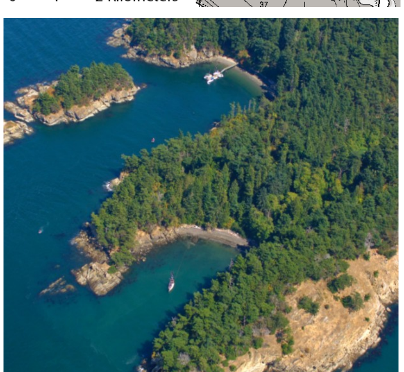


Photo by WA Dept. of Ecology (2006)

Matia Island is a 158.965 acre wilderness island located in the Gulf of Georgia, north of Orcas Island, and east of Sucia Island. Its habitat includes old-growth dry-mesic Douglas-fir-Western Hemlock forest, dry Douglas-fir-(Madrone) forest and woodland, cliffs, freshwater emergent wetland, herbaceous bald, rocky shoreline, and sandy, gravelly shoreline. In 2009 cormorants, swallows, pigeon guillemots, glaucous-winged gulls, Canada geese, black oystercatchers, and bald eagles were present. Also present in 2009 were harbor seals with pups. Between 2000 and 2004 bald eagles, black oystercatchers, harlequin ducks, harbor seals, pelagic cormorants, and pigeon guillemots were observed.

78. Puffin Island

48° 44' 41" N, 122° 49' 16" W

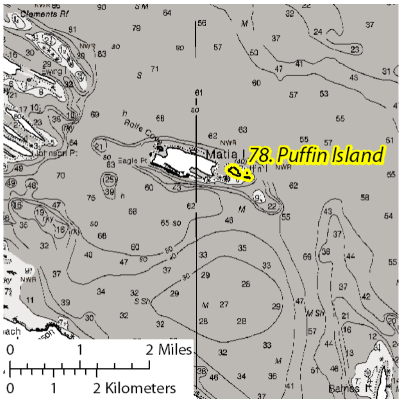


Photo by Khem So/USFWS (2007)

Photo by WA Dept. of Ecology (2006)

Puffin Island is a wilderness island located to the east of Matia Island and 7.346 acres in size. The Puffin Island Shoal Light "19" navigational aid is located here. Its habitat consists of rocky shoreline, cliffs, herbaceous bald, and woodlands. Vegetation noted here includes Douglas fir, willow, wild rose, oceanspray, snowberry, Himalayan blackberry, and grasses. The 2009 survey found harlequin ducks, glaucous-winged gulls, and black oystercatchers. Also harbor seals with pups and an immature bald eagle were present in 2009. Bald eagles, black oystercatchers, harlequin ducks, harbor seals, pelagic cormorants, and pigeon guillemots were present between 2000 and 2004.

79. Turn Island

48° 31' 59" N, 122° 58' 18" W

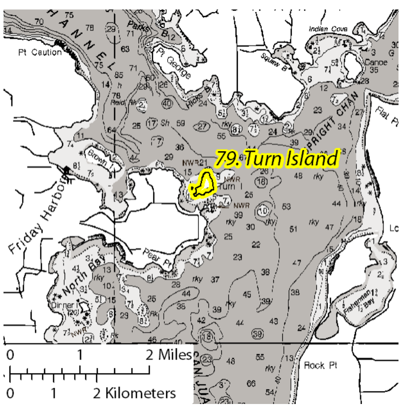


Photo by WA Dept. of Ecology (2006)

Photo by Khem So/USFWS (2007)

Turn Island is a 32.96 acre non-wilderness island located 300 yards east of San Juan Island. The island is underlain with consolidated rock excepting the southwestern extremity, where the shoreline is fringed with glacial drift. The habitat of this island includes dry Douglas-fir-(Madrone) forest and woodland, herbaceous bald, rocky shoreline, and sandy, gravelly shoreline. Tree species observed here include Douglas fir, madrone, shore pine, Rocky Mountain juniper, and Garry oak. In 2009 glaucous-winged gulls, great blue herons, and American crows were present on the island. Between 2000 and 2004 bald eagles, rhinoceros auklets, and raccoons were noted here.

80. Four Bird Rocks

48° 29' 8" N, 122° 45' 42" W

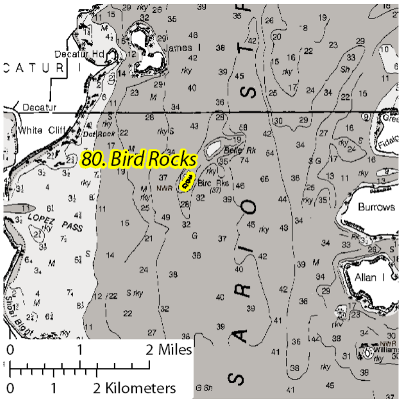



Photo by Khem So/USFWS (2007)

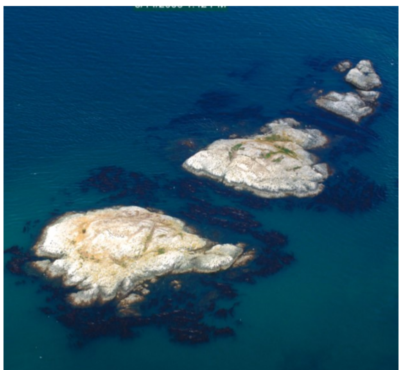


Photo by WA Dept. of Ecology (2006)

Four Bird Rocks is a wilderness group located in the Rosario Strait, east of Decatur Island. They total 3.328 acres. The navigational aid Belle Rock Sector Light is located northeast of, but not on, the refuge islands. The habitat of this group is identified as rocky shoreline. Wildlife present in 2009 included pigeon guillemots, pelagic cormorants, Heermann's gulls, double-crested cormorants, and black oystercatchers. Wildlife present with nests and young in 2009 included glaucous-winged gulls. Brant's cormorants were present with nests. Harbor seals were also present with young. From 2000 to 2004 black oystercatchers, Brandt's cormorants, double-crested cormorants, glaucous-winged gulls, harlequin ducks, harbor seals, pelagic cormorants, and pigeon guillemots were observed.

81. Three Williamson Rocks

48° 26' 59" N, 122° 42' 21" W

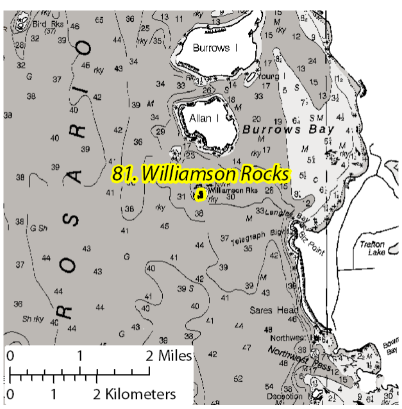



Photo by Khem So/USFWS (2007)


Photo by WA Dept. of Ecology (2006)

Williamson Rocks are a wilderness group located south of Allan Island that total 1.55 acres in size. The Williamson Rocks Lighted Gong Buoy "4" navigational aid is south of, but not on, the refuge islands. The habitat here is rocky shoreline. Wildlife present in 2009 included surf birds, pigeon guillemots, Heermann's gulls, harbor seals, double-crested cormorants, Brant's cormorants, and black oystercatchers. Pelagic cormorants and glaucous-winged gulls were both present with young and nests in 2009. Between 2000 and 2004 black oystercatchers, double-crested cormorants, glaucous-winged gulls, harbor seals, pelagic cormorants, and pigeon guillemots were present.

82. Colville Island

48° 24' 55" N, 122° 49' 22" W

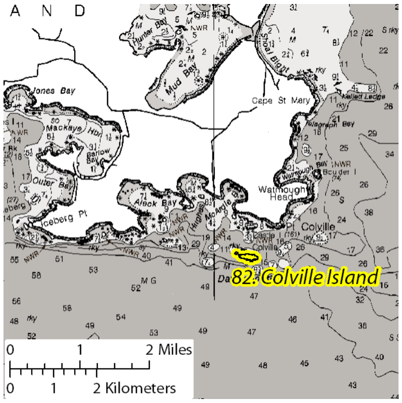



Photo by Khem So/USFWS (2007)


Photo by WA Dept. of Ecology (2006)

Colville Island is a wilderness island located south of Lopez Island. It is 11.632 acres. The habitat of this island is rocky shoreline and herbaceous bald. Wildlife present here in 2009 included turkey vultures, pigeon guillemots, glaucous-winged gulls, and black oystercatchers, along with harbor seals and their pups. Black oystercatchers, double-crested cormorants, harbor seals, and pigeon guillemots were found between 2000 and 2004.

83. Buck Island

48° 27' 8" N, 122° 55' 17" W

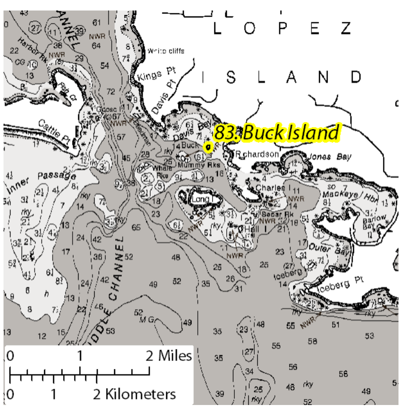



Photo by Khem So/USFWS (2007)


Photo by WA Dept. of Ecology (2006)

Buck Island is a wilderness island located south of Lopez Island. It is 1.302 acres. Its habitat consists of rocky shoreline and herbaceous bald. Wildlife found on this island in 2009 included pigeon guillemots and harlequin ducks. Black oystercatchers, double-crested cormorants, harbor seals, and pigeon guillemots were observed between 2000 and 2004.

84. Bare Island 48° 43' 47" N, 123° 0' 52" W

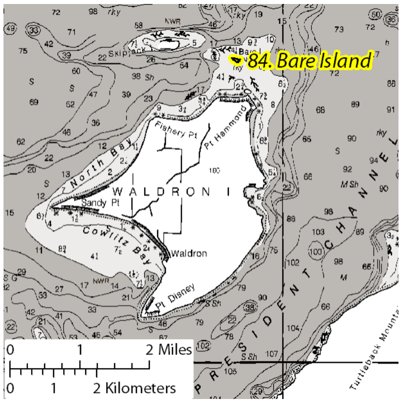



Photo by Khem So/USFWS (2007)


Photo by WA Dept. of Ecology (2006)

Bare Island is a wilderness island located north of Waldron Island and is 2.091 acres. Habitat here includes herbaceous bald, rocky shoreline, and sandy, gravelly shoreline. In 2009 pigeon guillemots, pelagic cormorants, Heermann's gulls, great blue herons, double-crested cormorants, black turnstones, black oystercatchers, and bald eagles were present on the island. Harbor seals and glaucous-winged gulls were present with young in 2009. Between 2000 and 2004 black oystercatchers, double-crested cormorants, harbor seals, pelagic cormorants, and pigeon guillemots were present.

Appendix C. Habitats and Wildlife

C. Introduction

In preparing this plan, the Service reviewed other local, regional, and national plans that pertain to the wildlife and habitats of Protection Island and San Juan Islands NWRs. The Service also sought input from Washington State conservation agencies, non-governmental organizations, and the general public. Refuge purposes, as stated in the enabling legislation for each refuge, were carefully reviewed as was the refuges' contribution to maintenance of Biological Integrity, Diversity, and Environmental Health (BIDEH) within the ecoregion. As a result of this information gathering and review process, a comprehensive list of resources of concern (Section C.1) was developed. From this list, those species and habitats that are most representative of refuge purposes and habitats, BIDEH, as well as other Service and ecosystem priorities, were chosen as priority resources of concern (habitat types) and focal resources (plant and animal species) (presented in Section C.2). BIDEH considered as Priority Resources of Concern are listed below in Section C.3. Important elements of BIDEH are presented according to *A Marine and Estuarine Habitat Classification System for Washington State* (Dethier 1990) and classified by vegetation type descriptions according to the International Terrestrial Ecological System Classification under development by NatureServe and its natural heritage program members in Section C.4. The last section (C.5) in this appendix contains the common and scientific names of plant and animals species mentioned in the entire CCP.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	**Comprehensive List of Resources of Concern for Protection Island and San Juan Islands NWRs**															
2	**Potential Resources of Concern Considered**	**PI Purposes**	**SJI+PI Purposes Mig bird[1]**	**Fed. ESA Status[2]**	**State Status[3]**	**State Rank WNHP[4]**	**MMPA species[5]**	**USFWS Bird of Mgt. Concern or Bird of Conservation Concern[6]**	**Pacific Retion Seabird Plan[7]**	**N Pacific Coast Shorebird Plan[8]**	**WA CWCP Priorities[9]**	**WPG EA Tar.[10]**	**Refuge Occurance**	**Ecological Significance**	**Selection**	
3	SEABIRDS															
4	Rhinocerous Auklet	√	√			S4B S4N			HC			√	breeding colonies on PI and Smith Island (SJI)	3rd largest colony in NA on PI	selected	
5	Tufted Puffin	√	√	SC	C	S3S4B, S4N			MC		√	√	breeding colonies on PI and Smith Island (SJI)	Federal Species of Concern; State Candidtate. PI and Smith represent last know breeding colonies in SJI/Puget Sound	selected	
6	Pigeon Guillemot	√	√			S4B S4N			MC			√	widely spread nesting colonies on the Refuges	represents 30-40% of SJ/Puget Sound breeding pop.	selected	
7	Pelagic Cormorant	√	√			S4B,S4N		BCR5	HC			√	nests on PI and selected islands in SJI, roosts on additional islands	refuges provide undisturbed breeding sites for this species that is frequently harassed.	selected	
8	Glaucous-winged/ Western Gulls		√			S5B, S5N S4B,S4N			NAR			√	large colony on PI -breeds on select islands in SJI.	PI supports one of the largest colonies in the Salish Sea and other large colonies on SJI	selected	
9	Marbled Murrelet		√	T	T	S3		T/E	HC		√	√	not observed on the refuges but forage in waters around the refuges	Federal and State Threatened species; refuge islands not ecologically signigicant to this species	not selected because species does not use the refuges	
10	Double-crested Cormorant	√	√			S4S5B			NAR			√	nests on PI and select islands in SJI, roosts on additional islands	refuges provide undisturbed breeding sites for this species that is frequently harassed.	selected, colonies in BC and WA have declined (USFWS 2005-seabird plan)	
11	Brandt's Cormorant		√		C	S3B,S4N			MC			√	very rare breeding, primarily non-breeding roosts		not selected habitat needs will be met by management for other cormorants	
12	Heermann's Gull		√			S5N			MC			√	summer/fall migrant throughout SJI		not selected	
13	Caspian Tern		√		M	S3B		BCR5	MC			√	none, possible nesting habitat on PI and Smith/Minor Islands	Low potential for alternate breeding colony sites.	not selected	
14	Arctic Tern		√		M	S2B		BCR5	MC		√	√		Low potential for alternate breeding colony sites.	not selected	
15	Brown Pelican		√	SC	E	S3N			HC			√	transient - rare fall use of shorelines	Federal Species of Concern; State Endangered	not selected	
16	SHOREBIRDS															

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
2	Potential Resources of Concern Considered	PI Purposes	SJI+PI Purposes Mig bird[1]	Fed. ESA Status[2]	State Status[3]	State Rank WNHP[4]	MMPA species[5]	USFWS Bird of Mgt. Concern or Bird of Conservation Concern[6]	Pacific Retion Seabird Plan[7]	N Pacific Coast Shorebird Plan[8]	WA CWCP Priorities[9]	WPG EA Tar.[10]	Refuge Occurance	Ecological Significance	Selection	
17	Black Oystercatcher		√		M	S4		N, R1, BCR5		4	√	√	Refuges provide important habitat year round. Many of the refuge rocks and islands have breeding pairs.	indicator species, high conservation priority, refuges support a high percentage of breeding birds	selected	
18	Black Turnstone		√			S4S5N				4		√	migrant/winter on PI and most SJI	refuge does not support a significant portion of the population.	not selected	
19	Ruddy Turnstone		√			S4N				4		√	migrant	refuge does not support a significant portion of the population.	not selected	
20	Surfbird		√			S4N				4		√	migrant/winter on PI and most SJI	refuge does not support a significant portion of the population.	not selected	
21	Rock Sandpiper		√			S3N		N		3	√	√	migrant/winter	refuge does not support a significant portion of the population.	not selected	
22	Wandering Tattler		√			S3N				3		√	migrant	refuge does not support a significant portion of the population.	not selected	
23	Black bellied Plover		√			S4N				3		√	migrant/winter	refuge does not support a significant portion of the population.	not selected	
24	Sanderling		√			S4N				4		√	migrant/winter	refuge does not support a significant portion of the population.	not selected	
25	Dunlin		√			S4S5N				3		√	migrant/winter	refuge does not support a significant portion of the population.	not selected	
26	Western Sandpiper		√			S4S5N				3		√	migrant	refuge does not support a significant portion of the population.	not selected	
27	Killdeer		√			S4S5B S4S5N				3		√	breeding	refuge does not support a significant portion of the population.	not selected	
28	WATERFOWL															
29	Black Brant		√			S3N		GBBD C			√	√	migrant/winter - PI, Smith, possible on other islands		not selected	
30	Harlequin Duck		√			S2B,S3N		GBBD C				√	year round, molting, migration to Smith, PI	medium priority in Sea duck plan	not selected	
31	Mallard		√			S5B,S5N		GBBD C					year-round	refuge does not support a significant portion of the population.	not selected	

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
2	**Potential Resources of Concern Considered**	**PI Purposes**	**SJI+PI Purposes Mig bird[1]**	**Fed. ESA Status[2]**	**State Status[3]**	**State Rank WNHP[4]**	**MMPA species[5]**	**USFWS Bird of Mgt. Concern or Bird of Conservation Concern[6]**	**Pacific Retion Seabird Plan[7]**	**N Pacific Coast Shorebird Plan[8]**	**WA CWCP Priorities[9]**	**WPG EA Tar.[10]**	**Refuge Occurance**	**Ecological Significance**	**Selection**	
32	Canada Goose ssp moffita & maxima		√			S5B,S5N							year-round	introduced residents	not selected	
33	OTHER WATERBIRDS															
34	Great Blue Heron		√		M	S4S5B S5N					√		year-round		not selected	
35	RAPTORS															
36	Bald Eagle	√	√	SC	S	S4B S4N		N, R1, BCR5			√		~ 10+ territories encompas refuges, immatures, common throughout the year, abundant spring - August.	Refuge purpose species; high conservation priority dispite recent delisting;	selected	
37	Peregrine Falcon ssp *peals*		√	SC	S	S2B S3N		N, R1, BCR5			√		forages on the refuges, Observed almost daily during the breeding season off of PI.	Federal Species of Concern; State Sensitive thought refuges do not support a nest	not selected	
38	Great-horned Owl		√			S5							1-2 pr. breeding on PI		not selected	
39	Short-eared Owl		√			S2S3B S3N		N, R1					former breeding on PI, current status unknown		not selected	
40	Snowy Owl		√		M	S3N							eruptive species present on PI in some years during the winter		not selected	
41	Northern Harrier		√			S3B S3N							2004 last known active breeding on PI		not selected	
42	American Kestrel		√			S4S5B							1 pr.breeding on PI		not selected	
43	OTHER LANDBIRDS															
44	Streaked Horned Lark		√	C	E	S1B		N, R1, BCR5			√		Small remnant pop. In Puget sound - not observed on refuges	Federal Candidate; State Endangered, though very limited habitat on refuges - sp experts believe PI size too limited	not selected	
45	Purple Martin		√		C	S3B					√		very limited breeding on PI	very few breeding pairs in WA - citizen recovery effort	not selected	
46	Savanna Sparrow		√			S4N,S5B							breeding on PI	common species	not selected	
47	MARINE MAMMALS															
48	Steller Sea Lion			T	T	S2N	√				√	√	Observed in low numbers during the nonbreeding period	Threatened and MMPA species	selected	
49	CA Sea Lion					SNA	√					√	Observed during the nonbreeding period	MMPA species	selected	
50	Elephant Seal					SNA	√						Breeding, pupping, molting on PI	MMPA species; recolonizing refuges	selected	
51	Harbor Seal	√			M	S4	√					√	Abundant species observed on almost all refuge islands during breeding and non breeding periods	MMPA species	selected	
52	Sea otter				E	S2S3	√				√		Very few sightings historically in waters off refuge		not selected	
53	OTHER MAMMALS															

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
2	**Potential Resources of Concern Considered**	**PI Purposes**	**SJI+PI Purposes Mig bird**[1]	**Fed. ESA Status**[2]	**State Status**[3]	**State Rank WNHP**[4]	**MMPA species**[5]	**USFWS Bird of Mgt. Concern or Bird of Conservation Concern**[6]	**Pacific Retion Seabird Plan**[7]	**N Pacific Coast Shorebird Plan**[8]	**WA CWCP Priorities**[9]	**WPG EA Tar.**[10]	**Refuge Occurance**	**Ecological Significance**	**Selection**	
54	Northern River otter					S4							Year-round on PI, many observations in SJI		not selected	
55	Black-tailed Deer					S5							Feb, 2010 count of 71 deer on PI; observations noted in the SJI at all times of year	very high densities on PI are beginning to affect seabird breeding habitat	not selected	
56	AMPHIBIANS AND REPTILES															
57	garter snake 3spp					S5							On PI and Matia.	Study indicated PI species are genetically different	not selected	
58	western toad				C	S3					√		none known on refuges, despite limited surveys (Matia)		not selected	
59	INSECTS															
60	Valley silverspot, *Speyeria zerene bremerii*			SC	C	S2S3					√		no known occurrence but potential habitat in SJI	Federal Species of Concern; State Canditate	not selected	
61	Island Marble, *Euchloe ausonides insulanus*			SC	C	S1					√		no known occurrence but potential habitat in SJI	Federal Species of Concern; State Canditate	not selected	
62	Taylor's Checkerspot			C	E	S1					√		no known occurrence but potential habitat on PI	Federal Candidate; State Endangered - second largest population in the state found on nearby Miller Penninsula.	not selected	
63	RARE PLANT SPECIES															
64	Castilleja levisecta, (golden paintbrush)			T	E	S1							none found on refuges but refuge lands might provide suitable habitat	Threatened Species	selected	
65	Opuntia fragilis (brittle prickly-pear cactus)				E	SNR							SJI (Castle, Rum, Aleck, Fortress); historically on PI	State Endangered Species	selected	
66	Ranunculus californicus (California buttercup)				E	S1							SJI (Aleck and Castle)	State Endangered Species	selected	
67	Sanicula arctopoides (bear's foot sanicle)			SC	E	S1							SJI (Boulder)	State Endangered Species	selected	
68	Boschniakia hookeri (Vancouver groundcone)				R1	S3							Found on PI only		not selected	
69	Oxytropis campestris var. gracilis (slender crazyweed)				S	S2							SJI (Swirl)		not selected	
70	Puccinellia nutkaensis (Alaska alkaligrass)				S	S2							SJI (Swirl Rock, Secar, island w of Castle)		not selected	

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
2	**Potential Resources of Concern Considered**	**PI Purposes**	**SJI+PI Purposes Mig bird[1]**	**Fed. ESA Status[2]**	**State Status[3]**	**State Rank WNHP[4]**	**MMPA species[5]**	**USFWS Bird of Mgt. Concern or Bird of Conservation Concern[6]**	**Pacific Retion Seabird Plan[7]**	**N Pacific Coast Shorebird Plan[8]**	**WA CWCP Priorities[9]**	**WPG EA Tar.[10]**	**Refuge Occurance**	**Ecological Significance**	**Selection**	
71	ECOLOGICAL SYSTEMS															
72	Shoreline											√	Shoreline common to all refuge islands consisting of spit, sandy/gravel, rocky or rocky cliff habitats	very important marine ecosystem component	selected	
73	Sandy Bluff												Protection and Smith islands	important habitat for rhinoceros auklet nesting in the Salish Sea	selected	
74	Grasslands,Savannas and Herbaceous Bald											√	Protection, Smith and select SJI	native praires are rare	selected	
75	Forests and Woodland											√	old-growth stand on Matia Island (in SJI), smaller and younger stands on a few other islands in SJI and PI; Garry oak on Turn Island (in SJI) and possibly other islands	very little old growth left; Garry oak is a severely declined veg type	selected	
76	Wetland											√	Currently no more than 1 ac of wetlands consisting of: 1 freshwater wetland on Matia Island and 1 brackish wetland on Smith. PI supported a brackish wetland prior to construction of the marina, however that wetland no longer exists	ucommon on islands within the Salish Sea	selected	
77																
78																
79	1 Cited in the Refuge Puporse															
80	2 Status under the Endangered Species Act - E = Endangered; T = Threatened; C = Candidate**;** SC = Species of Concern															
81	3 State listing status - E = Endangered; T = Threatened; C = Candidate; S = Sensitive; M = Monitor; R1 = More date required to review status															
82	4 Washington Natural Heritage Program state rank - see http://www1.dnr.wa.gov/nhp/refdesk/lists/animal_ranks.html#key for a description of ranks															
83	5 Species listed under the Marine Mammal Protection Act															
84	6 USFWS Bird of Management Concer and Birds of Conservation Concern 2008 lists - N = National; R1 = Region 1; BCR5 = Bird Conservation Region 5; GBBDC -															
85	7 Pacific Region Seabird Conservation Plan status - HC = High Concern; MC = Moderate Concern; NAR = Not at Risk															
86	8 Northern Pacific Coast Regional Shorebird Conservation Plan status - 4 = High Concern; 3 = Moderate Concern															
87	9 Washington Comprehensive Wildlife Conservation Plan priority species															
88	10 Willamette Valley/Puget Trough Ecoregional Assessment Conservation Target															

C.2 Protection Island and San Juan Islands NWRs Priority Resources of Concern and Focal Resources

Focal Resources	Habitat Type	Habitat Structure and Other Ecological Requirements	Life History	Other Benefiting Species
Shoreline				
Pelagic Cormorant	Rocky Cliffs	• Human disturbance is minimized near rocky shoreline and cliff habitat used by breeding cormorants, oystercatcher, and marine mammals year-round on all refuge islands. • PI, Smith, Minor shorelines are cleaned of marine debris annually; other San Juan Island NWR shorelines are cleaned once every 5 years on a rotational basis. • No non-native rats or rabbits on any refuge islands. • Reduce impacts from other mammalian predators.	Year-round	Brandt's cormorant, peregrine falcon, swallows
Double-crested Cormorant	Rocky Cliffs	• See Habitat Structure and Other Ecological Requirements for Pelagic Cormorant above.	Year-round	Brandt's cormorant, peregrine falcon, swallows
Pigeon Guillemot	Sandy/Gravel Shoreline	• 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. • Remove creosote pilings from marina on Protection Island. • PI and Smith/Minor shorelines are cleaned of marine debris annually. • No non-native rats or rabbits on any refuge islands. • Reduce impacts from other mammalian predators.	Year-round	Harlequin duck, brant, dunlin, western sandpiper, black and ruddy turnstone, surfbird, rock sandpiper, wandering tattler, killdeer, great blue heron, brown pelican, snowy owl, peregrine falcon, river otter, herring, and sand lance

Glaucous-winged Gull	Spit	• Sparse (<30% cover), medium (3-4 foot) grasses. • Vegetation associated with North Pacific Maritime Coastal Sand Dune and Strand. • Natural screens (e.g., driftwood or variation in topography) for concealment from nearest nests are present. • <25% invasive species (e.g., Scotch broom or Spartina grass) on spit habitat. • Eliminate disturbance and impacts from deer. • No non-native rates or rabbits on any refuge islands. • Reduce impacts from mammalian predators. • PI, Smith/Minor shorelines are cleaned of marine debris annually.	Year-round	Heermann's gull, Caspian tern, and snowy owl
Black Oystercatcher	Rocky Shoreline	• Human disturbance on Matia and Turn is minimized during oystercatcher nesting and brood rearing periods (April – Sept). • Plus see Habitat Structure and Other Ecological Requirements for Pelagic Cormorant above.	Year-round	Brant, harlequin duck, black and ruddy turnstone, surfbird, rock sandpiper, wandering tattler, peregrine falcon, brown pelican, great blue heron, river otter
Harbor Seal	Spit, Rocky and Sandy/Gravel Shorelines	• See Habitat Structure and Other Ecological Requirements for Pelagic Cormorant, Pigeon Guillemot, and Glaucous-winged Gull above.	Year-round	Harlequin duck, brant, dunlin, western sandpiper, black and ruddy turnstone, surfbird, rock sandpiper, wandering tattler, killdeer, great blue heron, brown pelican, snowy owl, peregrine falcon, river otter, herring, and sand lance
Elephant Seal	Spit, Rocky and Sandy/Gravel Shorelines	• See Habitat Structure and Other Ecological Requirements for Pelagic Cormorant, Pigeon Guillemot, and Glaucous-winged Gull above.	Year-round	Harlequin duck, brant, dunlin, western sandpiper, black and ruddy turnstone, surfbird, rock sandpiper, wandering tattler, killdeer, great blue heron, brown pelican, Heermann's gull and Caspian tern, snowy owl, peregrine falcon, river otter, herring and sand lance
Steller Sea Lion	Spit, Rocky and Sandy/Gravel Shorelines	• See Habitat Structure and Other Ecological Requirements for Pelagic Cormorant, Pigeon Guillemot, and Glaucous-winged Gull above.	Non-breeding	Brant, harlequin duck, black and ruddy turnstone, surfbird, rock sandpiper, wandering tattler, peregrine falcon, brown pelican, great blue heron, river otter

California Sea Lion	Spit, Rocky and Sandy/Gravel Shorelines	• See Habitat Structure and Other Ecological Requirements for Pelagic Cormorant, Pigeon Guillemot, and Glaucous-winged Gull above.	Non-breeding	Brant, harlequin duck, black and ruddy turnstone, surfbird, rock sandpiper, wandering tattler, peregrine falcon, brown pelican, great blue heron, river otter
Sandy Bluffs				
Rhinoceros Auklet	Sandy Bluffs	• > 75% of the vegetation is composed of species associated with the Willamette Valley Upland Prairie and Savanna and North Pacific Coastal Cliff and Bluff ecological systems. • At least 50% vegetative cover at the beginning of the rainy season. • <25% invasive plant species (e.g., cheat grass). • No Scotch broom or other invasive shrub species. • Eliminate disturbance and impacts to habitats from deer. • No non-native rats or rabbits. • Reduce impacts from other mammalian predators.	Breeding	Canada goose, and snowy owl
Tufted Puffin	Sandy Bluffs	• See Habitat Structure and Other Ecological Requirements for Rhinoceros Auklet above.	Breeding	Canada goose, swallows, snowy owl
Savanna, Grassland, and Herbaceous Bald				
Golden Paintbrush	Grassland	• <15-20% canopy cover of trees and native shrubs. • >50% cover of native grasses and native forbs of the Willamette Valley Upland Prairie and Savanna ecological system. • <25% cover of non-native plant species. • <10% cover of invasive plant species. • No presence of English ivy, Scotch broom, or other new noxious weed invaders. • Eliminate disturbance and impacts to habitats from deer and rabbits.	Year-round	northern harrier, American kestrel, short-eared owl, streaked horned lark, swallows, purple martin,, savanna sparrow, black-tailed deer, valley silverspot, island marble, Taylor's checkerspot
Brittle Prickly-pear Cactus	Grassland and Sandy Bluffs	• See Habitat Structure and Other Ecological Requirements for Golden Paintbrush above.	Year-round	See species listed for golden paintbrush above, plus Canada goose, swallows, snowy owl
California Buttercup	Grassland and Sandy Bluffs	• See Habitat Structure and Other Ecological Requirements for Golden Paintbrush above.	Year-round	See species listed for brittle prickly-pear cactus
Bear's Foot Sanicle	Grassland and Sandy Bluffs	• See Habitat Structure and Other Ecological Requirements for Golden Paintbrush above.	Year-round	See species listed for brittle prickly-pear cactus

Forests and Woodlands				
Bald Eagle	Forests and Woodlands	• >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 or rabbits. • Reduce impacts from other mammalian predators.	Year-round	Downy, hairy, and pileated woodpeckers, olive-sided flycatcher, American kestrel, great horned owl, and bats
Wetlands				
Biological Integrity	Wetlands	• No invasive aquatic species (e.g., green crab or spartina). • No non-native rats or rabbits on any refuge islands. • Reduce impacts from other mammalian predators.	Year-round in brackish; potentially seasonal in freshwater	Heermann's gull, Brant, harlequin duck, black and ruddy turnstone, surfbird, rock sandpiper, wandering tattler, great blue heron, river otter, dunlin, western sandpiper, northern pintail, mallards, Canada geese, amphibians, and bats

Definitions for Column Headings:
Focal Resources: Species selected as representatives or indicators for the overall condition of the Priority Resources of Concern. In situations where the Priority Resources of Concern may include a broad variety of habitat structures and plant associations, several different focal resouces may be listed. In addition, species with specific "niche" ecological requirements may be listed as focal resources. Management will be focused on attaining conditions required by the focal resources.
Habitat Type: The general habitat description utilized by the focal resource.
Habitat Structure and Other Ecological Requirements: The specific and measurable habitat attributes considered necessary to support the focal resource.
Life History: The general season of use for the focal resources.
Other Benefiting Species: Other species that are expected to benefit from management for the selected focal resources. The list is not comprehensive; see the *Table of Potential Resources of Concern for the Refuges* for a more complete list.

C.3 Summary of BIDEH for Protection Island and San Juan Islands NWRs

Habitats that Represent Existing BIDEH	Population/Habitat Attributes (age, class, structure, serial, species composition)	Natural Processes Responsible for These Conditions	Limiting Factors
Shoreline			
Spit	North Pacific Maritime Coastal Sand Dune and Strand ecological system. Sand and gravelly sediment from adjacent bluffs form a low elevation (<3' above mean high tide) point of land or narrow shoal projecting into the marine water. American dune grass, yellow sandverbena, plantain, yarrow, black knotweed.	Eroding glacial-till bluffs; salt spray; high winds; excessively drained soils	Sea level rise; high waves and storm intensity; armoring bluffs; invasive species; lack of large driftwood, contamination
Rocky Shoreline and Cliff	Basalt or meta-sedimentary consolidated rock with or without minimal soil. Native lichen/sedum dominated vegetation sparsely interspersed with windswept shrubs, succulents, or grasses growing from fissures.	Volcanic and tectonic activities, glacial processes, and mean sea level	Sea level raise; volcanic and tectonic activity; wind, waves, and other erosive forces; invasive spp.
Sandy/Gravel Shoreline	The stratum consists of components smaller than cobble (10" diameter) including gravel, sand mud, and organic materials. If vegetation is present, represents the North Pacific Maritime Coastal Sand Dune and Strand ecological system though very sparse.	Eroding glacial-till bluffs; salt spray; high winds; excessively drained soils; volcanic and tectonic activities, glacial processes, and mean sea level	Sea level rise; high waves and storm intensity; armoring bluffs; invasive species; lack of large driftwood; contamination; volcanic and tectonic activity
Forest and Woodlands			
Forests	Westside Lowlands Conifer-Hardwood (Mature) Forest ecological system consisting of late-succession (>300 years old) Douglas fir, western hemlock, western red cedar forest with muti-layer canopy and understory of sword fern, dwarf Oregon grape and salal.	Configuration of islands (interior buffered by rock ledges) created a deposition area for well-developed soils and increased retention of precipitation	Invasive species; logging; development (trails, campsites); fire; disease; and extreme winds.
Woodlands	Westside Oak and Dry Douglas-fir Forest and Woodlands includes dry Douglas-fir forests, Pacific madrone /Douglas-fir/ Grand fir forests, and areas of lodgepole (shore) pine. Garry oak currently	Drained soils, low precipitation, natural fire regimes	Lack of seed dispersing animals and birds, such as Steller's jay; disease; invasive species; fire suppression; climate

Habitats that Represent Existing BIDEH	Population/Habitat Attributes (age, class, structure, serial, species composition)	Natural Processes Responsible for These Conditions	Limiting Factors
	or historically present.		change
Sandy Bluffs			
	The North Pacific Coastal Cliff and Bluff ecological system.	Deposition of glacial-till; well drained soils; natural fire regimes	Erosion; invasive species; increasing storm events in combination with sea level raise accelerating natural erosion
Savanna, Grassland, and Herbaceous Bald			
	Willamette Valley Upland Prairie and Savanna and North Pacific Herbaceous Bald and Bluff ecological systems with native plants, such as camas and Roemer's fescue.	Drained soils, low precipitation, natural fire regimes	Invasive species; grazing and soil disturbance; dune stabilization and agricultural use (seeding of non-natives); roads and structures; fire suppression; climate change
Small Wetlands			
	Temperate Pacific Freshwater Emergent Marsh with the predominant vegetation of cattails, slough sedge and duckweed; North Pacific Coastal Interdunal Wetland fringed by pickleweed and other salt-tolerant wetland species.	Semipermanent to seasonal flooding, muck or mineral soil, and high-nutrient water; deflation plain and swales of larger active and stabilized sand spits receives freshwater input from precipitation runoff and few seeps and limited saltwater intrusion from storm or high tide over wash events.	Level of the water table; amount of salt water intrusion; alteration of precipitation patterns and sea level raise as a result of climate change

C.4. Shoreline Habitat and Ecological Systems Descriptions

C.4.1 Shoreline Habitat Descriptions

Physical attributes for the shoreline areas were characterized according to *A Marine and Estuarine Habitat Classification System for Washington State* (Dethier 1990), a hierarchical system based on the National Wetland Inventory classification (Cowardin et al. 1979).

Overview of *A Marine and Estuarine Habitat Classification System for Washington State* (Dethier 1990).

System	Subsystem	Class	Subclass	Energy	Water Regime
Marine	Intertidal	Consolidated	Bedrock		
			Boulder	Exposed	
			Hardpan		
		Unconsolidated	Cobble		Eulittoral
			Mixed Coarse	Partially Exposed	
			Gravel		
			Sand		
			Mixed Fine	Semi-protected	
			Mud		Backshore
			Organic		
		Reef		Protected	
		Artificial			
	Subtidal	Consolidated	Bedrock		
			Boulder		
			Hardpan	High	
		Unconsolidated	Cobble		Shallow
			Mixed Coarse		
			Gravel	Moderate	
			Sand		
			Mixed Fine		
			Mud		Deep
			Organic	Low	
		Reef			
		Artificial			
Estuarine	Intertidal	Consolidated	Bedrock		
			Boulder	Open	
			Hardpan		
		Unconsolidated	Cobble		Eulittoral
			Mixed Coarse	Partly Enclosed	
			Gravel		
			Sand		
			Mixed Fine	Lagoon	
			Mud		Backshore
			Organic		
		Reef		Channel/Slough	
		Artificial			
	Subtidal	Consolidated	Bedrock		Shallow
			Boulder		
			Hardpan		
		Unconsolidated	Cobble		
			Mixed Coarse		

System	Subsystem	Class	Subclass	Energy	Water Regime
			Gravel		Deep
			Sand		
			Mixed Fine		
			Mud		
			Organic		
		Reef			
		Artificial			

Using the results of the WDNR Nearshore Habitat Program's ShoreZone Inventory (Berry et al. 2001, WDNR 2001) and Puget Sound Intertidal Habitat Inventory (Berry and Ritter 1997, Ritter et al. 1999) in combination with field reconnaissance and photo-interpretation of oblique and orthorectified aerial photographs (So 2009), shoreline characteristics for the refuges were described at the following classification levels: System, Subsystem, Substrate, Energy, and Water Regime.

System-level categorization of each island as either Estuarine or Marine is difficult since salinities are generally high (>25 ppt) and the flora and fauna resemble those on the marine outer coast. However, the strong influences of the Fraser River from the north and the freshwater runoff into Bellingham, Padilla, and Skagit Bays from the east lead to occasional large drops in surface salinities. Consequently, the Dethier (1990) classification system arbitrarily considers areas to the east of a line from Green Point (Fidalgo Island) to Lawrence Point (Orcas Island) as well as all of the Strait of Georgia and the San Juans north of Orcas as Estuarine. Areas to the west of this line are considered Marine.

Rocky (consolidated) shoreline:

Rocky shoreline habitat descriptions adapted from Dethier (1990), Bailey et al. (1993) and Don (2002) follow:

Habitat Type	Marine: Intertidal: Consolidated: Bedrock: Partially Exposed: Eulittoral
Refuge Units	8, 9, 11, 14, 15, 16, 17, 18, 19, 20, 21, 27, 28, 80, 81, 82
Description	Sites not directly exposed to oceanic swell but with substantial wave action. Wave energies are less but there is a consequent increase in desiccation and other stresses leading to somewhat lower diversities than at the most exposed sites. Low tides on the more inland waters also fall at highly stressful hours (nearer midday in the summer and midnight in the winter), contributing to lower diversities. Diagnostic species include the kelp *Hedophyllum sessile*, the surfgrass *Phyllospadix scouleri*, and the chiton *Katharina tunicata* (all low zones), and the cloning anemone *Anthopleura elegantissima* (mid zone).

Habitat Type	Marine: Intertidal: Consolidated: Bedrock: Protected and Semi-protected: Eulittoral
Refuge Units	Protected: 2, 3, 4, 5, 10, 26, 29, 50, 51, 52, 54, 55, 57, 61, 68, 69, 70, 71, 72, 73, 74, 79 Semi-protected: 6, 10, 12, 13, 22, 23, 24, 30, 31, 32, 34, 35, 36, 37, 38, 39, 40, 42, 43, 58, 59, 60, 62, 63, 64, 79, 83, 84
Description	Areas that receive neither oceanic swell nor extensive wind fetch but retain their rocky character due to steepness of the shore or currents that sweep away most sediment. Siltation, desiccation, and temperature stresses all take their toll on rocky-shore organisms in these areas, and diversity is correspondingly relatively low. Diagnostic species include the brown rockweed *Fucus gardneri* (=*distichus*), the red algae *Porphyra spp.* and *Mastocarpus papillatus*, the snails *Littorina spp.* (all high zones), and the whelk *Nucella lamellosa*.

Habitat Type	Marine: Intertidal: Consolidated: Boulders: Partially Exposed and Semi-protected: Eulittoral
Refuge Units	Partially exposed: 81 Semi-protected: 42
Description	Boulder shores generally resemble bedrock shores of similar wave exposures. A few species are more common in boulder fields than on bedrock shores, probably because the bases of boulders provide protection from sun and from predators; these include the red algae *Plocamium cartilagineum* and *Prionitis spp.*, the limpet *Tectura persona*, the shore crab *Hemigrapsus nudus* and the red rock crab *Cancer productus*, the anemones *Metridium senile*, and *Urticina crassicornis*, and several tunicates (especially *Pyura haustor*) and intertidal sponges (*Halichondria panicea*, *Haliclona permollis*, and *Ophlitaspongia pennata*). Characteristic species in the gravel commonly found at the base of boulders include the northern clingfish, porcelain crabs *Petrolisthes spp.*, sipunculid worms, and the polychaete *Thelepus spp*.

Habitat Type	Marine: Subtidal: Consolidated: Bedrock: Moderate energy: Shallow
Refuge Units	7, 25, 33, 41, 49, 56
Description	These habitats, like the rocky intertidal, are productive and diverse. Communities are often patchy, containing areas with herbivorous urchins and few kelps, or no urchins and many kelps. Kelp beds create a semi-protected habitat used as resting areas by gulls, heron, waterfowl, and cormorants, and as feeding sites by surf scoters and white-winged scoters, loons, grebes, goldeneyes, buffleheads, and harbor seals.

Habitat Type	Estuarine: Intertidal: Consolidated: Bedrock: Open: Eulittoral
Refuge Units	47, 48, 66, 77, 78
Description	In the San Juan Islands refuge, these habitats are very similar to their marine counterparts except with higher amount of freshwater dilution. These habitats are exposed to moderate waves or currents which keep silt from settling on the substratum and allow an epifauna to develop. The plants and animals seen on these rocky substrata are largely a freshwater-tolerant subset of those seen on marine shores. These habitats are used at high tide by sculpins and probably other fishes.

Habitat Type	Estuarine: Intertidal: Consolidated: Bedrock: Partially Enclosed: Eulittoral
Refuge Units	45, 46, 65, 77
Description	In the San Juan Islands refuge, these habitats are estuarine equivalents to Marine Intertidal Consolidated Bedrock Semi-protected habitats, except with higher amounts of freshwater dilution. The consolidated bedrock is protected by headlands, bars, or spits which reduce circulation, leading to minimal wave action or currents.

Habitat Type	Estuarine: Subtidal: Consolidated: Bedrock: Moderate energy: Shallow
Refuge Units	44
Description	In the San Juan Islands refuge, these habitats are estuarine equivalents to Marine Subtidal Consolidated Bedrock Moderate energy habitats, except with higher amounts of freshwater dilution.

Unconsolidated (sandy/gravelly) shoreline:

Sandy/gravelly shoreline habitat descriptions adapted from Dethier (1990), Bailey et al. (1993) and Don (2002) follow:

Habitat Type	Marine: Intertidal: Unconsolidated: Mixed-coarse: Partially Exposed: Eulittoral
Refuge Units	75, Protection Island
Description	Mixed-coarse sediments are those where no one grain size occupies more than 70-75 percent of a stretch of beach. Instead, the beach is a mix (in variable quantities) of a few boulders, with cobble, gravel, and sand. Most of the shoreline around Smith Island (especially on the southwest spit) and the north shoreline of Protection Island are composed of a mixed-coarse substrate. Located in the

	Strait of Juan de Fuca, this shoreline is substantially exposed to wind waves and attenuated oceanic swell.

Habitat Type	Marine: Intertidal: Unconsolidated: Mixed-coarse: Protected and Semi-protected: Eulittoral
Refuge Units	Protected: 1, 6, 10, 15, 29, 38, 53, 54, 70, 73, Protection Island Semi-protected: 13, 62, 64, Protection Island
Description	These habitats are composed of a mix of boulders, cobble, gravel, and sand with no one substratum exceeding 70-75 percent cover. The shoreline is to some degree protected from sea swell and receives moderate to restricted wave action from wind fetch. Drift algae may accumulate in these habitats seasonally, creating anaerobic sediments beneath them but providing food and habitat for a variety of small organisms. On Protection Island, this habitat type occurs within the protected marina on Violet Point, on the north side of Kanem Point, and along the middle portion of the southern shoreline.

Habitat Type	Marine: Intertidal: Unconsolidated: Mixed-fine: Partially Exposed: Eulittoral
Refuge Units	75
Description	The eastern low spit extending away from Smith Island and towards Minor Island is composed of a mixed-fine substrate with sand, mud, and gravel being the most common constituents. Located in the Strait of Juan de Fuca, the shoreline is substantially exposed to wind waves and attenuated oceanic swell.

Habitat Type	Marine: Intertidal: Unconsolidated: Mixed-fine: Protected and Semi-protected: Eulittoral
Refuge Units	Protected: 50, 71, 79 Semi-protected: 35, 39, 64
Description	Protection from waves allows finer sediments to accumulate, and the substratum is relatively stable. The beaches tend to be accretional. The mixed-fine sediments include sand and mud with patches of gravel (especially in the higher intertidal). Species are generally a mix of those found in sand and in mud habitats. Drift algae and seagrass may be abundant.

Habitat Type	Marine: Intertidal: Unconsolidated: Sand: Partially Exposed: Eulittoral
Refuge Units	76
Description	The shoreline of Minor Island is largely composed of sand without significant silt or organic content. Consequently, the shoreline is well-drained, moderately sloped, and unstable nature. They have no permanent vegetation and are low-diversity habitats, although a few species may be abundant. These areas are used extensively by loons, scoters, and grebes at high tide, and by gulls, sanderling and other sandpipers, and herons at low tide.

Habitat Type	Marine: Intertidal: Unconsolidated: Sand: Semi-Protected: Eulittoral
Refuge Units	Protection Island
Description	These sands begin to have some silt mixed in with them and are more stable, making them a more favorable environment for burrowing and for deposit-feeding organisms. These habitats are found in bays and inlets with some wave action, and often are bordered at their upper edges by salt marshes. The shallow water fish and fauna in these habitats provides food for seals and for a variety of local and migratory birds, including mew gulls, grebes, and great blue herons. The clams *Macoma secta*, *Tellina bodegensis* and *Transennella tantilla*, the burrowing sea cucumber *Leptosynapta clarki*, the lugworm *Abarenicola claparedi*, the tanaid crustacean *Leptochelia savignyi*, and sand sole are diagnostic species. Common associates include *Zostera marina*, the sand dollar *Dendraster excentricus* and the moon snail *Polinices lewisii* in low zones. Other species in these sometimes rich assemblages include the ghost shrimp *Callianassa californiensis*, the clams *Tellina modesta*, *Macoma balthica* and others; the polychaetes *Malacoceros glutaeus* (= *Rhynchospio arenincola*), *Axiothella rubrocincta*, *Owenia fusiformis*, and many others. Seines tend to catch *Cancer magister* and *gracilis*, and diverse shrimp, including *Crangon alaskensis*, *Pandalus spp*., and *Heptacarpus brevirostris*. Sole, salmonids, and sculpin (especially Pacific staghorn) feed extensively in these habitats. This is a spawning habitat for surf smelt, and is used

	by larvae of sand lance and candlefish.

Habitat Type	Estuarine: Intertidal: Unconsolidated: Mixed-fine: Open: Eulittoral
Refuge Units	47
Description	In the San Juan Islands refuge, these habitats are estuarine equivalents to Marine Intertidal Unconsolidated Mixed-fine Partially Exposed habitats, except with higher amounts of freshwater dilution. Located in the Strait of Georgia, Lone Tree Island and its associated rocks are exposed to moderate to long fetch and receive some wind waves and/or currents.

Habitat Type	Estuarine: Intertidal: Unconsolidated: Mixed-fine: Partly enclosed: Eulittoral
Refuge Units	77
Description	The pocket beach in the southeast corner of Matia Island consists of mixed sand and mud with small amounts of gravel or with some clay and peat. The substratum is generally stable, firm, and organic-rich. Drift algae and seagrass may be abundant seasonally. Detritivores in the sediment are very dense, and are preyed upon by other invertebrates as well as by numerous birds and fishes. The amphipod *Corophium* provides a major food resource for numerous fish and shorebirds.

Habitat Type	Estuarine: Intertidal: Unconsolidated: Sand: Open: Eulittoral
Refuge Units	77
Description	The beach at Rolfe Cove is a gently to moderately sloping beach with sandy substrata. Drift algae and seagrass may accumulate in high zones seasonally.

Habitat Type	Estuarine: Intertidal: Unconsolidated: Sand: Partly enclosed: Eulittoral
Refuge Units	77
Description	The smaller pocket beaches on Matia Island, excluding the beach at Rolfe Cove and the southeastern beach, are considered partly enclosed. Substrata are sand, silty sand, or gravelly sand.

C.4.2 Ecological Systems Descriptions

Vegetation types and nomenclature in the following section are classified according to the International Terrestrial Ecological System Classification being developed by NatureServe and its natural heritage program members. Ecological systems are being described for the coterminous United States, southern Alaska, and adjacent portions of Mexico and Canada and are defined as follows:

> "Terrestrial ecological systems are specifically defined as a group of plant community types (associations) that tend to co-occur within landscapes with similar ecological processes, substrates, and/or environmental gradients. A given system will typically manifest itself in a landscape at intermediate geographic scales of tens to thousands of hectares and will persist for 50 or more years. This temporal scale allows typical successional dynamics to be integrated into the concept of each unit. With these temporal and spatial scales bounding the concept of ecological systems, we then integrate multiple ecological factors—or diagnostic classifiers—to define each classification unit. The multiple ecological factors are evaluated and combined in different ways to explain the spatial co-occurrence of plant associations." (Comer et al. 2003)

Thus, ecological systems link together recurring groupings of U.S. National Vegetation Classification (US-NVC) associations and alliances (Grossman et al. 1998, Anderson et al. 1998, Jennings et al. 2003) found in similar physical settings and influenced by similar dynamic processes such as fire or flooding. The nested US-NVC hierarchy groups associations into alliances based on common dominant or diagnostic species in the upper most canopy. By non-hierarchically grouping together associations and alliances using larger-scale environmental patterns and concepts, ecological systems form a “meso-scale” classification that lies between the finer-scale (floristic) classes and the generalized formation (physiognomic) levels of the US-NVC (Comer et al. 2003). As a “meso-scale” classification, ecological systems are more readily mapped, identifiable in the field, and practically understood as ecological units and wildlife habitats. Consequently, regional GAP analysis efforts have generally adopted them as target map units. Given their utility for standardized vegetation type mapping, ecological systems classification was performed for Protection, Matia, Turn, Smith, and Minor Islands.

North Pacific Coastal Sand Dune and Strand:

Coastal dunes include beach strand (not the beach itself but sparsely or densely vegetated areas behind the beach), foredunes, sand spits, and active to stabile backdunes and sandsheets derived from quartz or gypsum sands. The mosaic of sparse to dense vegetation in dune systems is driven by sand deposition, erosion, and lateral movement. Disturbance processes include dune blowouts caused by wind and occasional wave overwash during storm tidal surges. Dune vegetation typically includes herbaceous, succulent, shrub, and tree species with varying degrees of tolerance for salt spray, wind and sand abrasion, and substrate stability. Dune succession is highly variable, so species composition can vary significantly among occurrences. These dunes can be dominated by *Leymus arenarius* (= *Elymus arenarius*), *Festuca rubra*, *Leymus mollis*, or various forbs adapted to salty dry conditions. *Gaultheria shallon* and *Vaccinium ovatum* are major shrub species. Forested portions of dunes are included within this system and are characterized by *Pinus contorta var. contorta* early in succession, *Picea sitchensis* somewhat later in the sere, and in some cases *Tsuga heterophylla* later still (NatureServe 2010).

Coastal Cliff and Bluff:

This ecological system includes unvegetated or sparsely vegetated rock cliffs and very steep bluffs of glacial deposits. It is composed of barren and sparsely vegetated substrates, typically including exposed sediments, bedrock, and scree slopes. Exposure to waves, eroding and desiccating winds, slope failures and sheet erosion create gravelly to rocky substrates that are often unstable. There can be sparse cover of forbs, grasses, lichens and low shrubs (NatureServe 2010).

Willamette Valley Upland Prairie and Savanna:

This ecological system occurs within the Puget Lowland and Willamette Valley on relatively level terrain, primarily on deep, well-draining gravelly/sandy glacial outwash, and was historically maintained by frequent anthropogenic burning practices (Chappell and Crawford 1997, Crawford and Hall 1997, Chappell et al. 2001a, NatureServe 2010). Grassland structure is more common than savanna (defined here as <30% tree or shrub cover) (Chappell et al. 2001b). Bunch grasses such as Roemer’s fescue (*Festuca roemeri = Festuca idahoensis var. roemeri),* red fescue (*Festuca rubra*), and California oatgrass (*Danthonia californica*) are frequently dominant or co-dominant. Abundant and diverse native forbs are indicative of sites in good condition.

Prior to Euroamerican settlement, Willamette Valley Upland Prairie and Savanna were the dominant landscape features on the glacial outwash soils within the region (Lang 1961). However, the area occupied by this system has declined dramatically due to altered fire regimes, invasion of non-native species, grazing, and urban and agricultural conversion (Giles 1970, Agee 1993, Clampitt 1993, Chappell and Crawford 1997, Crawford and Hall 1997). Remnant grasslands and prairies are typically small fragments that have been degraded by invasive non-native species. Scattered deciduous (*Quercus garryana*) and/or coniferous (*Pseudotsuga menziesii*) trees are rarely found now but formerly formed extensive savannas that covered roughly one-third of the historical ecological system acreage (NatureServe 2010).

North Pacific Herbaceous Bald and Bluff:

This system is characterized by low-growing vegetation, relatively shallow soils with an underlying restrictive layer of bedrock, and relatively dry topographic positions. During the growing season, balds can be moist or wet but then dry out to an extreme degree late in the growing season. Balds typically occur in small patches and can be intermixed with rock outcrops and fringed by areas of forest and woodland (Chappell et al. 2001a, Chappell et al. 2001b, Chappell 2006).

Dominant or co-dominant native grasses include Roemer's fescue (*Festuca roemeri = Festuca idahoensis var. roemeri)*, red fescue (*Festuca rubra*), and California oatgrass (*Danthonia californica*), Lemmon's needlegrass (*Achnatherum lemmonii*), and prairie junegrass (*Koeleria macrantha*). Major exotic dominant grasses include brome (*Bromus sp.*), velvet grass (*Holcus lanatus*), wheatgrass (*Agropyron dasystachyum*), and Kentucky bluegrass (*Poa pratensis*). Forb diversity can be high. Some typical co-dominant forbs include common camas (*Camassia quamash*), great camas (*Camassia leichtlinii*), hyacinth triteleia (*Triteleia hyacinthine*), rosy plectritis (*Plectritis congesta*), Martindale's lomatium (*Lomatium martindalei*), nodding onion (*Allium cernuum*), Hooker's onion (*Allium acuminatum*), spreading phlox (*Phlox diffusa*), sea thrift (*Armeria maritima*), and chocolate lily (*Fritillaria lanceolata*) (Atkinson and Sharpe 1993, NatureServe 2010). Important dwarf-shrubs are kinnikinnick (*Arctostaphylos uvaursi*), pinemat manzanita (*Arctostaphylos nevadensis*), and common juniper (*Juniperus communis*). Significant portions of some balds, especially on rock outcrops, are dominated by bryophytes (mosses) and to a lesser degree lichens (NatureServe 2010).

With the accumulation and enrichment of soil through the actions of erosion and plant matter decay, shrubs and trees scattered may eventually appear within balds forming open savanna-like woodlands. Garry oak (*Quercus garryana*), Rocky Mountain juniper (*Juniperus scopulorum*), and Pacific madrona (*Arbutus menziesii*) are among the tree species able to anchor in the thin soil of these areas. Other tree species which may be found on these sites include Douglas fir (*Pseudotsuga menziesii*) and shore pine (*Pinus contorta*) (Atkinson and Sharpe 1993).

North Pacific Dry Douglas-Fir Forest and Woodland

The North Pacific Dry Douglas-Fir-(Madrone) Forest and Woodland system occupies dry sites with shallow soils overlying bedrock, very stony soils, or moderately deep, moderately well-drained glacial outwash. These forest and woodland sites tend to be subject to higher winds and higher summer temperatures than the North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest system and also tend to occur on southern or western facing slopes (Chappell et al. 2001).

As the name implies, the North Pacific Dry Douglas-Fir Forest and Woodland ecological system is dominated by the long-lived Douglas-fir tree (*Pseudotsuga menziesii*). A variety of other trees including Pacific madrona (*Arbutus menziesii*), the short-lived shore pine (*Pinus contorta*), big-leaf maple (*Acer macrophyllum*), and the shade-tolerant grand fir (*Abies grandis*) occur along with the Douglas-fir depending on local site conditions (Atkinson and Sharpe 1993, NatureServe 2010). Small amounts of western hemlock (*Tsuga heterophylla*) or Western red cedar (*Thuja plicata*) can be present but are unable to thrive due to the dryness of the site or due to frequent and extensive fires (NatureServe 2010). Deciduous shrubs that dominate or co-dominate the understory include oceanspray (*Holodiscus discolor*), serviceberry (*Amelanchier alnifolia*), trailing blackberry (*Rubus ursinus*), Indian plum (*Oemleria cerasiformis*), Nootka rose (*Rosa nutkana*), and snowberry (*Symphoricarpos albus*). Evergreen shrubs that can sometimes be important in areas that are conifer-dominated include salal (*Gaultheria shallon*) and dwarf Oregon grape (*Mahonia nervosa*). Native graminoids such as blue wildrye (*Elymus glaucus*) commonly dominate or co-dominate the understory. A diversity of forbs is often abundant. However, forbs typically do not dominate (Chappell et al. 2001).

North Pacific Maritime Dry Mesic Douglas-fir-Western Hemlock Forest

This is generally the most extensive forest in the lowlands on the west side of the Cascades and forms the matrix within which other systems occur as patches. In dry areas it occurs adjacent to or in a mosaic with North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland.

Douglas-fir and western hemlock are the most characteristic species of this ecological system and one or both are generally canopy dominant. Other co-dominants include grand fir, western red-cedar, and big-leaf maple. Dominant or co-dominant understory shrub species include salal, dwarf Oregongrape, Pacific rhododendron (*Rhododendron macrophyllum*), twinflower (*Linnaea borealis*), vanilla leaf (*Achlys triphylla*), and evergreen huckleberry (*Vaccinium ovatum*). Vine maple (*Acer circinatum*) is a common co-dominant with one or more of these other species. On mesic sites, sword fern can be co-dominant with one or more of the evergreen shrubs (NatureServe 2010).

North Pacific Oak Woodlands

Within the Puget Trough region, this ecological system is found in small patches on dry sites typically featuring either shallow bedrock or deep glacial outwash soils. The oak-dominated communities comprising this system are strongly associated with a pre-Euroamerican settlement, frequent (every few years) to moderately frequent (once every 50-100 years), low-severity fire regime (Chappell et al. 2001, NatureServe 2010). The vegetation ranges from open woodland to forest. The deciduous broadleaf Garry oak, also known as Oregon white oak (*Quercus garryana*), is the dominant tree species with the coniferous Douglas-fir often being co-dominant. Madrone and lodgepole pine (*Pinus contorta*) are also common associates (WDFW 2005).

In savanna-like open woodlands, the understory is dominated by long-stolon sedge and camas. This community type is most similar in composition to pre-settlement oak savannas (Chappell and Crawford 2007). In the absence of fire, commonly observed successional changes include an increase in conifers, the proliferation of a shrub understory, higher oak densities, and an increasing abundance of non-native annuals and perennials in the understory (Agee 1993, Chappell and Crawford 1997, NatureServe 2010). The increase in woody trees and shrubs include native species such as Douglas-fir, Oregon grape, snowberry, and manzanita, and non-native species such as Scotch broom (*Cytisus scoparius*).

Temperate Pacific Freshwater Emergent Marsh

Freshwater emergent marshes are characterized by semipermanent to seasonal flooding, muck or mineral soil, and high-nutrient water. Emergent herbaceous graminoids such as *Carex spp.*, *Scirpus spp.*, *Eleocharis spp.*, *Juncus spp.*, and *Typha latifolia* typically dominate. A consistent source of freshwater is essential to the function of these systems (NatureServe 2010).

North Pacific Coastal Interdunal Wetland

North Pacific Coastal Interdunal Wetlands occur in the deflation plain and swales of larger active and stabilized coastal barrier islands, spits, and coastal dunes, ranging from southern Oregon through the Aleutian Islands (NatureServe 2010). These freshwater wetlands form between dunes where wind has scoured the sand down to the water table. Consequently, interdunal wetlands are sustained almost entirely by groundwater and are flooded seasonally or perennially. Because the water table declines to below the bottom of some deflation plains in the dry season (midsummer to early fall), some of these wetlands are seasonal (USGS 2010). Vegetation in interdunal wetlands is variable, depending upon hydrology and geography. The closer the deflation plain or swale is to the nearby waterbody, the higher the likelihood for a hydrologic linkage. For wet dune swales and broad deflation plains, several distinct communities have been reported (Wiedemann 1984). Where deposition of wind-blown sand is heavy and dune migration is active, interdunal wetlands may become uplands when covered by thick sand deposits.

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C.5 Common and Scientific Names of Species mentioned in the CCP

The following tables contain the common and scientific names of plants and animals that are mentioned in this CCP.

Plants

Common Name	**Scientific Name**	**Family**
Alfalfa	*Medicago sativa*	Fabaceae
Alaska alkali grass	*Puccinellia kamtschatica*	Poaceae
Alaska brome	*Bromus sitchensis*	Poaceae
Alaska oniongrass	*Melica subulata*	Poaceae
American dunegrass	*Leymus mollis*	Poaceae
Bear's foot sanicle	*Sanicula arctopoides*	Apiaceae
Bigleaf maple	*Acer macrophyllum*	Aceraceae
Black lily	*Fritillaria camschatcensis*	Liliaceae
Black medic	*Medicago lupulina*	Fabaceae
Blue wild rye	*Elymus glaucous*	Poaceae
Bracken fern	*Pteridium aquilinum*	Dennstaedtiaceae
Brittle prickly-pear cactus	*Opuntia fragilis*	Cactaceae
Bull thistle	*Cirsium vulgare*	Asteraceae
California buttercup	*Ranunculus californicus*	Ranunculaceae
California oat-grass	*Danthonia californica*	Poaceae
Camas	*Camassia quamash*	Liliaceae
Canada thistle	*Cirsium arvense*	Asteraceae
Cattails	*Typha latifolia*	Typhaceae
Caulerpa	*Caulerpa* ssp.	Caulerpaceae
Cheatgrass	*Bromus tectorum*	Poaceae
Common cordgrass	*Spartina anglica*	Poaceae
Common mustard	*Brassica campestris*	Brassicaceae
Common sow thistle	*Sonchus Oleraceus*	Asteraceae
Common velvet-grass	*Holcus lanatus*	Poaceae

Common Name	**Scientific Name**	**Family**
Douglas-fir	*Pseudotsuga menziesii* ssp. *menziesii*	Pinaceae
Douglas maple	*Acer glabrum*	Aceraceae
Eel-grass	*Zostera marina*	Zosteraceae
English ivy	*Hedera helix*	Araliaceae
Erect pygmy-weed	*Crassula connata*	Crassulaceae
European beachgrass	*Ammophila arenaria*	Poaceae
False dandelion	*Nothocalais* ssp.	Asteraceae
Field bindweed	*Convolvulus arvensis*	Convolvulaceae
Garry oak	*Quercus garryana*	Fagaceae
Golden paintbrush	*Castilleja levisecta*	Scrophulariaceae
Grand fir	*Abies grandis*	Pinaceae
Gumweed	*Grindelia integrifolia*	Asteraceae
Hedge mustard	*Sisymbrium officinale*	Brassicaceae
Himalayan blackberry	*Rubus armeniacus*	Rosaceae
Hookedspur violet	*Viola adunca*	Violaceae
Hooker's willow	*Salix hookeriana*	Salicaceae
Idaho fescue	*Festuca idahoensis*	Poaceae
Japanese eelgrass	*Zostera japonica*	Zosteraceae
Japanese kelp	*Undaria pinnatifida*	Alariaceae
Kentucky bluegrass	*Poa pratensis*	Poaceae
Lance-leaved stonecrop	*Sedum lanceolatum*	Crassulaceae
Lemmon's needlegrass	*Achnatherum lemmonii*	Poaceae
Meadow barley	*Hordeum brachyantherum*	Poaceae
Nootka rose	*Rosa nutkana*	Rosaceae
Northern adder's-tongue	*Ophioglossum pusillum*	Ophioglossaceae
Orange honeysuckle	*Lonicera ciliosa*	Caprifoliaceae
Orchard grass	*Dactylis glomerata*	Poaceae
Pacific madrone	*Arbutus menziesii*	Ericaceae
Pacific sanicle	*Sanicula crassicaulis*	Apiaceae
Paintbrush	*Castilleja* ssp.	Scrophulariaceae
Pickleweed	*Salicornia virginica*	Chenopodiaceae
Plantain	*Plantago* ssp.	Plantaginaceae
Prairie junegrass	*Koeleria macrantha*	Poaceae
Quackgrass	*Elymus repens*	Poaceae
Red alder	*Alnus rubra*	Betulaceae
Redcedar	*Thuja plicata*	Cupressaceae
Red fescue	*Festuca rubra*	Poaceae
Ripgut brome	*Bromus diandrus*	Poaceae
Rocky Mountain juniper	*Juniperus scopulorum*	Cupressaceae
Salal	*Gaultheria shallon*	Ericaceae
Sargassum	*Sargassum* ssp.	Sargassaceae
Scotch broom	*Cytisus scoparius*	Fabaceae

Common Name	**Scientific Name**	**Family**
Scouler's willow	*Salix scouleriana*	Salicaceae
Sea blush	*Plectritis congesta*	Valerianaceae
Sea thrift	*Armeria maritime*	Plumbaginaceae
Sharpfruited peppergrass	*Lepidium oxycarpum*	Brassicaceae
Sheep sorrel	*Rumex acetosella*	Polygonaceae
Shore pine	*Pinus contorta* var. *contorta*	Pinaceae
Silver burweed	*Ambrosia chamissonis*	Asteraceae
Slender crazyweed	*Oxytropis campestris* var. *gracilis*	Fabaceae
Slough sedge	*Carex obnupta*	Cyperaceae
Snowberry	*Symphoricarpos albus*	Caprifoliaceae
Sow thistle	*Sonchus arvensis*	Asteraceae
Sword fern	*Polystichum munitum*	Dryopteridaceae
Vancouver groundcone	*Boschniakia hookeri*	Orobanchaceae
Verbena	*Verbena* ssp.	Nyctaginaceae
Western hemlock	*Tsuga heterophylla*	Pinaceae
White meconella	*Meconella oregana*	Papaveraceae
Yarrow	*Achillea millefolium*	Asteraceae
Yerba buena	*Clinopodium douglasii*	Lamiaceae

Mammals

Common Name	**Scientific Name**	**Family**
Bat		Chioptera (order)
Black-tailed deer	*Odocoileus hemionus*	Cervidae
California sea lion	*Zalophus californianus*	Otariidae
Domestic cat	*Felis catus*	Felidae
Domestic dog	*Canis familiaris*	Canidae
European rabbit	*Oryctolagus cuniculus*	Leporidae
Harbor seal	*Phoca vitulina*	Phocidae
Mink	*Mustela vison*	Mustelidae
Northern elephant seal	*Mirounga angustirostris*	Phocidae
Raccoon	*Procyon lotor*	Procyonidae
Rat	*Rattus* spp.	Muridae
Red fox	*Vulpes vulpes*	Canidae
River otter	*Lutra canadensis*	Mustelidae
Short and long-tailed weasel	*Mustela* spp.	Mustelidae
Shrew	*Sorex* spp.	Soricidae
Steller (northern) sea lion	*Eumetopias jubatus*	Otariidae
Townsend's chipmunk	*Tamias (Neotamias) townsendii*	Sciuridae

Birds

Common Name	Scientific Name	Family
American kestrel	*Falco sparverius*	Falconidae
Bald eagle	*Haliaeetus leucocephalus*	Accipitridae
Black-bellied plover	*Pluvialis squatarola*	Charadriidae
Black oystercatcher	*Haematopus bachmani*	Haematopodidae
Black turnstone	*Arenaria melanocephala*	Scolopacidae
Brant	*Branta bernicla*	Anatidae
Brandt’s cormorant	*Phalacrocorax penicillatus*	Phalacrocoracidae
Brown pelican	*Pelecanus occidentalis*	Pelecanidae
Canada goose	*Branta Canadensis*	Anatidae
Caspian tern	*Hydroprogne caspia*	Laridae
Common murre	*Uria aalge*	Alcidae
Double-crested cormorant	*Phalacrocorax auritus*	Phalacrocoracidae
Downy woodpecker	*Picoides pubescens*	Picidae
Dunlin	*Calidris alpina*	Scolopacidae
Glaucous-winged gull	*Larus glaucescens*	Laridae
Great blue heron	*Ardea herodias*	Ardeidae
Great horned owl	*Bubo virginianus*	Strigidae
Hairy woodpecker	*Picoides villosus*	Picidae
Harlequin duck	*Histrionicus histrionicus*	Anatidae
Heermann’s gull	*Larus heermanni*	Laridae
Killdeer	*Charadrius vociferus*	Charadriidae
Mallard	*Anas platyrhynchos*	Anatidae
Marbled murrelet	*Brachyramphus marmoratus)*	Alcidae
Northern harrier	*Circus cyaneus*	Accipitridae
Northern pintail	*Anas acuta*	Anatidae
Olive-sided flycatcher	*Contopus cooperi*	Tyrannidae
Pelagic cormorant	*Phalacrocorax pelagicus*	Phalacrocoracidae
Peregrine falcon	*Falco peregrinus*	Falconidae
Pileated woodpeckers	*Dryocopus pileatus*	Picidae
Pigeon guillemot	*Cepphus columba*	Alcidae
Purple martin	*Progne subis*	Hirundinidae
Rhinoceros auklet	*Cerorhinca monocerata*	Alcidae
Rock sandpiper	*Calidris ptilocnemis*	Scolopacidae
Ruddy turnstone	*Arenaria interpres*	Scolopacidae

Common Name	Scientific Name	Family
Surfbird	*Aphriza virgata*	Scolopacidae
Sanderling	*Calidris alba*	Scolopacidae
Savannah sparrow	*Passerculus sandwichensis*	Emberizidae
Snowy owl	*Bubo scandiacus*	Strigidae
Swallow		Hirundinidae
Tufted puffin	*Fratercula cirrhata*	Alcidae
Wandering tattler	*Tringa incana*	Scolopacidae
Western sandpiper	*Calidris mauri*	Scolopacidae

Butterflies

Common Name	Scientific Name	Family
Island marble	*Euchloe ausonides insulanus*	Pieridae
Taylor's checkerspot	*Euphydryas editha taylori*	Nymphalidae
Valley silverspot	*Speyeria zerene bremnerii*	Nymphalidae

Fish and Shellfish

Common Name	Scientific Name	Family
Cod	*Gadus* ssp.	Gadidae
European green crab	*Carcinus maenas*	Portunidae
Flounder		Pleuronectidae
Herring	*Clupea pallasii*	Clupeidae
Limpets		Patellogastropoda (order)
Mussels	*Mytilus* ssp.	Mytilidae
Rockfish	*Sebastes* ssp.	Scorpaenidae
Salmon	*Oncorhynchus* ssp.	Salmonidae
Sandlance		Ammodytidae
Smelt		Osmeridae

Appendix D. Sign Plans

D. Introduction

This appendix contains the following two elements:

- Protection Island National Wildlife Refuge Sign Inventory and Maintenance Plan
- San Juan Islands National Wildlife Refuge Sign Inventory and Maintenance Plan

The sign inventory and maintenance plans are intended to guide decisions regarding the type, placement, and maintenance of signs within the refuges. No substantial changes to the current Protection Island NWR signs and protocol are anticipated, however, a number of changes are proposed with this CCP for the San Juan Islands NWR signs.

Protection Island National Wildlife Refuge

Jefferson County, Washington

USFWS - Robinson

Sign Inventory and Maintenance Plan

U.S. Fish and Wildlife Service

August 2010

Protection Island National Wildlife Refuge was established in 1988 through the efforts of local citizens "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 hauling-out area of harbor seals; and to provide for scientific research and wildlife-oriented public education and interpretation" (1). The fact that Protection Island NWR and the attached Zella M. Schulz Seabird Sanctuary are closed to the public is somewhat at odds with the wildlife-oriented interpretation portion of the establishing purpose. Although it is easy to view wildlife on the Island and in the surrounding waters from outside the 200 yard disturbance buffer, particularly with the aid of binoculars and telescopes, there is currently no formal interpretation program offered by the refuge except for an outdated interpretive panel at John Wayne Marina in Sequim, WA.

Included in the refuge's Comprehensive Conservation Plan is an objective to increase area visitors' knowledge of the refuge and its wildlife by updating/replacing the interpretive panel at John Wayne Marina and installing another panel at a location frequented by recreational boaters (to be determined) in Port Townsend.

The Island lies approximately 2.5 miles north of Diamond Point, a small affluent Jefferson County community, and is due north of the mouth of Discovery Bay. The area is popular for sightseeing cruises, recreational boating, and commercial fishing and crabbing. The area is also known for its wildlife abundance and is a frequent destination for kayakers who present a significant disturbance and trespassing issue due to the shallow draft of their boats and ability to access areas where wildlife is typically unmolested, including sensitive nesting sites.

USFWS – Davis

Protection Island NWR is especially important to seabirds. About 70% of Puget Sound's breeding seabird population nests on the Island. Located near the mouth of Discovery Bay on the southeast side of the Strait of Juan de Fuca, the 316-acre refuge consists of grassland, shrubland, a small upland forest, and a relatively undisturbed shoreline with two sandy spits and extensive glacial-till sandy bluffs that support one of North America's largest colonies of rhinoceros auklets. In fact, it is typical to see thousands of rhinoceros auklets returning to their burrows to feed their young as the sun sets each evening. Furthermore, Protection Island is considered the "last stand" for breeding tufted puffins in Salish Sea. In addition to seabirds, harbor and elephant seals haul out to rest and have their pups on the Island's sand spits which extend to the east and west.

Protection Island NWR also includes an additional 340-acre aquatic lands lease from the Washington Department of Natural Resources which is due to expire on December 31, 2013. The tideland lease is overlayed on a WDNR reservation and effectively withdraws " . . . the bedlands of navigable water owned by the state of Washington, surrounding Protection Island extending waterward 600 feet from the line of extreme low water . . . from conflicting uses for an indefinite term . . . ." (2) This withdrawal order further states that public access may be permitted under conditions mutually agreed upon by the WDNR and U.S. Department of the Interior.

Zella M. Schultz Seabird Sanctuary: Protection Island NWR encompasses the entirety of the Island except for a 48-acre section on the west end of the island on Kanem Point, known as the Zella M. Schultz Seabird Sanctuary, which was protected prior to refuge establishment, first through purchase by The Nature Conservancy in 1972, then by the Washington Department of Game (now the Washington State Department of Fish and Wildlife) acquisition in 1974. The seabird sanctuary encompasses approximately half of the Island's rhinoceros auklet and tufted puffin colonies. The Service (USFWS) and WDFW have a Memorandum of Understanding with the primary objective being the protection and enhancement of the wildlife resources on Protection Island. The goal of each agency is compatible and complimentary management (3).

This sign plan is not intended to alter or supersede any sign procedures or policies established by WDFW or the State of Washington. Rather it is intended as guidance to USFWS personnel in regards to regulatory and interpretive signage within the National Wildlife Refuge portion of Protection Island. Any reference to signs within the Zella M. Schultz Seabird Sanctuary in this document is purely for the purpose of establishing a comprehensive sign inventory and maintenance plan for all of Protection Island. Currently there is only one non-FWSsign on the island which is located in the Sanctuary. It is an informational sign with the sanctuary name.

<u>Use and Visitation</u>

While the Protection Island NWR establishing purpose includes wildlife-oriented public education and interpretation, the refuge is not open to the public except for researchers operating under special use permits. However, a number of people with interest in tracts of land on Protection Island prior to the establishment of the refuge were granted extended use privileges, including island access, under a variety of terms. While most of these terms have already expired, and many of the rest will expire in 2011, there is one lifetime user who maintains a primary residence on the island. All other current extended users have unimproved lots that receive only occasional use.

In addition, Walla Walla College, whose extended use term expired years ago, continues to use a USFWS-maintained cabin under a special use permit, as does Andrews University. Their activities also serve to satisfy the wildlife-oriented education component of the refuge's founding purpose. The Service also maintains a year round caretaker's residence. That small cabin is usually occupied by one or two caretakers responsible for overseeing island maintenance, interacting with researchers, and contacting trespassers to provide information about island regulations and wildlife disturbance issues.

<u>Hazards</u>

Protection Island lies within the Straights of Juan De Fuca, an area known for high winds, strong currents, and rough marine conditions. Although it is closed to the public, on occasion vessels in distress seek shelter within the Island's small protected harbor. In addition, there are a number of hazardous shoreline areas with submerged rocks and shoals. The island is flanked by two low-lying, partially submerged sand and rock spits, Kanem to the west and Violet to the east. The majority of the island is a large open plateau surrounded by steep unstable bluffs. These bluffs represent a particularly severe hazard for staff, visiting researchers, in-holders, guests, and occasional trespassers.

Regulatory and Entrance Signs

<u>Sign Specification and Mounting Criteria (Regulatory)</u>

Signs will meet the specifications set forth in the Service's Sign Manual (4). Large format signs posted on the island will have wooden posts and supports and will be constructed of high quality, medium density overlay (MDO), ¾ inch plywood except as otherwise indicated. Sign background color will be reflective white and lettering will be black, or, in the case of standard Service signs (small format), dark blue. Text font will be Helvetica Medium. All signs will have the USFWS reflective shield measuring a minimum of 10" wide by 12" tall except as otherwise indicated.

<u>Large Format Signs</u>

Protection Island shoreline areas will utilize large format signs which can be read unaided from the water at least 200 yards offshore. These signs may also include the national Wildlife Refuge System's Blue Goose logo. Large format signs are at least 6' wide and 4 – 5' high. These signs should be well supported using at least two 4" x 4" posts to protect against high winds common in the area. Examples of signs currently in use:

New version   Old version (still in use)

<u>Small Format, Standard Service "closed area" signs</u>
Standard USFWS closed area signs may be utilized on a limited case-by-case basis as determined by the Refuge Manager to warn island visitors and residents to avoid specific areas. Such signs will be used sparingly to warn of particularly sensitive habitats or hazards. These signs will be posted on standard galvanized steel or wood posts buried at least 2' deep.

Note: Since the entire island is closed to the public, there is no need to post standard boundary and closed area signs. Furthermore, it would be difficult to maintain such signs in the dynamic shoreline and unstable cliff environment, installing signs would likely have a negative impact on nesting sites, and these small signs would be unreadable from outside of the 200 yard disturbance buffer. Also, the unsigned areas to the north and west side of the island are bounded by hazardous and rocky waters which tend to serve as an approach barrier.

11" X 14"

<u>Special Purpose (Regulatory)</u>
Description: Harbor Entrance, Marina Closed Sign
Material: Heavy polymetal

- Reflective white with blue lettering and red reflective stop sign symbol
- Text: MARINA CLOSED To Public Entry
  To Protect Wildlife Stay 200 Yards From Shore
  U.S. Fish and Wildlife Service
- Dimensions: 42.5" X 25.5"
- Location: Harbor entrance approach
- No USFWS reflective shield

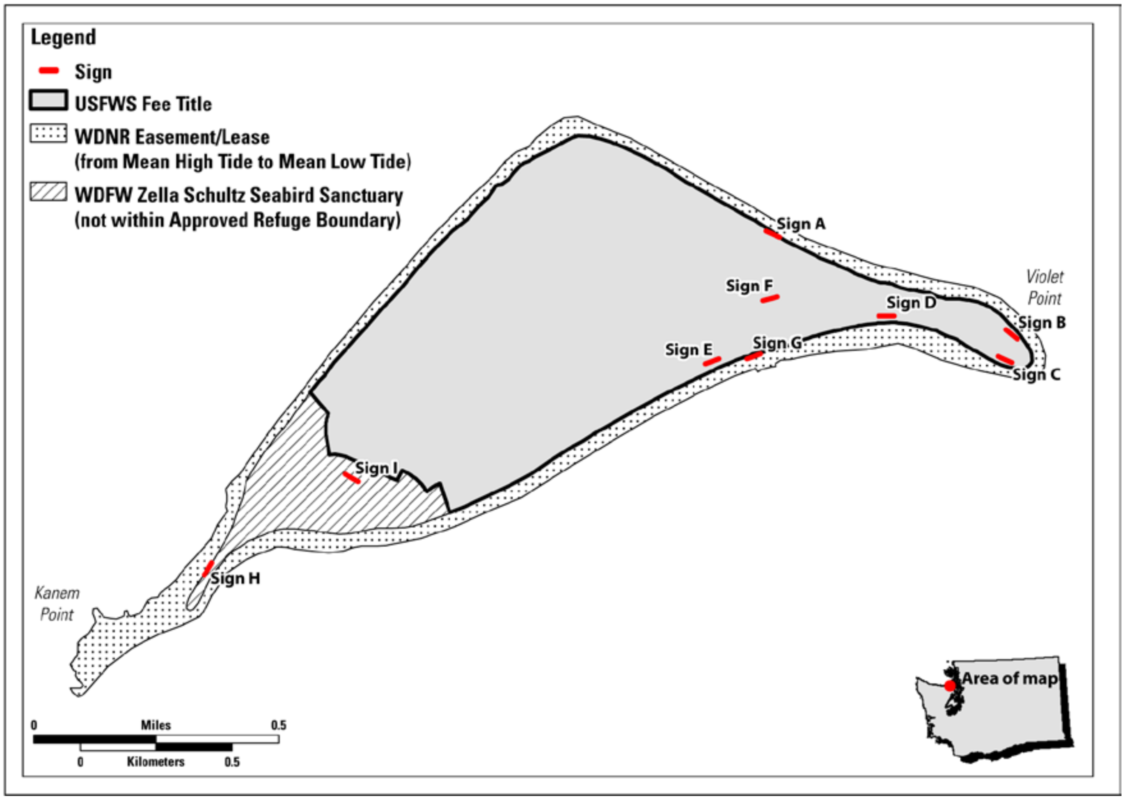
Sign Specification and Placement Criteria (Information)
There is currently only one information sign on Protection Island, the refuge entrance sign located due west of the harbor (Sign F).

Sign F.

USFWS - Davis

Description: Brown painted background with light blue and green lettering
Material : ¾" MDO plywood
- Picture of puffin
- Text: Protection Island National Wildlife Refuge
  Established August 26, 1988
  U.S. Fish and Wildlife Service
  Department of the Interior
- Dimensions: 6' X 5'
- Location: Approximately 50 yards south west of dock, visible on harbor approach

A. Sign Inventory (entrance and large format regulatory)
Large Format: 6 (signs A – E, H)
Marina Closed: 1 (sign G)
Refuge Entrance: 1 (sign F)
Zella M. Schultz Seabird Sanctuary (WDFW): 1 (sign I)



Legend
Sign
USFWS Fee Title
WDNR Easement/Lease
(from Mean High Tide to Mean Low Tide)
WDFW Zella Schultz Seabird Sanctuary
(not within Approved Refuge Boundary)
Sign A
Sign F
Sign D
Violet Point
Sign B
Sign C
Sign E
Sign G
Sign I
Sign H
Kanem Point
Area of map
0
Miles
0.5
0
Kilometers
0.5

NATIONAL
WILDLIFE
REFUGE
STAY 200 YDS. AWAY

A.

NATIONAL
WILDLIFE
REFUGE
STAY 200 YDS. AWAY

C.

NATIONAL
WILDLIFE
REFUGE
STAY 200 YDS. AWAY

B.

NATIONAL
WILDLIFE
REFUGE
STAY 200 YDS. AWAY

D.

E.

H.

G. (replaced 4/2009)

I.

Sign Inventory Table ("entrance" and large format regulator)

Sign designations: A – I

200 Yard: 7 (signs A – E and H)
Entrance: 2, 1 FWS (sign F) and 1 WDFW (sign I)
Harbor Closed: 1 (sign G)

Sign ID / type	Location	Condition	Recommendation	Last Inspection
A, regulatory	North central	Good, decal replaced 8/09	None	3/15/10
B, regulatory	Violet Spit North	Sign damaged	Replace sign	3/15/10
C, regulatory	Violet Spit SE	Good, decal replaced 8/09	None	3/1510
D, regulatory	Violet Spit SW	Good, decal/posts replaced 8/09	None	3/15/10
E, regulatory	South central	Good, decal faded	Replace decal	3/15/10
F, information	Marina	Good	None	3/15/10
G, regulatory	Marina entrance	Very Good, new 4/2009	None	3/15/10
H, regulatory	Kanem Spit	Good, decal replaced 8/09	None	3/15/10
I, information (WDFW sign)	Kanem Spit bluff base	Lettering repainted 2/2010	None (WDFW sign)	3/15/10

B. Sign Inventory (small format regulatory and miscellaneous)

Signs ID Numbers: PI 1 - 15

Area Closed: 12 (signs PI 1 -2, 4 – 13)
Government Property: 1 (sign PI – 3)

Miscellaneous: 1 (Coast and Geodetic Survey Witness Post, sign PI - 15)

Small Format Sign Inventory Table

Sign number	Photo	Description (Text)	Location, direction	Condition	Last Inspection	Recommendation
PI 1		Area Beyond This Sign Closed All Public Entry Prohibited	150 feet southeast of caretaker cabin facing southeast	Good	3/21/10	None
PI 2		Area Beyond This Sign Closed All Public Entry Prohibited	200 ft southwest of caretaker cabin facing west	Worn, faded	3/21/10	Replace

PI 3		Notice Government Property Molesting, Damaging, or Stealing Government Property Is Punishable By Fine And/Or Imprisonment No Trespassing	South side of caretaker shed, faces east	Good	3/21/10	None
PI 4		Area Beyond This Sign Closed All Public Entry Prohibited	Faces southeast	Worn, Faded	3/21/10	Replace
PI 5		Area Beyond This Sign Closed All Public Entry Prohibited	Faces southwest	Good	3/21/10	None
PI 6		Area Beyond This Sign Closed All Public Entry Prohibited	Faces northeast	Faded	3/21/10	None
PI 7		Area Beyond This Sign Closed All Public Entry Prohibited	Northwest side of abandoned cabin in small wooded area	Faded	3/21/10	Clean
PI 8		Area Beyond This Sign Closed All Public Entry Prohibited	In field 150 feet southwest of Odegard cabin	Worn, Faded, Damaged	3/21/10	Replace
PI 9		Area Beyond This Sign Closed All Public Entry Prohibited	Faces southwest	Worn, Faded, Post rotten	3/21/10	Replace sign and post

PI 10		Area Beyond This Sign Closed All Public Entry Prohibited	Southeast side of water tower	Good	3/21/10	None
PI 11		Area Beyond This Sign Closed All Public Entry Prohibited	100 feet from the end of road on Violet bluff, faces north	Good	3/21/10	None
PI 12		Area Beyond This Sign Closed All Public Entry Prohibited	100 feet northwest of Walla Walla cabin, faces northwest	Good	3/21/10	None
PI 13		Area Beyond This Sign Closed All Public Entry Prohibited	At base of Violet bluff on old bluff road, faces northeast.	Faded	3/21/10	None
PI 14	See sign F	Refuge Entrance Sign	West of marina	Good	3/21/10	None
PI 15		Witness Post Please Do Not Disturb Nearby Survey Marker For Information Write To The Director Coast And Geodetic Survey Department Of Commerce Washington D.C. 20230 **(NOT FWS)**	East of water tower	Bent	3/21/10	None

Interpretive Signs

There are currently no interpretive signs on Protection Island National Wildlife Refuge and only one off-refuge interpretive sign, a panel located at John Wayne Marina. However, the Comprehensive Conservation Plan calls for establishing an off-refuge interpretive sign program.

<u>Off-Refuge Interpretive Signs (proposed)</u>

* Locations being considered for interpretive panels:
- John Wayne Marina (replace existing)
- Port Townsend Marina
- Miller Peninsula State Park (a future park plan)

* Specific locations to be determined

<u>Future Interpretive Sign Specification and Placement Criteria (Interpretive)</u>
Material: TBD
Description: Protection Island Interpretive Panel
Text: TBD
Dimensions: TBD

Signs Inspection and Maintenance

Island caretakers will be responsible for routine inspections and maintenance of all signs. Under normal conditions all island signs will be visually inspected on a monthly basis and physically inspected on an annual basis. In addition, caretakers and staff will assess for sign damage as soon after high wind events as possible to insure signs have not been lost or damaged. Any sign damage will be reported immediately to the Refuge Manager or Deputy Manager. Materials necessary to repair signs will be kept on the island in the maintenance building. These materials will include replacement USFWS shields, posts, cribbing, tools, and bolts. Due to their size and expense, most replacement signs will be stored at the Refuge Complex Headquarters at 715 Holgerson Rd. in Sequim, Washington, or made to order as needed. A review of this sign plan will occur every 5 years unless conditions necessitate an earlier review.

<u>References</u>
1. Protection Island NWR establishing authority: Protection Island National Wildlife Refuge Act, Public Law 977-333, Oct 15, 1982, 96 Stat. 1623

2. Washington Department of Natural Resources, Withdrawal Order 88 017, 1988

3. Memorandum of Understanding regarding Protection Island between WDFW and USFWS, 1995

4. U.S. Fish and Wildlife Service Sign Manual, Director's Memorandum signed by Acting Assistant Regional Director Carolyn Bohan, May 15, 1992, updated 1998

San Juan Islands National Wildlife Refuge

Island, San Juan, Skagit, and Whatcom Counties, Washington

USFWS

Sign Inventory and Maintenance Plan

U.S. Fish and Wildlife Service

August 2010

San Juan Islands National Wildlife Refuge is comprised of 83 rocks, reefs and islands located in the San Juan Archipelago, which lies approximately 85 miles northwest of Seattle, Washington. The archipelago includes 172 islands in an area encompassing about 175 square miles and borders the U.S./Canadian international boundary. The refuge is managed by the U.S. Fish and Wildlife Service as part of the National Wildlife Refuge System.

Most (81 islands) of the San Juan Islands NWR are also designated wilderness and are known as the San Juan Islands Wilderness Area. The only refuge units (islands) that are not designated wilderness are Smith and Minor Islands, Turn Island, and a 2-acre portion of the 135 acre Matia Island.

Note: Many Refuge signs are in poor condition and should be repaired or replaced. There is a pressing need to complete a thorough inspection of all refuge signs and begin a systematic replacement/repair regime. However, such an effort is complicated by the remote nature of the refuge, rugged island terrain, dangerous currents, and short boating season. Maintaining signs on islands is inherently more difficult and more expensive than maintaining signs on the mainland. This is further complicated by wildlife disturbance considerations. The following is intended to be a starting point for the further development of a comprehensive sign inventory and maintenance plan.

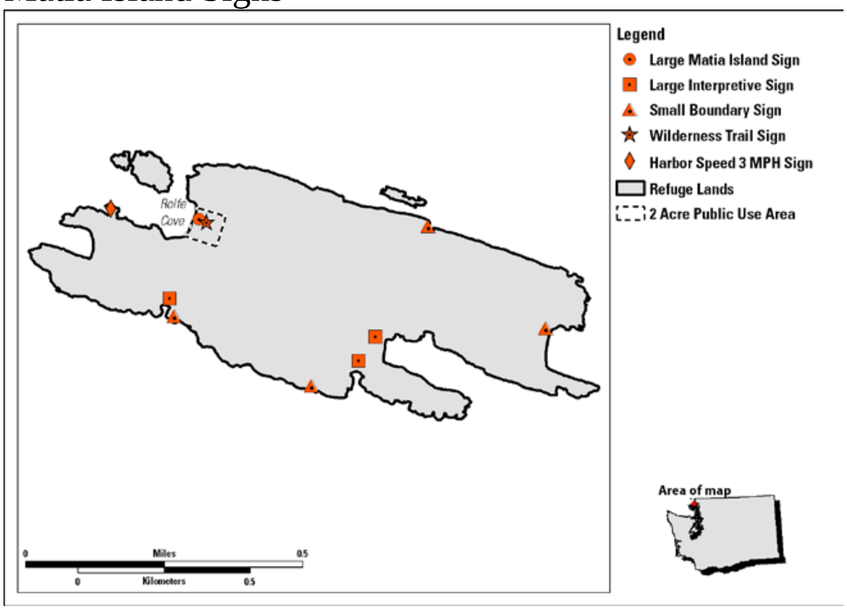
<u>Use and Visitation</u>
The area is popular for sightseeing cruises including wildlife viewing, recreational boating and kayaking, diving, and commercial fishing and crabbing. However, only two Refuge islands are open to the public, Matia and Turn. The whole of Turn Island and the 2-acre recreation area on Matia are open year round. Additionally there is a public trail through the otherwise closed wilderness area on Matia Island. Both islands allow overnight camping in designated sites which are maintained by the Washington State Parks and Recreation Commission (WSPRC). The primary recreational activities on both islands are hiking, wildlife viewing and photography, and camping.

Matia Island is remotely located in the far northeast corner of the archipelago and receives approximately 10,500 visitors annually, while Turn Island is located just outside of busy Friday Harbor, the county seat, and receives approximately 13,500 visitors each year. Although WSPRC maintains most of the infrastructure on these islands, including some signs, an information kiosk on Matia, and camping and restroom facilities, the Service maintains all Service signs.

Public Use Areas

The following maps show sign locations for Matia and Turn Islands. The round symbol shows the location of the Island's "entrance sign" while square symbols represent informational signs. Triangular symbols represent standard service boundary signs and the star symbol on Matia Island represents the location of the wilderness trailhead sign. In addition, both islands have signs posted and maintained by the WSPRC which are not covered under this plan.

Matia Island Signs

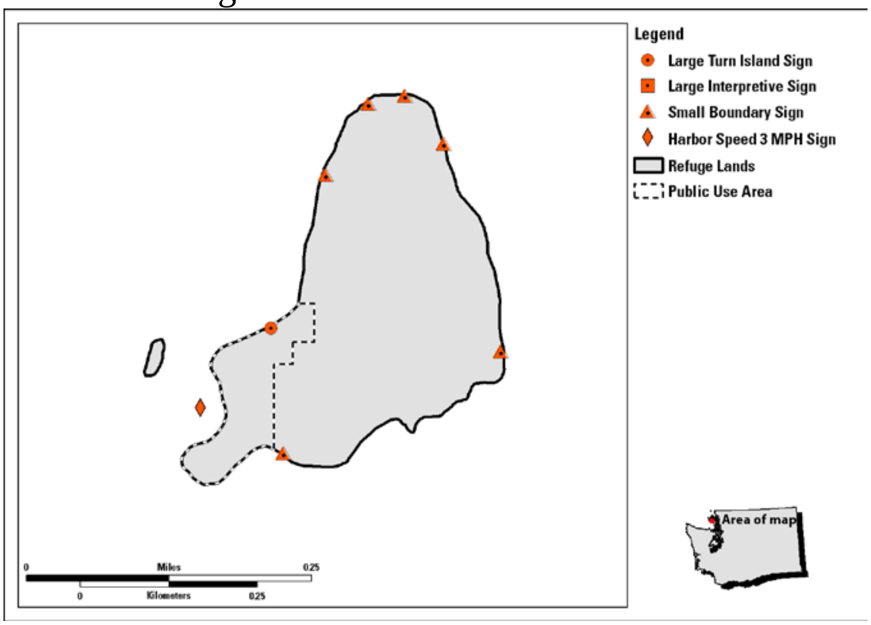


Matia Island "Entrance" sign

Matia Island NW Cove

Matia Is. Wilderness Trailhead (FWS) Matia Island kiosk (WSPRC)

Turn Island Signs



Turn Island "Entrance" sign "Entrance" sign and information kiosk

Regulatory Signs

Sign Specification and Placement Criteria (Regulatory)
Signs will meet the specifications set forth in the USFWS Sign Manual. (1) Signs posted within the refuge will have galvanized or epoxy coated steel or wooden posts and supports and will be constructed of coated steel or high quality, medium density overlay (MDO) ¾ inch plywood, except as otherwise indicated. Sign background color will be white or brown and lettering will be white or black, or, in the case of standard USFWS signs, dark blue. Text font will be Helvetica Medium. All large plywood signs will have the UFWS reflective shield measuring a minimum of 10” wide by 12” tall except as otherwise indicated.

Certain sensitive habitat locations such as seabird nesting sites will utilize **large format** signs which can be read unaided from the water at least 200 yards offshore. These signs may also include the National Wildlife Refuge System’s Blue Goose Logo. Large format signs are approximately 6’ wide and 4 – 5’ high. These signs should be well supported to protect against high winds common in the area. There are currently 16 islands with large format signs. Due to the expense of installing and maintaining large format signs and their visually obtrusive nature, the number of islands with such signs will be reduced to 10 or less in the next 5 years. Each island will be evaluated based on the following criteria; habitat/wildlife sensitivity, marine traffic, and trespassing issues to determine sign needs.

Wilderness Areas
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. The act states no signs will be placed in wilderness areas except those which are determined to be absolutely necessary for effective administration. Where the Refuge Manager determines signs are necessary in wilderness, such as in wildlife areas particularly sensitive to human disturbance, the minimal tool concept will be utilized.

The concept relies on a minimum requirement analysis, which means that when planning necessary actions such as installing signage, management will use the minimum methods needed to accomplish the objective. Staff will develop alternatives and methods that result in minimum impacts and will utilize tools that allow the installation to be accomplished safely with a minimal amount of impairment to the wilderness character.

Standard USFWS signs modified for island use paired with refuge boundary signs
Standard USFWS "closed area" signs will be utilized on a limited case-by-case basis as determined by the Refuge Manager to warn visitors to avoid closed and/or hazardous areas. On closed islands, these signs will be replaced with special order signs that read: "Island Closed, No Entry." Such signs will otherwise be the same as the current standard closed area signs and will be used sparingly in wilderness areas to warn of particularly sensitive habitats such as seabird nesting locations. Where practicable these signs will be posted on standard galvanized steel or wood posts buried at least 2' deep. However, island terrain may dictate a different attachment system such as hanging signs with steel chains. When utilizing such systems, installers should insure that the signs cannot turn over or wear against the mounting surface. If "closed area" or "closed island" signs are posted at or near boundaries, these signs will be paired with standard refuge boundary signs. These signs measure 11" x 14".

In areas determined to be "wildlife sensitive," such as seabird nesting sites, it is important to maintain a larger disturbance buffer. At such locations the Refuge Manager may elect to install larger signs that can be read from a greater distance. These signs will measure approximately 15" x 20" or 22" x 28". The specific sign size utilized will be determined on a case-by-case basis. See the Wilderness Area section above for more information on installing signs on wilderness islands while employing the minimal tool concept. In general it is anticipated that the 15" x 20" version will be of adequate size to warn vessels at 200 yards. However, because it is not always practicable to mount signs on the shoreline, it may be necessary to use the larger 22" x 28" versions where signs are installed on the tops or interiors of islands.

Sign Specification and Placement Criteria (Regulatory)
Description: Closed area, Island Closed, Refuge Boundary
Material: Coated metal
Text:
- Closed Area (Standard): Area Beyond This Sign Closed, All Public Entry Prohibited
- Island Closed (Modified): Island Closed, No Entry, All Public Entry Prohibited
- Refuge Boundary (Standard): National Wildlife Refuge, Unauthorized Entry Prohibited, U.S. Department of the Interior, Fish and Wildlife Service

Color: Blue text on white background
Dimensions: 11" X 14"
Placement criteria for "closed area" and "island closed" signs: used in closed areas and/or hazardous locations closed by refuge management adjacent to public access areas.
Note: In general, when posted on a refuge boundary these signs will be mounted directly below a standard "NWR Boundary" sign.
Placement criteria for boundary signs: used at refuge boundaries in non-wilderness areas.

Spacing: Generally not more than ¼ mile distance between signs on a continuous boundary. However, terrain may dictate the need for additional signs. On small islands it may be sufficient to install a single post with signs facing in opposite directions.

Special Purpose (Regulatory)
Description: Large format
Material: High quality ¾" MDO plywood
Text:
- Current: National Wildlife Refuge, To Protect Wildlife Stay Away 200 Yards
- Replacement: National Wildlife Refuge, Island Closed, Keep Off 200 Yards to Protect Wildlife

Color: White or brown background, blue and black text
Dimensions: 6' X 4 – 5'
Location: Wildlife disturbance sensitive areas

Interpretive Signs

There are currently no truly interpretive signs in the San Juan Islands National Wildlife Refuge, although some signs do provide general information. However, the Comprehensive Conservation Plan calls for establishing an interpretive sign program.

Future on-refuge interpretive signs (proposed)

- Matia Island, 1 refuge-wide panel, up to 3 island specific signs
  Locations being considered: Rolfe cove, both ends of the wilderness trail
- Turn Island, up to 3 refuge-wide panels, up to 5 island specific signs
  Locations being considered: West beach adjacent to mooring area, both ends of the outer loop trail, and various locations along the loop trail and camping area

Future off-refuge interpretive signs

Locations being considered for interpretive panels:

San Juan Islands locations
Friday Harbor, Roche Harbor, Lopez Island (2), Orcas Island, and Shaw Island

Mainland locations
Bellingham and Anacortes

General Information Signs

Sign Specification and Placement Criteria
Material: Wood, ¾” MDO plywood
Description: Matia and Turn Island identifying signs

Text:

- Matia Island
- Turn Island
- Matia Island Wilderness Trail, This one mile loop takes you through the old growth forest of the Matia Island wilderness, Please Stay On The Trail, No Pets Allowed

Sign Inventory

#15 Hall Island

#15 Hall Island

#68 Bird (Rock) Island

#78 Puffin Island

#81 Williamson Island (Rocks)

San Juan IslandsNWR Sign Inventory 2007 (the most recent comprehensive survey)

#	Island Name	Signs and Condition	Recommendations
1	Small Island	3 signs on 1 post -- blue goose, wilderness (faces North). Signs face North and South. All Faded.	Replace all signs

#	Island Name	Signs and Condition	Recommendations
2A	Rum & Rim Islands	No signs on North island.	None
2B	Rum & Rim Islands	No signs on South island.	None
3	Fortress Island	Signs on East side - 3 on chain; South side- 3 on chain (boundary, blue goose, closure). All signs faded.	Replace all signs
4	Skull Island	1 boundary, 1 wilderness sign -- both on same post, both down. Post on East side.	Replace and repair all signs except wilderness
5	Crab Island	No sign.	None
6	Boulder Island	North side - blue goose, wilderness signs on chain. Faded.	Replace all signs
7	Davidson Rock	Under water, no signs.	None
8	Castle Island	Area closed, wilderness signs on West side. Faded wilderness, OK condition for closure sign. Area closed sign on North side behind grass, falling down on post. East side has 3 signs on chain - faded blue goose, closure, boundary.	Replace and repair all signs
9	Blind Island	3 signs on chain on South side, turned over. Unable to read.	Replace all signs
10	Aleck Rocks	No signs.	None
11	Swirl Island	3 signs on chain on North side, 2 flipped and 3rd is faded; sign frame on top is down	Replace and repair all signs
12	Unnamed Rock	No signs.	None
13	Unnamed	North island has "Private Property" sign. Possible former sign on South side is fallen or in grass? SURVEY required on North island because island is signed "PRIVATE" and connected to mainland.	Replace and repair all signs Survey island
14	Unnamed	No signs.	None
15	Hall Island	Large sign on North is on side, fallen flat.	Replace and repair all signs
16	Unnamed	No signs.	None
17	Secar Rock	No signs.	None
18	Unnamed	No signs.	None
19	Unnamed	No signs.	None
20	Unnamed	No signs.	None
21	Mummy Rocks	No signs.	None
22	Unnamed	No signs.	None
23	Shark Reef	No signs.	None
24	Harbor Rock	No signs.	None
25	North Pacific Rock	No signs.	None

#	Island Name	Signs and Condition	Recommendations
26	Halftide Rocks	No signs.	None
27	Unnamed	No signs.	None
28	Low Island	2 large format come together in triangle (back to back). 2 small signs facing East and West on 1 post chained to ground. Blue goose on top, wilderness on bottom (faded out completely).	Replace all signs except wilderness
29	Pole Island	Large "Slow - No wake" signs on both sides.	None
30	Barren Island	Large format sign chained down faces South, needs new decal. 2 signs on post - faded, face East.	Replace all signs or decals
31	Battleship Island	2 Large format signs chained down to ground. Need new decals and are faded. 2 signs on chain on West including blue goose. 2 additional signs - 1 turned. 2 signs faded out.	Replace all signs or decals
32	Sentinel Rock	No signs.	None
33	Center Reef	No signs. No day beacon.	None
34	Gull Reef	No signs.	None
35	Ripple Island	1) Large format sign. Needs new decal. 3 signs in overgrown area on post. Blue goose, closure, boundary. Sign on West side by beach.	Replace all signs or decals
36	Unnamed (Shag Reef)	No signs.	None
37	Unnamed (Little Cactus Island)	Metal sign on post lying flat on ground. Used to be on high point.	Replace and repair all signs
38	Gull Rock	Small sign at East side beach. Blue goose and closure. Large format sign. 3 signs on chain on South finger - Blue goose, wilderness, closure.	Replace all signs or decals except wilderness
39	Flattop Island	3 signs on chain, faded; boundary at bottom, then closed area and blue goose. 2 Large format signs, 1 facing NE and 1 facing W – both need replacing.	Replace all signs or decals
40	White Rock	No signs.	None
41	Mouatt Reef	No signs. Underwater.	None
42	Skipjack Island	Light on NW end. 2 Large format older signs, 1 facing SW, 1 facing E. Both need new decals. 3 small signs on chain. All faded.	Replace all signs or decals
43	Unnamed	No signs.	None
44	Clements Reef	No signs. Buoy to W of reef.	None
45	Unnamed	No signs. Danger daymark to E.	None
46	Parker Reef	No signs. Light & daymark on reef.	None

#	Island Name	Signs and Condition	Recommendations
47	Lone Tree Island (The Sisters)	Large format sign facing NW. Newer sign, needs new decal. 3 signs on chain. All turned around. Light.	Replace all signs or decals
48	Little Sister (The Sisters)	Sign on chain facing W. Turned. 2 Signs on chain facing N, turned around.	Replace all signs
49	Unnamed	No signs. Navigation aid. Wasp Passage Light. Made of wood.	None
50	Tift Rocks	3 signs on post. The only readable sign Is Area Closed. Top and bottom signs faded.	Replace all signs
51	Reef Point	No signs.	None
52	Turn Rock	No signs. USCG channel marker #3 Light/daymark	None
53	Shag Rock	No signs. Daymark/daybeacon	None
54	Flower Island	3 signs on chain west side, bottom is boundary, middle is closed area, top is blue goose boundary. All faded.	Replace all signs
55	Willow Island	W - 3 signs on chain, faded, turned. E- sign on post on ground. Can't see text.	Replace and repair all signs
56	Lawson Rock	No signs. Underwater. Navigation Aid.	None
57	Pointer Island	No signs.	None
58	Black Rock	No signs. Navigation aid.	None
59	Spindle Rock	No signs. Daybeacon.	None
60	Brown Rock	2 signs. Both faded. Blue goose & Wilderness.	Replace all signs
61	Unnamed	No signs.	None
62	South Peapod (Peapod Rocks)	Old large format.	Replace decal
63	Unnamed (Peapod Rocks)	No signs.	None
64	North Peapod (Peapod Rocks)	Old style large format sign. Faded. 3 signs on chain, blue goose, wilderness, closed area. All in OK condition.	Replace all signs and decals
65	Eliza Rock	No signs. Junction light/daymark.	None
66	Viti Rocks	Large format sign. Needs new decals. Small sign turned on channel.	Replace all signs and decals
68	Bird Rock	No sign. Bird Rock Light and Danger Rock daymark.	None
69	Unnamed	No signs.	None
70	Low Island	Area closed sign on N. Fallen down. 2 signs on 1 post facing N, blue goose and wilderness. Good condition.	Replace and repair bad signs except wilderness
71	Nob Island	Sign on small island on post on ground. On big island - 2 signs on chain, blue goose on top, Area closed	Replace all signs

#	Island Name	Signs and Condition	Recommendations
		on bottom. Area closed sign turned around.	
72	Unnamed	No signs.	None
73	Unnamed	Blue goose and wilderness signs faded and facing W and falling down to NE. Signs located on W tip of island.	Replace and repair all signs except wilderness
74	Unnamed	No signs.	None
75	Smith Island		Inventory
76	Minor Island		Inventory
77	Matia Island	3 Interpretive signs (Matia Island, rules, WSPRC). 4 Small faded signs - can't read.	Remove faded signs
78	Puffin Island	3 faded small signs on chain. 2) Old large format sign faces S. Needs new decal. facing S. Light/daymark.	Replace all signs and decals
79	Turn Island	6 small faded signs. Large Turn Island interpretive sign, Dogs on leash sign, Take it in/Take it out signs in good condition. Harbor speed sign. Small sign facing E faded.	Replace all bad signs
80	Bird Rocks	Large format brown sign facing E located on 2nd rock from S. Small signs on S rock.	Replace all signs and decals
81	Williamson Rocks	Large format sign. 2 small signs on 1 post.	Replace all signs and decals
82	Colville Island	2 small signs, blue goose and closed area on post on E rock, placed at 90 degree angles. Small unreadable sign over closed area sign on SE side of W rock. Both on 1 post. Small blue goose sign over closed area sign on SW side of W rock. Both on 1 post. Large format sign on E side of W rock. Good condition. Turned from original angle to SE (was facing NE).	Replace and repair all signs
83	Buck Island	No signs.	None
84	Bare Island	Old large format sign on SW. Needs new decal. 3 signs on chain. All turned.	Replace all signs and decals

<u>Sign Inspection and Maintenance</u>

All signs will be visually inspected on an annual basis using. In addition, volunteers and staff will assess for sign damage as soon after high wind events as possible to insure signs have not been lost or damaged. Any sign damage will be reported immediately to the Refuge Manager or Deputy Manager. Materials necessary to repair signs will be stored at the Refuge Complex Headquarters at 715 Holgerson Rd. in Sequim, Washington, or made to order as needed. These materials will include replacement USFWS shields, posts, cribbing, tools, and bolts. Due to their size and expense, most large format replacement signs will be manufactured as needed. A review of this sign plan will occur every 5 years unless conditions necessitate an earlier review.

References

1. U.S. Fish and Wildlife Service Sign Manual, Director's Memorandum signed by Acting Assistant Regional Director Carolyn Bohan, May 15, 1992, updated 1998

Appendix E. Integrated Pest Management Program

E.1 Background

Integrated Pest Management (IPM) is an interdisciplinary approach utilizing methods to prevent, eliminate, contain, and/or control pest species in concert with other management activities on refuge lands and waters to achieve wildlife and habitat management goals and objectives. It is also a scientifically-based, adaptive management process where available scientific information and best professional judgment of the refuge staff as well as other resource experts would be used to identify appropriate management strategies that can be modified and/or changed over time for effective, site-specific management of pest species. After a pest population threshold is determined, considering the achievement of resource objectives and the ecology of pest species, one or more methods or combinations thereof would be selected that are feasible, efficacious, and protective of non-target resources, including native species (fish, wildlife, and plants) and Service personnel, Service authorized agents, volunteers, and the public. Staff time and available funding would be considered when determining the feasibility/practicality of various treatments.

The IPM techniques to address pests are presented as CCP strategies (see Chapter 2 of this Draft CCP/EA) in an adaptive management context to achieve refuge resource objectives. In order to satisfy requirements for IPM planning as identified in the Director's Memo (dated September 9,2004) entitled *Integrated Pest Management Plans and Pesticide Use Proposals: Updates, Guidance, and an Online Database*, the following elements of an IPM program have been incorporated into this Draft CCP/EA.

- Habitat and/or wildlife objectives that identify pest species and appropriate thresholds to indicate the need for and successful implementation of IPM techniques; and
- Monitoring before and/or after treatment to assess progress toward achieving objectives including pest thresholds.

Where pesticides would be necessary to address pests, this Appendix provides a structured procedure to evaluate potential effects of proposed uses involving ground-based applications to refuge biological resources and environmental quality in accordance with effects analyses presented in Chapter 6 (Environmental Effects) of this Draft CCP/EA. Only pesticide uses that likely would cause minor, temporary, or localized effects to refuge biological resources and environmental quality with appropriate best management practices (BMPs), where necessary, would be allowed for use on the refuge.

This Appendix does not describe the more detailed process to evaluate potential effects associated with aerial applications of pesticides. Moreover, it does not address effects of mosquito control with pesticides (larvicides, pupacides, or adulticides) based upon identified human health threats and the presence of disease-carrying mosquitoes in sufficient numbers from monitoring conducted on a refuge. However, the basic framework to assess potential effects to refuge biological resources and environmental quality from aerial application of pesticides or use of insecticides for mosquito management would be similar to the process described in this Appendix for ground-based treatments of other pesticides.

E.2 Pest Management Policies

In accordance with Service policy 7 RM 14 (Pest Control), wildlife and plant pests on units of the National Wildlife Refuge System can be controlled to assure balanced wildlife and fish populations in support of refuge-specific wildlife and habitat management objectives. Pest control on Federal (refuge) lands and waters also is authorized under the following legal mandates:

- National Wildlife Refuge System Administration Act of 1966, as amended (16 USC 668dd-668ee);
- Plant Protection Act of 2000 (7 USC 7701 *et seq*.);
- Noxious Weed Control and Eradication Act of 2004 (7 USC 7781-7786, Subtitle E);
- Federal Insecticide, Fungicide, and Rodenticide Act of 1996 (7 USC 136-136y);
- National Invasive Species Act of 1996 (16 USC 4701);
- Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (16 USC 4701);
- Food Quality Protection Act of 1996 (7 USC 136);
- Executive Order 13148, Section 601(a);
- Executive Order 13112; and
- Animal Damage Control Act of 1931 (7 USC 426-426c, 46 Stat. 1468).

Pests are defined as "…living organisms that may interfere with the site-specific purposes, operations, or management objectives or that jeopardize human health or safety" from Department policy 517 DM 1 (Integrated Pest Management Policy). Similarly, this policy defines an invasive species as "a species that is non-native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health." Throughout the remainder of this Draft CCP/EA, the terms pest and invasive species are used interchangeably because they both can prevent/impede achievement of refuge wildlife and habitat objectives and/or degrade environmental quality.

In general, control of pests (vertebrate or invertebrate) on the refuge would conserve and protect the nation's fish, wildlife, and plant resources as well as maintain environmental quality. From 7 RM 14, animal or plant species, which are considered pests, may be managed if the following criteria are met:

- Threat to human health and well being or private property, the acceptable level of damage by the pest has been exceeded, or State or local government has designated the pest as noxious;
- Detrimental to resource objectives as specified in a refuge resource management plan (e.g., comprehensive conservation plan, habitat management plan), if available; and
- Control would not conflict with attainment of resource objectives or the purposes for which the refuge was established.

From 7 RM 14, the specific justifications for pest management activities on the refuge are the following:

- Protect human health and well being;
- Prevent substantial damage to important to refuge resources;
- Protect newly introduced or re-established native species;
- Control nonnative (exotic) species in order to support existence of populations of native species;
- Prevent damage to private property; and
- Provide the public with quality, compatible wildlife-dependent recreational opportunities.

Based upon 50 CFR 31.14 (Official Animal Control Operations), animal species, which are surplus or detrimental to the management program of a refuge area, may be taken in accordance with Federal and state laws and regulations by Federal or state personnel or by permit issued to private individuals. In addition, animal species which are damaging or destroying Federal property within a refuge area may be taken or destroyed by Federal personnel. Within 7 RM15.3, the following are more specific justifications for management of furbearing animals using trapping on a refuge:

- "To maintain furbearer populations at levels compatible with refuge and surrounding habitat and with refuge objectives which may involve habitat manipulations.

- To contribute to the attainment of national migratory bird, mammal, nonmigratory bird, and endangered species objectives or goals.
- To minimize furbearer damage to physical facilities (e.g., dikes and water control structures).
- To minimize competition with or interaction among wildlife populations and species that conflict with refuge objectives.
- To minimize the occurrence of high population densities, which have the potential to transmit contagious diseases [to] humans, among furbearer populations, or other wildlife species, or domestic animals.
- To provide authorized individuals with quality wildlife-oriented recreational experiences, education opportunities, and opportunities to utilize a renewable natural resource."

Animal species damaging/destroying federal property and/or detrimental to the management program of a refuge may be controlled as described in 50 CFR 31.14 (Official Animal Control Operations). Based upon 7 RM 14.7E, a pest control proposal is required, in some cases, to initiate a control program on refuge lands. The required elements of a pest control proposal are described in 7 RM 14.7E. However, a pest control proposal is not required under the following scenarios:

- Routine protection of refuge buildings, structures (e.g., dikes, levees, water control structures), and facilities not involving prohibited chemicals.
- Incidental control of exotics (e.g., non-native rats, non-native rabbits) or feral animals on refuge lands that are not protected by either federal or state laws, except where chemicals may be used.
- The use of routine habitat management techniques, selective trapping, on-refuge transfer, and physical and mechanical protection such as barriers and fences (including electric fences).

For example, the incidental removal of beavers damaging refuge infrastructure (e.g., clogging with subsequent damaging of water control structures) and/or negatively affecting habitats (e.g., removing woody species from existing or restored riparian) managed on refuge lands may be conducted without a pest control proposal. We recognize beavers are native species and most of their activities or refuge lands represent a natural process beneficial for maintaining wetland habitats. Exotic nutria, whose denning and burrowing activities in wetland dikes causes cave-ins and breaches, can be controlled using the most effective techniques considered site-specific factors without a pest control proposal. Along with the loss of quality wetland habitats associated with breaching of impoundments, the safety of refuge staffs and public (e.g., auto tour routes) driving on structurally compromised levees and dikes can be threatened by sudden and unexpected cave-ins.

Trespass and feral animals also may be controlled on refuge lands. In accordance with 7 RM 14.9B(1), animals trespassing on refuge lands may be captured and returned to their owners or transferred to humane societies or local animal shelters, where feasible. Based upon 50 CFR 28.43 (Destruction of Dogs and Cats), dogs and cats running at large on a national wildlife refuge and observed in the act of killing, injuring, harassing, or molesting humans or wildlife may be disposed of in the interest of public safety and protection of wildlife. In accordance with 7 RM 14.9B(2), feral animals should be disposed by the most humane method(s) available and in accordance with relevant Service directives (including Executive Order 11643).

Disposed wildlife specimens may be donated or loaned to public institutions. Donation or loans of resident wildlife species will only be made after securing state approval (50 CFR 30.11 [Donation and

Loan of Wildlife Specimens]). Surplus wildlife specimens may be sold alive or butchered, dressed and processed subject to Federal and State laws and regulations (50 CFR 30.12 [Sale of Wildlife Specimens]).

As previously stated for controlling animals damaging/destroying federal property and/or detrimental to the management program of a refuge, incidentally removing such animals from refuge lands does not require a pest control proposal.

In accordance with Service policy 620 FW 1 (Habitat Management Plans), there are additional management directives regarding invasive species found on the refuge:

- "We are prohibited by Executive Order, law, and policy from authorizing, funding, or carrying out actions that are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere."
- "Manage invasive species to improve or stabilize biotic communities to minimize unacceptable change to ecosystem structure and function and prevent new and expanded infestations of invasive species. Conduct refuge habitat management activities to prevent, control, or eradicate invasive species..."

E.3 Strategies

To fully embrace IPM, the following strategies, where applicable, would be carefully considered on the refuge for each pest species:

E.3.1 Prevention

This would be the most effective and least expensive long-term management option for pests. It encompasses methods to prevent new introductions or the spread of the established pests to infested areas. It requires identifying potential routes of invasion to reduce the likelihood of infestation. Hazard Analysis and Critical Control Points (HACCP) planning can be used to determine if current management activities on a refuge may introduce and/or spread invasive species in order to identify appropriate BMPs for prevention. See http://www.haccp-nrm.org/ for more information about HACCP planning.

Prevention may include source reduction, using pathogen-free or weed-free seeds or fill; exclusion methods (e.g., barriers); and/or sanitation methods (e.g., wash stations) to prevent reintroductions by various mechanisms including vehicles, personnel, livestock, and horses. Because invasive species are frequently the first to establish in newly disturbed sites, prevention would require a reporting mechanism for early detection of new pest occurrences with quick response to eliminate any new satellite pest populations. Prevention would require consideration of the scale and scope of land management activities that may promote pest establishment within uninfested areas or promote reproduction and spread of existing populations. Along with preventing initial introduction, prevention would involve halting the spread of existing infestations to new sites (Mullin et al. 2000). The primary reason of prevention would be to keep pest-free lands or waters from becoming infested. Executive Order 11312 emphasizes the priority for prevention with respect to managing pests.

The following would be methods to prevent the introduction and/or spread of pests on refuge lands:

- Before beginning ground-disturbing activities (e.g., disking, scraping), inventory and prioritize pest infestations in project operating areas and along access routes. Refuge staff would identify pest species on site or within reasonably expected potential invasion vicinity. Where possible, the refuge staff would begin project activities in uninfested areas before working in pest-infested areas.

- The refuge staff would locate and use pest-free project staging areas. They would avoid or minimize travel through pest-infested areas, or restrict to those periods when spread of seed or propagules of invasive plants would be least likely.
- The refuge staff would determine the need for, and when appropriate, identify sanitation sites where equipment can be cleaned of pests. The refuge staff would clean equipment before entering lands at on-refuge approved cleaning site(s). This practice does not pertain to vehicles traveling frequently in and out of the project area that will remain on roadways. Seeds and plant parts of pest plants would need to be collected, where practical. The refuge staff would remove mud, dirt, and plant parts from project equipment before moving it into a project area.
- The refuge staff would clean all equipment before leaving the project site, if operating in areas infested with pests. The refuge staff would determine the need for, and when appropriate, identify sanitation sites where equipment can be cleaned.
- Refuge staffs, their authorized agents, and refuge volunteers would, where possible, inspect, remove, and properly dispose of seeds and parts of invasive plants found on their clothing and equipment. Proper disposal means bagging the seeds and plant parts and then properly discarding them (e.g., incinerating).
- The refuge staff would evaluate options, including closure, to restrict the traffic on sites with on-going restoration of desired vegetation. The refuge staff would revegetate disturbed soil (except travel ways on surfaced projects) to optimize plant establishment for each specific site. Revegetation may include topsoil replacement, planting, seeding, fertilization, liming, and weed-free mulching as necessary. The refuge staff would use native material, where appropriate and feasible. The refuge staff would use certified weed-free or weed-seed-free hay or straw where certified materials are required and/or are reasonably available.
- The refuge staff would provide information, training, and appropriate pest identification materials to refuge staffs, permit holders, and recreational visitors. The refuge staff would educate them about pest identification, biology, impacts, and effective prevention measures.
- The refuge staff would require grazing permittees to utilize preventative measures for their livestock while on refuge lands.
- The refuge staff would inspect borrow material for invasive plants prior to use and transport onto and/or within refuge lands.
- The refuge staff would consider invasive plants in planning for road maintenance activities.
- The refuge staff would restrict off road travel to designated routes.

The following would be methods to prevent the introduction and/or spread of pests into refuge waters:

The refuge staff would inspect boats (including air boats), trailers, and other boatingEquipment. Where possible, the refuge staff would remove any visible plants, animals, or mud before leaving any waters or boat launching facilities. The refuge staff would drain water from motor, live well, bilge, and transom wells while on land before leaving the site. The refuge staff would wash and dry boats, downriggers, anchors, nets, floors of boats, propellers, axles, trailers, and other boating equipment to kill pests not visible at the boat launch.

- Before transporting to new waters, the refuge staff would rinse boat and boating equipment with hot (40°C or 104°F) clean water, spray boat or trailer with high pressure water, or dry boat and equipment for at least 5 days, where possible.
- The refuge staff would maintain a l00-foot buffer of aquatic pest-free clearance around boat launches and docks or quarantine areas when cleaning around culverts, canals, or irrigation sites. The refuge staff would clean equipment before moving to new sites. Inspect and clean equipment before moving from one project area to another. These prevention methods to minimize/eliminate the introduction and/or spread of pests were taken verbatim or slightly modified from Appendix E of U.S. Forest Service (2005).

E.3.2 Mechanical/Physical Methods

These methods would remove and destroy, disrupt the growth of, or interfere with the reproduction of pest species. For plants species, these treatments can be accomplished by hand, hand tool (manual), or power tools (mechanical) and include pulling, grubbing, digging, tilling/disking, cutting, swathing, grinding, sheering, girdling, mowing, and mulching of the pest plants. Thermal techniques such as steaming, super-heated water, and hot foam may also be viable treatments.

For animal species, the refuge staff could use mechanical/physical methods that can include trapping. In some cases, non-lethally trapped animals could be relocated to off-refuge sites with prior approval from the state. Lethal trapping also can occur on a refuge as a wildlife management tool. Non-native animals (rats, rabbits, red fox, dogs, and cats) can be trapped at any time without further approval. Native predators (otter, raccoon, mink, etc.) can also be trapped, but these actions would require a trapping plan and annual trapping proposals with prior approval and coordination with the state as specified in 7 RM 15. In accordance with 7 RM 15.8E, a refuge with a current furbearer management plan or programmatic management documents (e.g., CCP) with the required information (7 RM 15.8B) would fulfill refuge trapping plan requirements.

Each of these tools would be efficacious to some degree and applicable to specific situations. In general, mechanical controls can effectively control annual and biennial pest plants. However, to control perennial plants, the root system has to be destroyed or it will resprout and continue to grow and develop. Mechanical controls are typically not capable of destroying a perennial plant’s root system. Although some mechanical tools (e.g., disking, plowing) may damage root systems, they may stimulate regrowth, producing a denser plant population that may aid in the spread depending upon the target species (e.g., Canada thistle). In addition, steep terrain and soil conditions would be major factors that can limit the use of many mechanical control methods.

Some mechanical control methods (e.g., mowing), which would be used in combination with herbicides, can be a very effective technique to control perennial species. For example, mowing perennial plants followed sequentially by treating the plant regrowth with a systemic herbicide often would improve the efficacy of the herbicide compared to herbicide treatment only.

E.3.3 Cultural Methods

These methods would involve manipulating habitat to increase pest mortality by reducing its suitability to the pest. Cultural methods would include water-level manipulation, mulching, winter cover crops, changing planting dates to minimize pest impact, prescribed burning (facilitate revegetation, increase herbicide efficacy, and remove litter to assist in emergence of desirable species), flaming with propane torches, trap crops, crop rotations that would include nonsusceptible crops, moisture management, addition of beneficial insect habitat, reducing clutter, vacuuming, proper trash disposal, planting or seeding desirable species to shade or out compete invasive plants, applying fertilizer to enhance desirable vegetation, prescriptive grazing, and other habitat alterations.

E.3.4 Biological Control Agents

Classical biological control would involve the deliberate introduction and management of natural enemies (parasites, predators, or pathogens) to reduce pest populations. Many of the most ecologically or economically damaging pest species in the United States originated in foreign countries. These newly introduced pests, which are free from the natural enemies found in their country or region of origin, may have a competitive advantage over cultivated and native species. This competitive advantage often allows introduced species to flourish, and they may cause widespread economic damage to crops or out compete and displace native vegetation. Once the introduced pest species population reaches a certain level, traditional methods of pest management may be cost prohibitive or impractical. Biological controls typically are used when these pest populations have become so widespread that eradication or effective control would be difficult or no longer practical.

Biological control has advantages as well as disadvantages. Benefits include reducing pesticide usage, host specificity for target pests, long-term self-perpetuating control, low cost/acre, capacity for searching and locating hosts, synchronizing biological control agents to hosts' life cycles, and the unlikelihood that hosts will develop resistance to agents. Disadvantages include limited availability of agents from their native lands, the dependence of control on target species density, slow rate at which control occurs, biotype matching, the difficulty and expense of conflicts over control of the target pest, and host specificity when host populations are low.

A reduction in target species populations from biological controls is typically a slow process, and efficacy can be highly variable. It may not work well in a particular area although it does work well in other areas. Biological control agents would require specific environmental conditions to survive over time. Some of these conditions are understood, whereas, others are only partially understood or not at all.

Biological control agents would not eradicate a target pest. When using biological control agents, residual levels of the target pest typically are expected; the agent population level or survival would be dependent upon the density of its host. After the pest population decreases, the population of the biological control agent would decrease correspondingly. This is a natural cycle. Some pest populations (e.g., invasive plants) would tend to persist for several years after a biological control agent becomes established due to seed reserves in the soil, inefficiencies in the agent's search behavior, and the natural lag in population buildup of the agent.

The full range of pest groups potentially found on refuge lands and waters would include diseases, invertebrates (insects, mollusks), vertebrates, and invasive plants (most common group).
Often it is assumed that biological control would address many if not most of these pest problems. There are several well documented success stories of biological control of invasive weed species in the Pacific Northwest, including Mediterranean sage, St Johnswort (Klamath weed) and tansy ragwort. Emerging success stories include the control of Dalmatian toadflax, diffuse knapweed, leafy spurge, purple loosestrife, and yellow star thistle. However, historically, each new introduction of a biological control agent in the United States has only about a 30 percent success rate (Coombs et al 2006). Refer to Coombs etal. (2006) for the status of biological control agents for invasive plants in the Pacific Northwest.

Introduced species without desirable close relatives in the United States would generally be selected as biological controls. Natural enemies that are restricted to one or a few closely related plants in their country of origin are targeted as biological controls (Center et al..1997, Hasan and Ayres 1990).

The refuge staff would ensure introduced agents are approved by the applicable authorities.
Except for a small number of formulated biological control products registered by USEPA under FIFRA, most biological control agents are regulated by the U.S.Department of Agriculture (USDA) Animal Plant Health Inspection Service, Plant Protection and Quarantine (PPQ). State departments of agriculture and, in some cases, county agricultural commissioners or weed districts, have additional approval authority.

Federal permits (USDA-APHIS-PPQ Form 526) are required to import biocontrols agents from another state. Form 526 may be obtained by writing:

USDA-APHIS-PPQ
Biological Assessment and Taxonomic Support
4700 River Road, Unit 113
Riverdale, MD 20737

Or through the internet at URL address:
http://www.aphis.usda.gov/ppq/permits/bioligical/weedbio.html.

The Service strongly supports the development and legal and responsible use of appropriate, safe, and effective biological control agents for nuisance and nonindigenous or pest species.

State and county agriculture departments may also be sources for biological control agents or they may have information about where biological control agents may be obtained. Commercial sources should have an Application and Permit to Move Live Plant Pests and Noxious Weeds (USDA-PPQ Form 226 USDA-APHIS-PPQ, Biological Assessment and Taxonomic Support, 4700 River Road, Unit 113, Riverdale, MD 20737) to release specific biological control agents in a state and/or county. Furthermore, certification regarding the biological control agent's identity (genus, specific epithet, subspecies, and variety) and purity (e.g., parasite free, pathogen free, and biotic and abiotic contaminants) should be specified in purchase orders.

Biological control agents are subject to 7 RM 8 (Exotic Species Introduction and Management). In addition, the refuge staff would follow the International Code of Best Practice for Classical Biological Control of Weeds (http://sric.ucdavis.edu/exotic /exotic.htm) as ratified by delegates to the X International Symposium on Biological Control of Weeds, Bozeman, MT, July 9, 1999. This code identifies the following:

- Release only approved biological control agents,
- Use the most effective agents,
- Document releases, and
- Monitor for impact to the target pest, non-target species, and the environment.

Biological control agents formulated as pesticide products and registered by the EPA (e.g., *Bti*) are also subject to PUP review and approval (see below).

A record of all releases would be maintained with date(s), location(s), and environmental conditions of the release site(s); the identity, quantity, and condition of the biological control agents released; and other relevant data and comments such as weather conditions. Systematic monitoring to determine the establishment and effectiveness of the release is also recommended.

NEPA documents regarding biological and other environmental effects of biological control agents prepared by another Federal agency, where the scope is relevant to evaluation of releases on refuge lands, would be reviewed. Possible source agencies for such NEPA documents include the Bureau of Land Management, U.S. Forest Service, National Park Service, USDAAPHIS- PPQ, and the military services. It might be appropriate to incorporate by reference parts or all of existing document(s) from the review. Incorporating by reference (40 CFR 1502.21) is a technique used to avoid redundancies in analysis. It also can reduce the bulk of a Service NEPA document, which only must identify the documents that are incorporated by reference. In addition, relevant portions must be summarized in the Service's NEPA document to the extent necessary to provide the decision maker and public with an understanding of relevance of the referenced material to the current analysis.

E.3.5 Pesticides

The selective use of pesticides would be based upon pest ecology (including mode of reproduction), the size and distribution of its populations, site-specific conditions (e.g., soils, topography), known efficacy under similar site conditions, and the capability to utilize best management practices (BMPs) to reduce/eliminate potential effects to non-target species, sensitive habitats, and potential to contaminate surface and groundwater. All pesticide usage (pesticide, target species, application rate, and method of application) would comply with the applicable Federal (FIFRA) and state regulations pertaining to pesticide use, safety, storage, disposal, and reporting. Before pesticides can be used to eradicate, control, or contain pests on refuge lands and waters, pesticide use proposals (PUPs) would be prepared and approved in accordance with 7 RM 14. Pesticide use proposal records would provide a detailed, time-, site-, and target-specific description of the proposed use of pesticides on the refuge. All PUPs would be created, approved, or disapproved, and stored in the Pesticide Use Proposal System (PUPS), which is a centralized database only accessible on the Service's intranet (https://sds.fws.gov/pups). Only Service employees would be authorized to access PUP records for the refuge in this database.

Chemical (baits) control of non-native predators or herbivores maybe considered mainly for relatively small infestations. If control of large populations is needed and the use of chemical control methods is chosen, then a pesticide use proposal and step-down plan identifying all phases of the activity will be developed. Application equipment would be selected to provide site-specific delivery to target pests while minimizing/eliminating direct or indirect (e.g., drift) exposure to non-target areas and degradation of surface and groundwater quality. Where possible, target-specific equipment (e.g., backpack sprayer, wiper) would be used to treat target pests. Other target-specific equipment to apply pesticides would include soaked wicks or paint brushes for wiping vegetation and lances, hatchets, or syringes for direct injection into stems. Granular pesticides may be applied using seeders or other specialized dispensers. In contrast, aerial spraying (e.g., fixed wing or helicopter) would only be used where access is difficult (remoteness or fragile habitat) and/or the size/distribution of infestations precludes practical use of ground-based methods.

Because repeated use of one pesticide may allow resistant organisms to survive and reproduce, multiple pesticides with variable modes of action would be considered for treatments on refuge lands and waters. This is especially important if multiple applications within years and/or over a growing season likely would be necessary for habitat maintenance and restoration activities to achieve resource objectives. Integrated chemical and non-chemical controls also are highly effective, where practical, because pesticide resistant organisms can be removed from the site. Cost may not be the primary factor in selecting a pesticide for use on the refuge. If the least expensive pesticide would potentially harm natural resources or people, then a different product would be selected, if available. The most efficacious pesticide available with the least potential to degrade environment quality (soils, surface water, and groundwater) as well as least potential effect to native species and communities of fish, wildlife, plants, and their habitats would be acceptable for use on the refuge in the context of an IPM approach.

E.3.6 Habitat restoration/maintenance

Restoration and/or proper maintenance of refuge habitats associated with achieving wildlife and habitat objectives would be essential for long-term prevention, eradication, or control (at or below threshold levels) of pests. Promoting desirable plant communities through the manipulation of species composition, plant density, and growth rate is an essential component of invasive plant management (Masters et al. 1996, Masters and Shelly 2001, Brooks et al. 2004). The following three components of succession could be manipulated through habitat maintenance and restoration, site availability, species availability, and species performance (Cox and Anderson 2004). Although a single method (e.g., herbicide treatment) may eliminate or suppress pest species in the short term, the resulting gaps and bare soil create niches that are conducive to further invasion by the species and/or other invasive plants. On degraded sites where desirable species are absent or in low abundance, revegetation with native/desirable grasses, forbs, and legumes may be necessary to direct and accelerate plant community recovery, and achieve site-specific objectives in a reasonable time frame. The selection of appropriate species for revegetation would be dependent on a number of factors including resource objectives and site-specific, abiotic factors (e.g., soil texture, precipitation/temperature regimes, and shade conditions). Seed availability and cost, ease of establishment, seed production, and competitive ability also would be important considerations.

E.4 Priorities for Treatments

For many refuges, the magnitude (number, distribution, and sizes of infestations) for pest problems is too extensive and beyond the available capital resources to effectively address during any single field season. To manage pests in the refuge, it would be essential to prioritize treatment of infestations. Highest priority treatments would be focused on early detection and rapid response to eliminate infestations of new pests, if possible. This would be especially important for aggressive pests potentially impacting species, species groups, communities, and/or habitats associated with refuge purpose(s), Refuge System resources of concern (federally listed species, migratory birds, selected marine mammals, and interjurisdictional fish), and native species for maintaining/restoring biological integrity, diversity, and environmental health. The next priority would be treating established pests that appear in one or more previously uninfested areas.

Moody and Mack (1988) demonstrated through modeling that small, new outbreaks of invasive plants eventually would infest an area larger than the established, source population. They also found that control efforts focusing on the large, main infestation rather than the new, small satellites reduced the chances of overall success. The lowest priority would be treating large infestations (sometimes monotypic stands) of well established pests. In this case, initial efforts would focus upon containment of the perimeter followed by work to control/eradicate the established infested area. If containment and/or control of a large infestation is not effective, then efforts would focus upon halting pest reproduction as the lowest priority.

Although state-listed noxious weeds would always have high priority for management, other pest species known to cause substantial ecological impact would also be considered. For example, cheatgrass may not be listed by a state as noxious, but it can greatly alter fire regimes in shrub steppe habitats resulting in large monotypic stands that displace native bunch grasses, forbs, and shrubs. Pest control would likely require a multi-year commitment from the refuge staff. Essential to the long-term success of pest management would be pre- and post-treatment monitoring, assessment of the successes and failures of treatments, and development of new approaches when proposed methods do not achieve desired outcomes.

E.5 Best Management Practices

Best Management Practices (BMPs) can minimize or eliminate possible effects associated with pesticide usage to non-target species and/or sensitive habitats as well as degradation of water quality from drift, surface runoff, or leaching. Based upon the Department of the Interior's Pesticide Use Policy (517 DM 1) and the Service's Pest Management Policy and Responsibilities (30 AM 12), the use of applicable BMPs (where feasible) would likely ensure that pesticide uses may not adversely affect federally listed species and/or their critical habitats through determinations made using the process described in 50 CFR part 402.

The following are BMPs pertaining to mixing/handling and applying pesticides for all groundbased treatments of pesticides, which would be considered and utilized, where feasible, based upon target- and site-specific factors and time-specific environmental conditions. Although not listed below, the most important BMP to eliminate/reduce potential impacts to non-target resources would be an IPM approach to prevent, control, eradicate, and contain pests.

E.5.1 Pesticide Handling and Mixing

- As a precaution against spilling, spray tanks would not be left unattended during filling.
- All pesticide containers would be triple rinsed and the rinsate would be used as water in the sprayer tank and applied to treatment areas.
- All pesticide spray equipment would be properly cleaned. Where possible, rinsate would be used as part of the make-up water in the sprayer tank and applied to treatment areas.
- The refuge staff would empty rinsed pesticide containers for recycling at local herbicide container collection facilities.
- All unused pesticides would be properly discarded at a local “safe send” collection facility.
- Pesticides and pesticide containers would be lawfully stored, handled, and disposed of in accordance with the label and in a manner safeguarding human health, fish, and wildlife and preventing soil and water contaminant.
- The refuge staff would consider the water quality parameters (e.g., pH, hardness) that are important to ensure greatest efficacy where specified on the pesticide label.
- All pesticide spills would be addressed immediately using procedures identified in the refuge spill respond plan.

E.5.2 Applying Pesticides

- Pesticide treatments would only be conducted by or under the supervision of Service personnel and non-Service applicators with the appropriate state or BLM certification to safely and effectively conduct these activities on refuge lands and waters.
- The refuge staff would comply with all Federal, state, and local pesticide use laws and regulations as well as Departmental, Service, and Refuge System pesticide-related policies. For example, the refuge staff would use application equipment and apply rates for the specific pest(s) identified on the pesticide label as required under FIFRA.
- Before each treatment season and prior to mixing or applying any product for the first time each season, all applicators would review the labels, Material Safety Data Sheets (MSDSs), and Pesticide Use Proposal (PUPs) for each pesticide, determining the target pest, appropriate mix rate(s), Personal Protective Equipment (PPE), and other requirements listed on the pesticide label.
- A 1-foot no-spray buffer from the water’s edge would be used, where applicable and where it does not detrimentally influence effective control of pest species.
- Spot treatment would be used rather than broadcast applications of pesticides, where practical.
- Applicators would use and adjust spray equipment to apply the coarsest droplet size spectrum with optimal coverage of the target species while reducing drift.
- Applicators would use the largest droplet size that results in uniform coverage.
- Applicators would use drift reduction technologies such as low-drift nozzles, where possible.
- Where possible, spraying would occur during low (average less than 10 mph and preferably 3 to 7 mph) and consistent direction wind conditions with moderate temperatures (typically lower than 85°F).
- Where possible, applicators would avoid spraying during inversion conditions (often

associated with calm and very low wind conditions) that can cause large-scale herbicide drift to non-target areas.

- Equipment would be calibrated regularly to ensure that the proper rate of pesticide is applied to the target area or species.
- Spray applications would be made at the lowest height for uniform coverage of target pests to minimize/eliminate potential drift.
- If windy conditions frequently occur during afternoons, spraying (especially boom treatments) would typically be conducted during early morning hours.
- Spray applications would not be conducted on days with more than a 30 percent forecast for rain within 6 hours, except for pesticides that are rapidly rain fast (e.g., glyphosate in 1 hour) to minimize/eliminate potential runoff.
- Where possible, applicators would use drift retardant adjuvants during spray applications, especially adjacent to sensitive areas.
- Where possible, applicators would use a nontoxic dye to aid in identifying target area treated as well as potential over spray or drift. A dye can also aid in detecting equipment leaks. If a leak is discovered, the application would be stopped until repairs can be made to the sprayer.
- For pesticide uses associated with cropland and facilities management, buffers, as appropriate, would be used to protect sensitive habitats, especially wetlands and other aquatic habitats.
- When drift cannot be sufficiently reduced through altering equipment set up and application techniques, buffer zones may be identified to protect sensitive areas downwind of applications. The refuge staff would only apply adjacent to sensitive areas when the wind is blowing the opposite direction.
- Applicators would utilize scouting for early detection of pests to eliminate unnecessary pesticide applications.
- The refuge staff would consider timing of application so native plants are protected (e.g., senescence) while effectively treating invasive plants.
- Rinsate from cleaning spray equipment after application would be recaptured and reused or applied to an appropriate pest plant infestation.
- Application equipment (e.g., sprayer, ATV, tractor) would be thoroughly cleaned and PPE would be removed/disposed of onsite by applicators after treatments to eliminate the potential spread of pests to uninfested areas.

E.6 Safety

E.6.1 Personal Protective Equipment

All applicators would wear the specific personal protective equipment (PPE) identified on the pesticide label. The appropriate PPE will be worn at all times during handling, mixing, and applying. PPE can include the following disposable (e.g., Tyvek) or laundered coveralls; gloves (latex, rubber, or nitrile); rubber boots; and/or a respirator approved by the National Institute for Occupational Safety and Health (NIOSH). Because exposure to concentrated product is usually greatest during mixing, extra care should be taken while preparing pesticide solutions. Persons mixing these solutions can be best protected if they wear long gloves, an apron, footwear, and a face shield.

Coveralls and other protective clothing used during an application would be laundered separately from other laundry items. Transporting, storing, handling, mixing and disposing of pesticide containers will be consistent with label requirements, EPA, and Occupational Safety and Health Administration (OSHA) requirements, and Service policy.

If a respirator is necessary for a pesticide use, then the following requirements would be met in accordance with Service safety policy—a written Respirator Program, fit testing, physical examination (including pulmonary function and blood work for contaminants), and proper storage of the respirator.

E.6.2 Notification

The restricted entry interval (REI) is the waiting period required after pesticide application.
Once the REI ends, individuals may safely enter a treated area without PPE. Refuge staff, authorized management agents of the Service, volunteers, and members of the public who could be in or near a pesticide treated area within the stated re-entry time period on the label would be notified about treatment areas. Posting would occur at any site where individuals might inadvertently become exposed to a pesticide during other activities on the refuge. Where required by the label and/or state-specific regulations, sites would also be posted on its perimeter and at other likely locations of entry. The refuge staff would also notify appropriate private property owners of an intended application, including any private individuals who have requested notification. Special efforts would be made to contact nearby individuals who are beekeepers or who have expressed chemical sensitivities.

E.6.3 Medical Surveillance

Medical surveillance may be required for Service personnel who mix, apply, and/or monitor use of pesticides (see 242 FW 7 [Pesiticide Users] and 242 FW 4 [Medical Surveillance]). In accordance with draft Service policy (242 FW 7 [Pesticide Users Safety]), medical monitoring would be necessary for Service personnel and approved volunteers engaged in "frequent pesticide use" that is defined as a "pesticide applicator handling, mixing, and applying pesticides for 8 or more hours in any week or 16 or more hours in any 30 day period." However, refuge cooperators (e.g., cooperative farmers) and other authorized agents (e.g., state and county employees) would be responsible for their own medical monitoring needs and costs. Standard examinations (at refuge expense) of appropriate refuge staff would be provided by the nearest certified occupational health and safety physician as determined by Federal Occupational Health.

E.6.4 Certification and Supervision of Pesticide Applicators

Appropriate refuge staff handling, mixing, and/or applying or supervising others engaged in pesticide use activities would be trained and state or Federally (BLM) licensed to apply pesticides to refuge lands or waters (242 FW 7). Preferably, all refuge staff participating in pest management activities involving pesticide usage would attend appropriate training. New staff unfamiliar with proper procedures for storing, mixing, handling, applying, and disposing of herbicides and containers would receive orientation and training before handling or using any products. Documentation of training would be kept in the files at the refuge office.

E.6.5 Record Keeping

E.6.5.1 Labels and material safety data sheets

Pesticide labels and MSDSs would be maintained at the refuge shop with laminated copies located in the mixing area. These documents would be carried by field applicators where possible. A written reference (e.g., note pad, chalk board, dry erase board) for each tank to be mixed would be kept in the mixing area for quick reference during mixing. In addition, approved PUPs stored in the PUPS database typically contain website links to pesticide labels and MSDSs.

E.6.5.2 Pesticide use proposals (PUPs)

A PUP would be prepared for each proposed pesticide use associated with annual pest management on refuge lands and waters. A PUP would include specific information about the proposed pesticide use including the common and chemical names of the pesticide(s), target pest species, size and location of treatment site(s), application rate(s) and method(s), and federally listed species determinations, where applicable.

In accordance with 30 AM 12 and 7 RM 14, PUPs would be required for the following:

- Uses of pesticides on lands and facilities owned or managed by the Service, including properties managed by Service personnel as a result of the Food Security Act of 1985;
- Service projects by non-Service personnel on Service-owned or controlled lands and facilities and other pest management activities that would be conducted by Service personnel; and
- Where the Service would be responsible or provides funds for pest management identified in protective covenants, easements, contracts, or agreements off Service lands.

In accordance with Service guidelines (Director's memo [December 12, 2007]), a refuge staff may receive up to 5-year approvals for Washington Office and field reviewed proposed pesticide uses based upon meeting identified criteria, including an approved IPM plan, where necessary (see http://www.fws.gov/contaminants/Issues/IPM.cfm). For a refuge, an IPM plan (requirements described herein) can be completed independently or in association with a CCP or HMP if IPM strategies and potential environmental effects are adequately addressed within appropriate NEPA documentation.

PUPs would be created, approved or disapproved, and stored as records in the Pesticide Use Proposal System (PUPS), which is centralized database on the Service's intranet (https://sds.fws.gov/pups). Only Service employees can access PUP records in this database.

E.6.5.3 Pesticide usage

In accordance with 30 AM 12 and 7 RM 14, the refuge Project Leader would be required to maintain records of all pesticides annually applied on lands or waters under refuge jurisdiction. This would encompass pesticides applied by other Federal agencies, state and county governments, nongovernment applicators, including cooperators and their pest management service providers, with Service permission. For clarification, pesticide means all insecticides, insect and plant growth regulators, dessicants, herbicides, fungicides, rodenticides, acaricides, nematicides, fumigants, avicides, and piscicides.

The following usage information can be reported for approved PUPs in the PUPS database:

- Pesticide trade name(s)
- Active ingredient(s)
- Total acres treated
- Total amount of pesticides used (lbs or gallons)
- Total amount of active ingredient(s) used (lbs)
- Target pest(s)
- Efficacy (percent control)

To determine whether treatments are efficacious (eradicating, controlling, or containing the target pest) and achieving resource objectives, habitat and/or wildlife response would be monitored both pre- and post-treatment, where possible. Considering available annual funding and staffing, appropriate monitoring data regarding characteristics (attributes) of pest infestations (e.g., area, perimeter, degree of infestation-density, % cover, density) as well as habitat and/or wildlife response to treatments may be collected and stored in a relational database, preferably a geo-referenced data management system (e.g., Refuge Lands GIS [RLGIS]) to facilitate data analyses. In accordance with adaptive management, data analysis and interpretation would allow treatments to be modified or changed over time, as necessary, to achieve resource objectives considering site-specific conditions in conjunction with habitat and/or wildlife responses.

E.7 Evaluating Pesticide Use Proposals

Pesticides would only be used on the refuge for habitat management as well as croplands/facilities maintenance after approval of a PUP. Proposed pesticide uses on the refuge would only be approved where there would likely be minor, temporary, or localized effects to fish and wildlife species as well as minimal potential to degrade environmental quality. Potential effects to listed and non-listed species would be evaluated with quantitative ecological risk assessments. Potential effects to environmental quality would be based upon pesticide characteristics of environmental fate (water solubility, soil mobility, soil persistence, and volatilization) and a quantitative screening tool for potential to move to groundwater. Risk assessments as well as characteristics of environmental fate and potential to degrade water quality for pesticides would be documented in Chemical Profiles (see Section 7.5). These profiles would include threshold values for quantitative measures of ecological risk assessments and screening tools for environmental fate that represent minimal potential effects to species and environmental quality. Only pesticide uses with appropriate BMPs (see Section 4.0) for habitat management and cropland/facilities maintenance on the refuge that would potentially have minor, temporary, or localized effects on refuge biological and environmental quality (threshold values not exceeded) would be approved.

E.7.1 Overview of Ecological Risk Assessment

An ecological risk assessment process would be used to evaluate potential adverse effects to biological resources as a result of a pesticide(s) proposed for use on the refuge. It is an established quantitative and qualitative methodology for comparing and prioritizing risks of pesticides and conveying an estimate of the potential risk for an adverse effect. The quantitative methodology would be an efficient way to integrate best available scientific information regarding hazard, patterns of use (exposure), and dose-response relationships in a manner that is useful for ecological risk decision-making. It would provide an effective way to evaluate potential effects where there is missing or unavailable scientific information (data gaps) to address reasonable, foreseeable adverse effects as required under 40 CFR Part 1502.22.

Protocols for ecological risk assessment of pesticide uses on the refuge were developed through research and established by the US Environmental Protection Agency (2004). Assumptions for these risk assessments are presented in Section 6.2.3.

The toxicological data used in ecological risk assessments are typically results of standardized laboratory studies provided by pesticide registrants to the US Environmental Protection Agency (USEPA) to meet regulatory requirements under the Federal Insecticide, Fungicide and Rodenticide Act of 1996 (FIFRA). These studies assess the acute (lethality) and chronic (reproductive) effects associated with short- and long-term exposure to pesticides on representative species of birds, mammals, freshwater fish, aquatic invertebrates, and terrestrial and aquatic plants, respectively (Table 1).

Other effects data publicly available would also be utilized for risk assessment protocols described herein. Toxicity endpoint and environmental fate data are available from a variety of resources. Some of the more useful resources can be found in Section 7.5.

Table E.1 Ecotoxicity tests used to evaluate potential effects to birds, fish, and mammals to establish toxicity endpoints for risk quotient calculations.

Species Group	Exposure	Measurement endpoint
Bird	Acute	Median Lethal Concentration (LC_{50})
	Chronic	No Observed Effect Concentration (NOEC) or No Observed Adverse Effect Concentration (NOAEC)[1]
Fish	Acute	Median Lethal Concentration (LC_{50})
	Chronic	No Observed Effect Concentration (NOEC) or No Observed Adverse Effect Concentration (NOAEC)[2]
Mammal	Acute	Oral Lethal Dose (LD_{50})
	Chronic	No Observed Effect Concentration (NOEC) or No Observed Adverse Effect Concentration (NOAEC)[3]

1. Measurement endpoints typically include a variety of reproductive parameters (e.g., number of eggs, number of offspring, eggshell thickness, and number of cracked eggs).
2. Measurement endpoints for early life stage/life cycle typically include embryo hatch rates, time to hatch, growth, and time to swim-up.
3. Measurement endpoints include maternal toxicity, teratogenic effects or developmental anomalies, evidence of mutagenicity or genotoxicity, and interference with cellular mechanisms such as DNA synthesis and DNA repair.

E.7.2 Determining Ecological Risk to Fish and Wildlife

The potential for pesticides used on the refuge to cause direct adverse effects to fish and wildlife would be evaluated using EPA's Ecological Risk Assessment Process (EPA 2004). This deterministic approach, which is based upon a two-phase process involving estimation of environmental concentrations and then characterization of risk, would be used for ecological risk assessments. This method integrates exposure estimates—estimated environmental concentration (EEC)—and toxicological endpoints (e.g., LC50 and oral LD50) to evaluate the potential for adverse effects to species groups (birds, mammals, and fish) representative of legal mandates for managing units of the Refuge System. This integration is achieved through risk quotients (RQs) calculated by dividing the EEC by acute and chronic toxicity values selected from standardized toxicological endpoints or published effect (Table 1).

$$RQ = EEC/Toxicological\ Endpoint$$

The level of risk associated with direct effects of pesticide use would be characterized by comparing calculated RQs to the appropriate Level of Concern (LOC) established by EPA (1998) (Table 2). The LOC represents a quantitative threshold value for screening potential adverse effects to fish and wildlife resources associated with pesticide use. The following are four exposure-species group scenarios that would be examined to characterize ecological risk to fish and wildlife on the refuge: acute-listed species, acute-nonlisted species, chronic-listed species, and chronic-nonlisted species.

Acute risk would indicate the potential for mortality associated with short-term dietary exposure to pesticides immediately after an application. For characterization of acute risks, median values from LC50 and LD50 tests would be used as toxicological endpoints for RQ calculations. In contrast, chronic risks would indicate the potential for adverse effects associated with long-term dietary exposure to pesticides from a single application or multiple applications over time (within a season and over years).

For characterization of chronic risks, the no observed concentration (NOAEC) or no observed effect concentration (NOEC) for reproduction would be used as toxicological endpoints for RQ calculations. Where available, the NOAEC would be preferred over a NOEC value. Listed species are those federally designated as threatened, endangered, or proposed in accordance with the Endangered Species Act of 1973 (16 USC 1531-1544, 87 Stat.884, as amended-Public Law 93-205). For listed species, potential adverse effects would be assessed at the individual level because loss of individuals from a population could detrimentally impact a species. In contrast, risks to nonlisted species would consider effects at the population level. An RQ less than LOC for a taxonomic group would indicate the proposed pesticide use is "may affect, not likely to adversely affect" individuals (listed species) or populations (nonlisted species) of the taxonomic group (Table 2). In contrast, an RQ greater than LOC, would indicate an unacceptable ecological risk considering the potential for adverse effects.

Table E.2 Presumption of unacceptable risk for birds, fish, and mammals (EPA 1998)

Risk Presumption		Level of Concern	
		Listed Species	Non-listed Species
Acute	Birds	0.1	0.5
	Fish	0.05	0.5
	Mammals	0.1	0.5
Chronic	Birds	1.0	1.0
	Fish	1.0	1.0
	Mammals	1.0	1.0

E.7.2.1 Environmental exposure

Following release into the environment through application, pesticides would experience several different routes of environmental fate. Pesticides which would be sprayed can move through the air (e.g., particle or vapor drift) and may eventually end up in other parts of the environment, such as non-target vegetation, soil, or water. Pesticides applied directly to the soil may be washed off the soil into nearby bodies of surface water (e.g., surface runoff) or may percolate through the soil to lower soil layers and groundwater (e.g., leaching) (Baker and Miller 1999, Pope et al. 1999, Buttler et al. 998, Ramsay et al.1995, EXTOXNET 1993*a*). Pesticides which would be injected into the soil may also be subject to the latter two fates.

The aforementioned possibilities are by no means complete, but they do indicate that movement of pesticides in the environment is very complex, with transfers occurring continually among different environmental compartments. In some cases, these exchanges occur not only between areas that are close together, but it also may involve transportation of pesticides over long distances (Barry 2004, Woods 2004).

Terrestrial exposure

The estimated environmental concentration (ECC) for exposure to terrestrial wildlife would be quantified using an EPA screening level approach (EPA 2004). This screening level approach is not affected by product formulation because it evaluates a pesticide's active ingredient(s). This approach would vary depending upon the proposed pesticide application method, spray or granular.

Terrestrial-spray application

For spray applications, exposure would be determined using the Kanaga nomogram method (EPA 2005*a*, EPA 2004, Pfleeger et al.1996) through the EPA's Terrestrial Residue Exposure model (T-REX) version 1.2.3 (EPA 2005*b*). To estimate the maximum (initial) pesticide residue on short grass (shorter than 20 cm tall) as a general food item category for terrestrial vertebrate species, T-REX input variables would include the following from the pesticide label: maximum pesticide application rate (pounds active ingredient acid equivalent/acre) and pesticide half-life (days) in soil. Although there are other food item categories (tall grasses; broadleaf plants and small insects; and fruits, pods, seeds and large insects), short grass was selected because it would yield maximum EECs (240 ppm per pound active ingredient/acre) for worst-case risk assessments. Short grass is not representative of forage for carnivorous species (e.g., raptors), but it would characterize the maximum potential exposure through the diet of avian and mammalian prey items. Consequently, this approach would provide a conservative screening tool for pesticides that do not biomagnify.

For RQ calculations in T-REX, the model would require the weight of surrogate species and Mineau scaling factors (Mineau et al.1996). Body weights of bobwhite quail and mallard are included in T-REX by default, but body weights of other organisms (Table 3) would be entered manually. The Mineau scaling factor accounts for small-bodied bird species that may be more sensitive to pesticide exposure than would be predicted only by body weight. Mineau scaling factors would be entered manually with values ranging from 1 to 1.55 that are unique to a particular pesticide or group of pesticides. If specific information to select a scaling factor is not available, then a value of 1.15 would be used as a default. Alternatively, zero would be entered if it is known that body weight does not influence toxicity of pesticide(s) being assessed. The upper bound estimate output from the T-REX Kanaga nomogram would be used as an EEC for calculation of RQs. This approach would yield a conservative estimate of ecological risk.

Table E.3 Average body weight of selected terrestrial wildlife species frequently used in research to establish toxicological endpoints (Dunning 1984).

Species	Body Weight (kg)
Mammal (15 g)	0.015
House sparrow	0.0277
Mammal (35 g)	0.035
Starling	0.0823
Red-winged blackbird	0.0526
Common grackle	0.114
Japanese quail	0.178
Bobwhite quail	0.178
Rat	0.200
Rock dove (aka pigeon)	0.542
Mammal (1000 g)	1.000
Mallard	1.082
Ring-necked pheasant	1.135

Terrestrial – granular application

Granular pesticide formulations and pesticide-treated seed would pose a unique route of exposure for avian and mammalian species. The pesticide is applied in discrete units which birds or mammals might ingest accidentally with food items or intentionally as in the case of some bird species actively seeking and picking up gravel or grit to aid digestion or seed as a food source. Granules may also be consumed by wildlife foraging on earthworms, slugs or other softbodied soil organisms to which the granules may adhere.

Terrestrial wildlife RQs for granular formulations or seed treatments would be calculated by dividing the maximum milligrams of active ingredient (ai) exposed (e.g., EEC) on the surface of an area equal to 1 square foot by the appropriate LD50 value multiplied by the surrogate's body weight (Table 3). An adjustment to surface area calculations would be made for broadcast, banded, and in-furrow applications. An adjustment also would be made for applications with and without incorporation of the granules. Without incorporation, it would be assumed that 100 percent of the granules remain on the soil surface available to foraging birds and mammals.

Press wheels push granules flat with the soil surface, but they are not incorporated into the soil.
If granules are incorporated in the soil during band or T-band applications or after broadcast applications, it would be assumed only 15 percent of the applied granules remain available to wildlife. It would be assumed that only 1 percent of the granules are available on the soil surface following in-furrow applications.

The EECs for pesticides applied in granular form and as seed treatments would be determined considering potential ingestion rates of avian or mammalian species (e.g., 10-30 percent body weight/day). This would provide an estimate of maximum exposure that may occur as a result of granule or seed treatment spills such as those that commonly occur at end rows during application and planting. The availability of granules and seed treatments to terrestrial vertebrates would also be considered by calculating the loading per unit area (LD50/ft2) for comparison to EPA Levels of Concern (EPA 1998). The T-REX version 1.2.3 (EPA 2005*b*) contains a submodel which automates Kanaga exposure calculations for granular pesticides and treated seed.

The following formulas will be used to calculate EECs depending upon the type of granular pesticide application:

- In-furrow applications assume a typical value of 1 percent granules, bait, or seed remain unincorporated.

$$mg\ a.i./ft.^2 = [(lbs.\ product/acre)(\%\ a.i.)(453{,}580\ mg/lbs)(1\%\ exposed))] / \{[(43{,}560\ ft.^2/acre)/(row\ spacing\ (ft.))] / (row\ spacing\ (ft.)\}$$

or

$$mg\ a.i./ft.^2 = [(lbs\ product/1000\ ft.\ row)(\%\ a.i.)(1000\ ft\ row)(453{,}580\ mg/lb.)(1\%\ exposed)$$

$$EEC = [(mg\ a.i./ft.^2)(\%\ of\ pesticide\ biologically\ available)]$$

- Incorporated banded treatments assume that 15 percent of granules, bait, or seeds are unincorporated.

$$mg\ a.i./ft.^2 = [(lbs.\ product/1000\ row\ ft.)(\%\ a.i.)(453{,}580\ mg/lb.)(1\text{-}\%\ incorporated)] / (1{,}000$$

ft.)(band width (ft.))

$$EEC = [(mg\ a.i./ft.^2)(\%\ of\ pesticide\ biologically\ available)]$$

- Broadcast treatment without incorporation assumes 100 percent of granules, bait, seeds are unincorporated.

$$mg\ a.i./ft.^2 = [(lbs.\ product/acre)(\%\ a.i.)(453{,}590\ mg/lb.)] / (43{,}560\ ft.^2/acre)$$

$$EEC = [(mg\ a.i./ft.^2)(\%\ of\ pesticide\ biologically\ available)]$$

Where:

- *% of pesticide biologically available = 100% without species specific ingestion rates*
- *Conversion for calculating mg a.i./ft.*^{2}*using ounces: 453,580 mg/lb. /16 = 28,349 mg/oz.*

The following equation would used to calculate a RQ based on the EEC calculated by one of the above equations. The EEC would be divided by the surrogate LD50 toxicological endpoint multiplied by the body weight (Table 3) of the surrogate.

$$RQ = EEC / [LD50\ (mg/kg) * body\ weight\ (kg)]$$

As with other risk assessments, an RQ greater than LOC, would be a presumption of unacceptable ecological risk. An RQ less than LOC would be a presumption of acceptable risk with only minor, temporary, or localized effects to species.

Aquatic exposure

Exposures to aquatic habitats (e.g., wetlands, meadows, ephemeral pools, water delivery ditches) would be evaluated separately for ground-based pesticide treatments of habitats managed for fish and wildlife compared with cropland/facilities maintenance. The primary exposure pathway for aquatic organisms from any ground-based treatments likely would be particle drift during the pesticide application. However, different exposure scenarios would be necessary as a result of contrasting application equipment and techniques as well as pesticides used to control pests on agricultural lands (especially those cultivated by cooperative farmers for economic return from crop yields) and facilities maintenance (e.g., roadsides, parking lots, trails) compared with other managed habitats on the refuge. In addition, pesticide applications may be done less than 25 feet from the high water mark of aquatic habitats for habitat management treatments; whereas, no-spray buffers (25 feet or more) would be used for croplands/facilities maintenance treatments.

Habitat treatments

For the worst-case exposure scenario to non-target aquatic habitats, EECs (Table 4) would be would be derived from Urban and Cook (1986) that assumes an intentional overspray to an entire, non-target water body (1-foot depth) from a treatment less than 25 feet from the high water mark using the max application rate (acid basis [see above]). However, use of BMPs for applying pesticides (see Section 4.2) would likely minimize/eliminate potential drift to non-target aquatic habitats during actual treatments. If there would be unacceptable (acute or chronic) risk to fish and wildlife with the simulated 100 percent overspray (RQ greater than LOC), then the proposed pesticide use may be disapproved or the PUP would be approved at a lower application rate to minimize/eliminate unacceptable risk to aquatic organisms (RQ=LOC).

Table E.4 Estimated Environmental Concentrations (ppb) of pesticides in aquatic habitats (1 foot depth) immediately after direct application (Urban and Cook 1986)

Lbs/acre	EEC (ppb)
0.10	36.7
0.20	73.5
0.25	91.9
0.30	110.2
0.40	147.0
0.50	183.7
0.75	275.6
1.00	367.5
1.25	459.7
1.50	551.6
1.75	643.5
2.00	735.7
2.25	827.6
2.50	919.4
3.00	1103.5
4.00	1471.4
5.00	1839
6.00	2207
7.00	2575
8.00	2943
9.00	3311
10.00	3678

Cropland/facilities maintenance treatments

Field drift studies conducted by the Spray Drift Task Force, which is a joint project of several agricultural chemical businesses, were used to develop a generic spray drift database. From this database, the AgDRIFT computer model was created to satisfy EPA's pesticide registration spray drift data requirements and as a scientific basis to evaluate off-target movement of pesticides from particle drift and assess potential effects of exposure to wildlife. Several versions of the computer model have been developed (i.e., v2.01 through v2.10). The Spray Drift Task Force AgDRIFT® model version 2.01 (SDTF 2003, AgDRIFT 2001) would be used to derive EECs resulting from drift of pesticides to refuge aquatic resources from ground-based pesticide applications greater than 25 feet from the high water mark. The Spray Drift Task Force AgDRIFT model is publicly available at http://www.agridrift.com. At this website, click "AgDRIFT 2.0" and then click "Download Now" and follow the instructions to obtain the computer model.

The AgDRIFT model is composed of submodels called tiers. Tier I Ground submodel would be used to assess ground-based applications of pesticides. Tier outputs (EECs) would be calculated with AgDRIFT using the following input variables: max application rate (acid basis [see above]), low boom (20 inches), fine to medium/coarse droplet size, 20 swaths, EPA-defined wetland, and a buffer of 25 feet or more from the treated area to water.

E.7.2.2 Use of information on effects of biological control agents, pesticides, degradates, and adjuvants

The NEPA documents regarding biological and other environmental effects of biological control agents, pesticides, degradates, and adjuvants prepared by another Federal agency, where the scope would be relevant to evaluation of effects from pesticide uses on refuge lands, would be reviewed. Possible source agencies for such NEPA documents would include the Bureau of Land Management, U.S. Forest Service, National Park Service, U.S. Department of Agriculture-Animal and Plant Health Inspection Service, and the U.S. military services. It might be appropriate to incorporate by reference parts or all of existing document(s). Incorporating by reference (40 CFR 1502.21) is a technique used to avoid redundancies in analysis. It would also reduce the bulk of a Service NEPA document, which would only identify the documents that are incorporated by reference. In addition, relevant portions would be summarized in the Service's NEPA document to the extent necessary to provide the decision maker and public with an understanding of relevance of the referenced material to the current analysis.

In accordance with the requirements set forth in 40 CFR 1506.3, the Service would specifically adopt and incorporate through reference ecological risk assessments prepared by the U.S. Forest Service (http://www.fs.fed.us/r6/invasiveplant-eis/Risk-Assessments/Herbicides-Analyzed-InvPlant-EIS.htm) and Bureau of Land Management (http://www.blm.gov/wo/st/en/prog/more/veg_eis.html). These risk assessments and associated documentation also are available in total with the administrative record for the Final Environmental Impact Statement entitled *Pacific Northwest Region Invasive Plant Program – Preventing and Managing Invasive Plants* (U.S. Forest Service 2005) and *Vegetation Treatments Using Herbicides on Bureau of Land Management Lands in 17 Western States Programmatic EIS (PEIS)* (BLM 2007).

As a basis for completing "Chemical Profiles" for approving or disapproving refuge PUPs, ecological risk assessments for the following herbicide and adjuvant uses prepared by the U.S. Forest Service would be adopted and incorporated by reference:

- 2,4-D
- Chlorosulfuron
- Clopyralid
- Dicamba
- Glyphosate
- Imazapic
- Imazapyr
- Metsulfuron methyl
- Picloram
- Sethoxydim
- Sulfometuron methyl
- Triclopyr
- Nonylphenol polyethylate (NPE) based surfactants

As a basis for completing "Chemical Profiles" for approving or disapproving refuge PUPs, ecological risk assessments for the following herbicide uses as well as evaluation of risks associated with pesticide degradates and adjuvants prepared by the Bureau of Land Management would be adopted and incorporated by reference:

- Bromacil
- Chlorsulfuron
- Diflufenzopyr
- Diquat

- Diuron
- Fluridone
- Imazapic
- Overdrive
- Sulfometuron methyl
- Tebuthiuron
- Pesticide degradates and adjuvants (*Appendix D – Evaluation of risks from degradates, polyoxyethylene-amine (POEA) and R-11, and endocrine disrupting chemicals*)

E.7.2.3 Assumptions for ecological risk assessments

There are a number of assumptions involved with the ecological risk assessment process for terrestrial and aquatic organisms associated with utilization of the EPA's (2004) process. These assumptions may be risk neutral or may lead to an over- or under-estimation of risk from pesticide exposure depending upon site-specific conditions. The following describes these assumptions, their application to the conditions typically encountered, and whether or not they may lead to recommendations that are risk neutral, underestimate, or overestimate ecological risk from potential pesticide exposure.

- Indirect effects would not be evaluated by ecological risk assessments. These effects include the mechanisms of indirect exposure to pesticides: consuming prey items (fish, birds, or small mammals); reductions in the availability of prey items; and disturbance associated with pesticide application activities.
- Exposure to a pesticide product can be assessed based upon the active ingredient. However, exposure to a chemical mixture (pesticide formulation) may result in effects that are similar or substantially different compared to only the active ingredient. Non-target organisms may be exposed directly to the pesticide formulation or only various constituents of the formulation as they dissipate and partition in the environment. If toxicological information for both the active ingredient and formulated product are available, then data representing the greatest potential toxicity would be selected for use in the risk assessment process (EPA 2004). As a result, this conservative approach may lead to an overestimation of risk characterization from pesticide exposure.
- Because toxicity tests with listed or candidate species or closely related species are not available, data for surrogate species would be most often used for risk assessments. Specifically, bobwhite quail and mallard duck are the most frequently used surrogates for evaluating potential toxicity to federally listed avian species. Bluegill sunfish, rainbow trout, and fathead minnow are the most common surrogates for evaluating toxicity for freshwater fishes. However, sheep's head minnow can be an appropriate surrogate marine species for coastal environments. Rats and mice are the most common surrogates for evaluating toxicity for mammals. Interspecies sensitivity is a major source of uncertainty in pesticide assessments. As a result of this uncertainty, data is selected for the most sensitive species tested within a taxonomic group (birds, fish, and mammals) given the quality of the data is acceptable. If additional toxicity data for more species of organisms in a particular group are available, the selected data will not be limited to the species previously listed as common surrogates.
- The Kanaga nomogram outputs maximum EEC values that may be used to calculate an average daily concentration over a specified interval of time, which is referred to as a time-weighted-average (TWA). The maximum EEC would be selected as the exposure input for both acute and chronic risk assessments in the screening-level evaluations. The initial or maximum EEC derived from the Kanaga nomogram represents the maximum expected instantaneous or acute exposure to a pesticide. Acute toxicity endpoints are determined using a single exposure to a known pesticide concentration typically for 48 to 96 hours. This value is assumed to represent ecological risk from acute exposure to a pesticide. On the other hand, chronic risk to pesticide exposure is a

function of pesticide concentration and duration of exposure to the pesticide. An organism's response to chronic pesticide exposure may result from either the concentration of the pesticide, length of exposure, or some combination of both factors. Standardized tests for chronic toxicity typically involve exposing an organism to several different pesticide concentrations for a specified length of time (days, weeks, months, years or generations). For example, avian reproduction tests include a 10-week exposure phase. Because a single length of time is used in the test, time response data is usually not available for inclusion into risk assessments. Without time response data it is difficult to determine the concentration which elicited a toxicological response.

- Using maximum EECs for chronic risk estimates may result in an overestimate of risk, particularly for compounds that dissipate rapidly. Conversely, using TWAs for chronic risk estimates may underestimate risk if it is the concentration rather than the duration of exposure that is primarily responsible for the observed adverse effect. The maximum EEC would be used for chronic risk assessments although it may result in an overestimate of risk. TWAs may be used for chronic risk assessments, but they will be applied judiciously considering the potential for an underestimate or overestimate of risk. For example, the number of days exposure exceeds a Level of Concern may influence the suitability of a pesticide use. The greater the number of days the EEC exceeds the Level of Concern translates into greater the ecological risk. This is a qualitative assessment, and is subject to reviewer's expertise in ecological risk assessment and tolerance for risk.
- The length of time used to calculate the TWA can have a substantial effect on the exposure estimates and there is no standard method for determining the appropriate duration for this estimate. The T-REX model assumes a 21-week exposure period, which is equivalent to avian reproductive studies designed to establish a steady-state concentration for bioaccumulative compounds. However, this does not necessarily define the true exposure duration needed to elicit a toxicological response. Pesticides, which do not bioaccumulate, may achieve a steady-state concentration earlier than 21 weeks. The duration of time for calculating TWAs will require justification and it will not exceed the duration of exposure in the chronic toxicity test (approximately 70 days for the standard avian reproduction study). An alternative to using the duration of the chronic toxicity study is to base the TWA on the application interval. In this case, increasing the application interval would suppress both the estimated peak pesticide concentration and the TWA. Another alternative to using TWAs would be to consider the number of days that a chemical is predicted to exceed the LOC.
- Pesticide dissipation is assumed to be first-order in the absence of data suggesting alternative dissipation patterns such as bi-phasic. Field dissipation data would generally be the most pertinent for assessing exposure in terrestrial species that forage on vegetation. However, this data is often not available and it can be misleading particularly if the compound is prone to "wash-off." Soil half-life is the most common degradation data available. Dissipation or degradation data that would reflect the environmental conditions typical of refuge lands would be utilized, if available.
- For species found in the water column, it would be assumed that the greatest bioavailable fraction of the pesticide active ingredient in surface waters is freely dissolved in the water column.
- Actual habitat requirements of any particular terrestrial species are not considered, and it is assumed that species exclusively and permanently occupy the treated area, or adjacent areas receiving pesticide at rates commensurate with the treatment rate. This assumption would produce a maximum estimate of exposure for risk characterization. This assumption would likely lead to an overestimation of exposure for species that do not permanently and exclusively occupy the treated area (EPA 2004).
- Exposure through incidental ingestion of pesticide contaminated soil is not considered in the EPA risk assessment protocols. Research suggests less than 15 percent of the diet can consist of

incidentally ingested soil depending upon species and feeding strategy (Beyer et al. 1994). An assessment of pesticide concentrations in soil compared to food item categories in the Kanaga nomogram indicates incidental soil ingestion will not likely increase dietary exposure to pesticides. Inclusion of soil into the diet would effectively reduce the overall dietary concentration compared to the present assumption that the entire diet consists of a contaminated food source (Fletcher et al. 1994). An exception to this may be soil-applied pesticides in which exposure from incidental ingestion of soil may increase. Potential for pesticide exposure under this assumption may be underestimated for soil-applied pesticides and overestimated for foliar-applied pesticides. The concentration of a pesticide in soil would likely be less than predicted on food items.

- Exposure through inhalation of pesticides is not considered in the EPA risk assessment protocols. Such exposure may occur through three potential sources: spray material in droplet form at time of application, vapor phase with the pesticide volatilizing from treated surfaces, and airborne particulates (soil, vegetative matter, and pesticide dusts). The EPA (1990) reported exposure from inhaling spray droplets at the time of application is not an appreciable route of exposure for birds. According to research on mallards and bobwhite quail, respirable particle size (particles reaching the lung) in birds is limited to maximum diameter of 2 to 5 microns. The spray droplet spectra covering the majority of pesticide application scenarios indicate that less than 1 percent of the applied material is within the respirable particle size. This route of exposure is further limited because the permissible spray drop size distribution for ground pesticide applications is restricted to ASAE medium or coarser drop size distribution.
- Inhalation of a pesticide in the vapor phase may be another source of exposure for some pesticides under certain conditions. This mechanism of exposure to pesticides occurs post appplication and it would pertain to those pesticides with a high vapor pressure. The EPA is currently evaluating protocols for modeling inhalation exposure from pesticides including near-field and near-ground air concentrations based upon equilibrium and kinetics-based models. Risk characterization for exposure with this mechanism is unavailable.
- The effect from exposure to dusts contaminated with the pesticide cannot be assessed generically as partitioning issues related to application site soils and chemical properties of the applied pesticides render the exposure potential from this route highly situation specific.
- Dermal exposure may occur through three potential sources: direct application of spray to terrestrial wildlife in the treated area or within the drift footprint, incidental contact with contaminated vegetation, or contact with contaminated water or soil. Interception of spray and incidental contact with treated substrates may pose risks to avian wildlife (Driver et al. 1991). However, available research related to wildlife dermal contact with pesticides is extremely limited, except dermal toxicity values are common for some mammals used as human surrogates (rats and mice). The EPA is currently evaluating protocols for modeling dermal exposure. Risk characterization may be underestimated for this route of exposure, particularly with high risk pesticides such as some organophosphates or carbamate insecticides. If protocols are established by the EPA for assessing dermal exposure to pesticides, they will be considered for incorporation into pesticide assessment protocols.
- Exposure to a pesticide may occur from consuming surface water, dew, or other water on treated surfaces. Water soluble pesticides have potential to dissolve in surface runoff, and puddles in a treated area may contain pesticide residues. Similarly, pesticides with lower organic carbon partitioning characteristics and higher solubility in water have a greater potential to dissolve in dew and other water associated with plant surfaces. Estimating the extent to which such pesticide loadings to drinking water occurs is complex and would depend upon the partitioning characteristics of the active ingredient, soils types in the treatment area, and the meteorology of the treatment area. In addition, the use of various water sources by wildlife is highly species-specific. Currently, risk characterization for this exposure mechanism is not available. The EPA

is actively developing protocols to quantify drinking water exposures from puddles and dew. If and when protocols are formally established by the EPA for assessing exposure to pesticides through drinking water, these protocols will be incorporated into pesticide risk assessment protocols.

- Risk assessments are based upon the assumption that the entire treatment area would be subject to pesticide application at the rates specified on the label. In most cases, there is potential for uneven application of pesticides through such plausible incidents such as changes in calibration of application equipment, spillage, and localized releases at specific areas in or near the treated field that are associated with mixing and handling and application equipment as well as applicator skill. Inappropriate use of pesticides and the occurrence of spills represent a potential underestimate of risk. It is likely not an important factor for risk characterization. All pesticide applicators are required to be certified by the state in which they apply pesticides. Certification training includes the safe storage, transport, handling, and mixing of pesticides, equipment calibration and proper application with annual continuing education.
- The EPA relies on Fletcher (1994) for setting the assumed pesticide residues in wildlife dietary items. The EPA (2004) "believes that these residue assumptions reflect a realistic upper-bound residue estimate, although the degree to which this assumption reflects a specific percentile estimate is difficult to quantify." Fletcher's (1994) research suggests that the pesticide active ingredient residue assumptions used by the EPA represent a 95th percentile estimate. However, research conducted by Pfleeger et al. (1996) indicates EPA residue assumptions for short grass was not exceeded. Behr and Habig (2000) compared EPA residue assumptions with distributions of measured pesticide residues for the EPA's UTAB database. Overall residue selection level will tend to overestimate risk characterization. This is particularly evident when wildlife individuals are likely to have selected a variety of food items acquired from multiple locations. Some food items may be contaminated with pesticide residues whereas others are not contaminated. However, it is important to recognize differences in species feeding behavior. Some species may consume whole above-ground plant material, but others will preferentially select different plant structures. Also, species may preferentially select a food item although multiple food items may be present. Without species-specific knowledge regarding foraging behavior, characterizing ecological risk other than in general terms is not possible.
- Acute and chronic risk assessments rely on comparisons of wildlife dietary residues with LC50 or NOEC values expressed as concentrations of pesticides in laboratory feed. These comparisons assume that ingestion of food items in the field occurs at rates commensurate with those in the laboratory. Although the screening assessment process adjusts dry-weight estimates of food intake to reflect the increased mass in fresh-weight wildlife food intake estimates, it does not allow for gross energy and assimilative efficiency differences between wildlife food items and laboratory feed. Differences in assimilative efficiency between laboratory and wild diets suggest that current screening assessment methods are not accounting for a potentially important aspect of food requirements.
- There are several other assumptions that can affect non-target species not considered in the risk assessment process. These include possible additive or synergistic effects from applying two or more pesticides or additives in a single application, co-location of pesticides in the environment, cumulative effects from pesticides with the same mode of action, effects of multiple stressors (e.g., combination of pesticide exposure, adverse abiotic and biotic factors) and behavioral changes induced by exposure to a pesticide. These factors may exist at some level contributing to adverse affects to non-target species, but they are usually characterized in the published literature in only a general manner limiting their value in the risk assessment process.
- It is assumed that aquatic species exclusively and permanently occupy the water body being assessed. Actual habitat requirements of aquatic species are not considered. With the possible exception of scenarios where pesticides are directly applied to water, it is assumed that no habitat

use considerations specific for any species would place the organisms in closer proximity to pesticide use sites. This assumption produces a maximum estimate of exposure or risk characterization. It would likely be realistic for many aquatic species that may be found in aquatic habitats within or in close proximity to treated terrestrial habitats. However, the spatial distribution of wildlife is usually not random because wildlife distributions are often related to habitat requirements of species. Clumped distributions of wildlife may result in an under- or over-estimation of risk depending upon where the initial pesticide concentration occurs relative to the species or species habitat.

- For species found in the water column, it would be assumed that the greatest bioavailable fraction of the pesticide active ingredient in surface waters is freely dissolved in the water column. Additional chemical exposure from materials associated with suspended solids or food items is not considered because partitioning onto sediments likely is minimal. Adsorption and bioconcentration occur at lower levels for many newer pesticides compared with older, more persistent bioaccumulative compounds. Pesticides with RQs close to the listed species level of concern, the potential for additional exposure from these routes may be a limitation of risk assessments, where potential pesticide exposure or risk may be underestimated.
- Mass transport losses of pesticide from a water body (except for losses by volatilization, degradation and sediment partitioning) would not be considered for ecological risk assessment. The water body would be assumed to capture all pesticide active ingredients entering as runoff, drift, and adsorbed to eroded soil particles. It would also be assumed that pesticide active ingredient is not lost from the water body by overtopping or flowthrough, nor is concentration reduced by dilution. In total, these assumptions would lead to a near maximum possible water-borne concentration. However, this assumption would not account for potential to concentrate pesticide through the evaporative loss. This limitation may have the greatest impact on water bodies with high surface-to-volume ratios such as ephemeral wetlands, where evaporative losses are accentuated and applied pesticides have low rates of degradation and volatilization.
- For acute risk assessments, there would be no averaging time for exposure. An instantaneous peak concentration would be assumed, where instantaneous exposure is sufficient in duration to elicit acute effects comparable to those observed over more protracted exposure periods (typically 48 to 96 hours) tested in the laboratory. In the absence of data regarding time-to-toxic event, analyses and latent responses to instantaneous exposure, risk would likely be overestimated.
- For chronic exposure risk assessments, the averaging times considered for exposure are commensurate with the duration of invertebrate life-cycle or fish-early life stage tests (e.g., 21-28 days and 56-60 days, respectively). Response profiles (time to effect and latency of effect) to pesticides likely vary widely with mode of action and species and should be evaluated on a case-by-case basis as available data allow. Nevertheless, because the EPA relies on chronic exposure toxicity endpoints based on a finding of no observed effect, the potential for any latent toxicity effects or averaging time assumptions to alter the results of an acceptable chronic risk assessment prediction is limited. The extent to which duration of exposure from water-borne concentrations overestimate or underestimate actual exposure depends on several factors. These include the following: localized meteorological conditions, runoff characteristics of the watershed (e.g., soils, topography), the hydrological characteristics of receiving waters, environmental fate of the pesticide active ingredient, and the method of pesticide application. It should also be understood that chronic effects studies are performed using a method that holds water concentration in a steady state. This method is not likely to reflect conditions associated with pesticide runoff. Pesticide concentrations in the field increase and decrease in surface water on a cycle influenced by rainfall, pesticide use patterns, and degradation rates. As a result of the dependency of this assumption on several undefined variables, risk associated with chronic exposure may in some situations underestimate risk and overestimate risk in others.

- There are several other factors that can affect non-target species not considered in the risk assessment process. These would include the following: possible additive or synergistic effects from applying two or more pesticides or additives in a single application, collocation of pesticides in the environment, cumulative effects from pesticides with the same mode of action, effects of multiple stressors (e.g., combination of pesticide exposure, adverse abiotic [not pesticides] and biotic factors), and sub-lethal effects such as behavioral changes induced by exposure to a pesticide. These factors may exist at some level contributing to adverse affects to non-target species, but they are not routinely assessed by regulatory agencies. Therefore, information on the factors is not extensive, limiting their value for the risk assessment process. As this type of information becomes available, it would be included, either quantitatively or qualitatively, in this risk assessment process.
- The EPA is required by the Food Quality Protection Act to assess the cumulative risks of pesticides that share common mechanisms of toxicity, or act the same within an organism. Currently, EPA has identified four groups of pesticides that have a common mechanism of toxicity requiring cumulative risk assessments. These four groups are the organophosphate insecticides, N-methyl carbamate insecticides, triazine herbicides, and chloroacetanilide herbicides.

E.7.3 Pesticide Mixtures and Degradates

Pesticide products are usually a formulation of several components generally categorized as active ingredients and inert or other ingredients. The term active ingredient is defined by the FIFRA as preventing, destroying, repelling, or mitigating the effects of a pest, or it is a plant regulator, defoliant, desiccant, or nitrogen stabilizer. In accordance with FIFRA, the active ingredient(s) must be identified by name(s) on the pesticide label along with its relative composition expressed in percentage(s) by weight. In contrast, inert ingredient(s) are not intended to affect a target pest. Their role in the pesticide formulation is to act as a solvent (keep the active ingredient is a liquid phase), an emulsifying or suspending agent (keep the active ingredient from separating out of solution), or a carrier such as clay in which the active ingredient is impregnated on the clay particle in dry formulations. For example, if isopropyl alcohol would be used as a solvent in a pesticide formulation, then it would be considered an inert ingredient. FIFRA only requires that inert ingredients identified as hazardous and associated percent composition, and the total percentage of all inert ingredients must be declared on a product label. Inert ingredients that are not classified as hazardous are not required to be identified.

The EPA (September 1997) issued Pesticide Regulation Notice 97-6, which encouraged manufacturers, formulators, producers, and registrants of pesticide products to voluntarily substitute the term “other ingredients” for “inert ingredients” in the ingredient statement. This change recognized that all components in a pesticide formulation potentially could elicit or contribute to an adverse effect on non-target organisms and, therefore, are not necessarily inert. Whether referred to as “inerts” or “other ingredients,” these constituents within a pesticide product have the potential to affect species or environmental quality. The EPA categorizes regulated inert ingredients into the following four lists (http://www.epa.gov/opprd001/inerts/index.html):

- List 1 – Inert Ingredients of Toxicological Concern
- List 2 – Potentially Toxic Inert Ingredients
- List 3 – Inerts of Unknown Toxicity
- List 4 – Inerts of Minimal Toxicity

Several of the List 4 compounds are naturally-occurring earthen materials (e.g., clay materials, simple salts) that would not elicit toxicological response at applied concentrations. However, some of the inerts (particularly the List 3 compounds and unlisted compounds) may have moderate to high potential toxicity to aquatic species based on MSDSs or published data.

Comprehensively assessing potential effects to non-target fish, wildlife, plants, and/or their habitats from pesticide use is a complex task. It would be preferable to assess the cumulative effects from exposure to the active ingredient, its degradates, and inert ingredients as well as other active ingredients in the spray mixture. However, it would only be feasible to conduct deterministic risk assessments for each component in the spray mixture singly. Limited scientific information is available regarding ecological effects (additive or synergistic) from chemical mixtures that typically rely upon broadly encompassing assumptions. For example, the U.S. Forest Service (2005) found that mixtures of pesticides used in land (forest) management likely would not cause additive or synergistic effects to non-target species based upon a review of scientific literature regarding toxicological effects and interactions of agricultural chemicals (ATSDR 2004, EPA-ORD 2000). Moreover, information on inert ingredients, adjuvants, and degradates is often limited by the availability of and access to reliable toxicological data for these constituents.

Toxicological information regarding "other ingredients" may be available from sources such as the following:

- TOMES (a proprietary toxicological database including EPA's IRIS, the Hazardous
- Substance Data Bank, the Registry of Toxic Effects of Chemical Substances [RTECS]).
- EPA's ECOTOX database, which includes AQUIRE (a database containing scientific papers published on the toxic effects of chemicals to aquatic organisms).
- TOXLINE (a literature searching tool).
- Material Safety Data Sheets (MSDSs) from pesticide suppliers.
- Other sources such as the Farm Chemicals Handbook.

Because there is a lack of specific inert toxicological data, inert(s) in a pesticide may cause adverse ecological effects. However, inert ingredients typically represent only a small percentage of the pesticide spray mixture, it would be assumed that negligible effects would be expected to result from inert ingredient(s).

Although the potential effects of degradates should be considered when selecting a pesticide, it is beyond the scope of this assessment process to consider all possible breakdown chemicals of the various product formulations containing an active ingredient. Degradates may be more or less mobile and more or less hazardous in the environment than their parent pesticides (Battaglin et al. 2003). Differences in environmental behavior (e.g., mobility) and toxicity between parent pesticides and degradates would make assessing potential degradate effects extremely difficult. For example, a less toxic and more mobile, bioaccumulative, or persistent degradate may have potentially greater effects on species and/or degrade environmental quality. The lack of data on the toxicity of degradates for many pesticides would represent a source of uncertainty for assessing risk.

An EPA-approved label specifies whether a product can be mixed with one or more pesticides. Without product-specific toxicological data, it would not possible to quantify the potential effects of these mixtures. In addition, a quantitative analysis could only be conducted if reliable scientific information allowed a determination of whether the joint action of a mixture would be additive, synergistic, or antagonistic. Such information would not likely exist unless the mode of action would be common among the chemicals and receptors. Moreover, the composition of and exposure to mixtures would be highly site- and/or time-specific and, therefore, it would be nearly impossible to assess potential effects to species and environmental quality.

To minimize or eliminate potential negative effects associated with applying two or more pesticides as a mixture, the use would be conducted in accordance with the labeling requirements. Labels for two or more pesticides applied as a mixture should be completely reviewed, where products with the least potential for negative effects would be selected for use on the refuge. This is especially relevant when a mixture would be applied in a manner that may already have the potential for an effect(s) associated with an individual pesticide (e.g., runoff to ponds in sandy watersheds). Use of a tank mix under these conditions would increase the level of uncertainty in terms of risk to species or potential to degrade environmental quality.

Adjuvants generally function to enhance or prolong the activity of pesticide. For terrestrial herbicides, adjuvants aid in the absorption into plant tissue. Adjuvant is a broad term that generally applies to surfactants, selected oils, anti-foaming agents, buffering compounds, drift control agents, compatibility agents, stickers, and spreaders. Adjuvants are not under the same registration requirements as pesticides and the EPA does not register or approve the labeling of spray adjuvants. Individual pesticide labels identify types of adjuvants approved for use with it. In general, adjuvants compose a relatively small portion of the volume of pesticides applied. Selection of adjuvants with limited toxicity and low volumes would be recommended to reduce the potential for the adjuvant to influence the toxicity of the pesticide.

E.7.4 Determining Effects to Soil and Water Quality

The approval process for pesticide uses would consider potential to degrade water quality on and off the refuge. A pesticide can only affect water quality through movement away from the treatment site. After application, pesticide mobilization can be characterized by one or more of the following (Kerle et al. 1996):

- Attach (sorb) to soil, vegetation, or other surfaces and remain at or near the treated area;
- Attach to soil and move off-site through erosion from run-off or wind;
- Dissolve in water that can be subjected to run-off or leaching.

As an initial screening tool, selected chemical characteristics and rating criteria for a pesticide can be evaluated to assess potential to enter ground and/or surface waters. These would include the following: persistence, sorption coefficient (Koc), groundwater ubiquity score (GUS), and solubility.

Persistence, which is expressed as half-life (t½), represents the length of time required for 50 percent of the deposited pesticide to degrade (completely or partially). Persistence in the soil can be categorized as the following: non-persistent less than 30 days, moderately persistent 30 to 100 days, and persistent less than 100 days (Kerle et al. 1996). Half-life data is usually available for aquatic and terrestrial environments.

Another measure of pesticide persistence is dissipation time (DT50). It represents the time required for 50 percent of the deposited pesticide to degrade and move from a treated site; whereas, half-life describes the rate for degradation only. As for half-life, units of dissipation time are usually expressed in days. Field or foliar dissipation time is the preferred data for use to estimate pesticide concentrations in the environment. However, soil half-life is the most common persistence data cited in the published literature. If field or foliar dissipation data is not available, soil half-life data may be used. The average or representative half-life value of most important degradation mechanism will be selected for quantitative analysis for both terrestrial and aquatic environments.

Mobility of a pesticide is a function of how strongly it is adsorbed to soil particles and organic matter, its solubility in water, and its persistence in the environment. Pesticides strongly adsorbed to soil particles, relatively insoluble in water, and not environmentally persistent wound be less likely to move across the soil surface into surface waters or to leach through the soil profile and contaminate groundwater. Conversely, pesticides that are not strongly adsorbed to soil particles, are highly water soluble, and are persistent in the environment would have greater potential to move from the application site (off-site movement).

The degree of pesticide adsorption to soil particles and organic matter (Kerle et al. 1996) is expressed as the soil adsorption coefficient (Koc). The soil adsorption coefficient is measured as micrograms of pesticide per gram of soil (µg/g) that can range from near zero to the thousands. Pesticides with higher Koc values are strongly sorbed to soil and, therefore, would be less subject to movement.

Water solubility describes the amount of pesticide that will dissolve in a known quantity of water. The water solubility of a pesticide is expressed as milligrams of pesticide dissolved in a liter of water (mg/l or ppm). Pesticide with solubility less than 0.1 ppm are virtually insoluble in water, 100-1,000 ppm are moderately soluble, and greater than 10,000 ppm highly soluble (U.S. Geological Survey 2000). As pesticide solubility increases, there would be greater potential for off-site movement.

The Groundwater Ubiquity Score (GUS) is a quantitative screening tool to estimate a pesticide's potential to move in the environment. It utilizes soil persistence and adsorption coefficients in the following formula.

$$GUS = \log10\ (t½) \times [4 - \log10\ (Koc)]$$

The potential pesticide movement rating would be based upon its GUS value. Pesticides with a GUS less than 0.1 would be considered to have an extremely low potential to move toward groundwater. Values of 1.0-2.0 would be low, 2.0-3.0 would be moderate, 3.0-4.0 would be high, and greater than 4.0 would have a very high potential to move toward groundwater.

Water solubility describes the amount of pesticide dissolving in a specific quantity of water, where it is usually measured as mg/l or parts per million (ppm). Solubility is useful as a comparative measure because pesticides with higher values are more likely to move by runoff or leaching. The GUS, water solubility, t½, and Koc values are available for selected pesticides from the Oregon State University Extension Pesticide Properties Database at http://npic.orst.edu/ppdmove.htm. Many of the values in this database were derived from the SCS/ARS/CES Pesticide Properties Database for Environmental Decision Making (Wauchope et al.1992).

Soil properties influence the fate of pesticides in the environment. The following six properties are mostly likely to affect pesticide degradation and the potential for pesticides to move off-site by leaching (vertical movement through the soil) or runoff (lateral movement across the soil surface).

- Permeability is the rate of water movement vertically through the soil. It is affected by soil texture and structure. Coarse textured soils (e.g., high sand content) have a larger pore size and they are generally more permeable than fine textured soils (i.e., high clay content). The more permeable soils would have a greater potential for pesticides to move vertically down through the soil profile. Soil permeability rates (inches/hour) are usually available in county soil survey reports.
- Soil texture describes the relative percentage of sand, silt, and clay. In general, greater clay content with smaller pore size would lower the likelihood and rate at which water would move through the soil profile. Clay also serves to adsorb (bind) pesticides to soil particles. Soils with high clay content would adsorb more pesticide than soils with relatively low clay content. In contrast, sandy soils with coarser texture and lower water holding capacity would have a greater potential for water to leach through them.

- Soil structure describes soil aggregation. Soils with a well developed soil structure have looser, more aggregated, structure that would be less likely to be compacted. Both characteristics would allow for less restricted flow of water through the soil profile resulting in greater infiltration.
- Organic matter would be the single most important factor affecting pesticide adsorption in soils. Many pesticides are adsorbed to organic matter which would reduce their rate of downward movement through the soil profile. Also, soils high in organic matter would tend to hold more water, which may make less water available for leaching.
- Soil moisture affects how fast water would move through the soil. If soils are already wet or saturated before rainfall or irrigation, excess moisture would runoff rather than infiltrate into the soil profile. Soil moisture also would influence microbial and chemical activity in soil, which effects pesticide degradation.
- Soil pH would influence chemical reactions that occur in the soil, which in turn determines whether or not a pesticide will degrade, rate of degradation, and, in some instances, which degradation products are produced.

Based upon the aforementioned properties, soils most vulnerable to groundwater contamination would be sandy soils with low organic matter. In contrast, the least vulnerable soils would be well-drained clayey soils with high organic matter. Consequently, pesticides with the lowest potential for movement in conjunction with appropriate BMPs (see below) would be used in an IPM framework to treat pests while minimizing effects to non-target biota and protecting environmental quality.

Along with soil properties, the potential for a pesticide to affect water quality through run-off and leaching would consider site-specific environmental and abiotic conditions including rainfall, water table conditions, and topography (Huddleston 1996).

- Water is necessary to separate pesticides from soil. This can occur in two basic ways. Pesticides that are soluble move easily with runoff water. Pesticide-laden soil particles can be dislodged and transported from the application site in runoff. The concentration of pesticides in the surface runoff would be greatest for the first runoff event following treatment. The rainfall intensity and route of water infiltration into soil, to a large extent, determine pesticide concentrations and losses in surface runoff. The timing of the rainfall after application also would have an effect. Rainfall interacts with pesticides at a shallow soil depth (¼ to ½ inch), which is called the mixing zone (Baker and Miller 1999). The pesticide/water mixture in the mixing zone would tend to leach down into the soil or runoff depending upon how quickly the soil surface becomes saturated and how rapidly water can infiltrate into the soil. Leaching would decrease the amount of pesticide available near the soil surface (mixing zone) to runoff during the initial rainfall event following application and subsequent rainfall events.
- Terrain slope would affect the potential for surface runoff and the intensity of runoff. Steeper slopes would have greater potential for runoff following a rainfall event. In contrast, soils that are relatively flat would have little potential for runoff, except during intense rainfall events. In addition, soils in lower areas would be more susceptible to leaching as a result of receiving excessive water from surrounding higher elevations.
- Depth to groundwater would be an important factor affecting the potential for pesticides to leach into groundwater. If the distance from the soil surface to the top of the water table is shallow, pesticides would have less distance to travel to reach groundwater. Shallower water tables that persist for longer periods would be more likely to experience groundwater contamination. Soil survey reports are available for individual counties. These reports provide data in tabular format regarding the water table depths and the months during which it is persists. In some situations, a hard pan exists above the water table that would prevent pesticide contamination from leaching.

E.7.5 Determining Effects to Air Quality

Pesticides may volatilize from soil and plant surfaces and move from the treated area into the atmosphere. The potential for a pesticide to volatilize is determined by the pesticide's vapor pressure which would be affected by temperature, sorption, soil moisture, and the pesticide's water solubility. Vapor pressure is often expressed in mm Hg. To make these numbers easier to compare, vapor pressure may be expressed in exponent form (I x 10-7), where I represents a vapor pressure index. In general, pesticides with I less than10 would have a low potential to volatilize; whereas, pesticides with I greater than 1,000 would have a high potential to volatilize (Oregon State University 1996). Vapor pressure values for pesticides are usually available in the pesticide product MSDS or the USDA Agricultural Research Service (ARS) pesticide database.

E.7.6 Preparing a Chemical Profile

The following instructions would be used by Service personnel to complete Chemical Profiles for pesticides. Specifically, profiles would be prepared for pesticide active ingredients (e.g., glyphosate, imazapic) that would be contained in one or more trade name products that are registered and labeled with EPA. All information fields under each category (e.g., Toxicological Endpoints, Environmental Fate) would be completed for a Chemical Profile. If no information is available for a specific field, then "No data is available in references" would be recorded in the profile. Available scientific information would be used to complete Chemical Profiles. Each entry of scientific information would be shown with applicable references.

Completed Chemical Profiles would provide a structured decision-making process utilizing quantitative assessment/screening tools with threshold values (where appropriate) that would be used to evaluate potential biological and other environmental effects to refuge resources. For ecological risk assessments presented in these profiles, the "worst-case scenario" would be evaluated to determine whether a pesticide could be approved for use considering the maximum single application rate specified on pesticide labels for habitat management and croplands/facilities maintenance treatments pertaining to refuges. Where the "worst-case scenario" likely would only result in minor, temporary, and localized effects to listed and non-listed species with appropriate BMPs (see Section 5.0), the proposed pesticide's use in a PUP would have a scientific basis for approval under any application rate specified on the label that is at or below rates evaluated in a Chemical Profile. In some cases, the Chemical Profile would include a lower application rate than the maximum labeled rate in order to protect refuge resources. As necessary, Chemical Profiles would be periodically updated with new scientific information or as pesticides with the same active ingredient are proposed for use on the refuge in PUPs.

Throughout this section, threshold values (to prevent or minimize potential biological and environmental effects) would be clearly identified for specific information presented in a completed Chemical Profile. Comparison with these threshold values provides an explicit scientific basis to approve or disapprove PUPs for habitat management and cropland/facilities maintenance on the refuge. In general, PUPs would be approved for pesticides with Chemical Profiles where there would be no exceedances of threshold values. However, BMPs are identified for some screening tools that would minimize/eliminate potential effects (exceedance of the threshold value) as a basis for approving PUPs.

E.7.6.1 Date

Service personnel would record the date when the Chemical Profile is completed or updated. Chemical Profiles (e.g., currently approved pesticide use patterns) would be periodically reviewed and updated, as necessary. The most recent review date would be recorded on a profile to document when it was last updated.

E.7.6.2 Trade Name(s)

Service personnel would accurately and completely record the trade name(s) from the pesticide label, which includes a suffix that describes the formulation (e.g., WP, DG, EC, L, SP, I, II or 64). The suffix often distinguishes a specific product among several pesticides with the same active ingredient. Service personnel would record a trade name for each pesticide product with the same active ingredient.

E.7.6.3 Common chemical name(s)

Service personnel would record the common name(s) listed on the pesticide label or material safety data sheet (MSDS) for an active ingredient. The common name of a pesticide is listed as the active ingredient on the title page of the product label immediately following the trade name, and the MSDS, Section 2: Composition/Information on Ingredients. A Chemical Profile is completed for each active ingredient.

E.7.6.4 Pesticide Type

Service personnel would record the type of pesticide for an active ingredient as one of the following: herbicide, dessicant, fungicide, fumigant, growth regulator, insecticide, pisicide, or rodenticide.

E.7.6.5 EPA Registration Number(s)

This number (EPA Reg. No.) appears on the title page of the label and MSDS, Section 1: Chemical Product and Company Description. It is not the EPA Establishment Number that is usually located near it. Service personnel would record the EPA Reg. No. for each trade name product with an active ingredient based upon PUPs.

E.7.6.6 Pesticide Class

Service personnel would list the general chemical class for the pesticide (active ingredient). For example, malathion is an organophosphate and carbaryl is a carbamate.

E.7.6.7 CAS (Chemical Abstract Service) Number

This number is often located in the second section (Composition/Information on Ingredients) of the MSDS. The MSDS table listing components usually contains this number immediately prior to or following the percent composition.

E.7.6.8 Other Ingredients

From the most recent MSDS for the proposed pesticide product(s), Service personnel would include any chemicals in the pesticide formulation not listed as an active ingredient that are described as toxic or hazardous, or regulated under the Superfund Amendments and Reauthorization Act (SARA), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Toxic Substances Control Act (TSCA), Occupational Safety and Health Administration (OSHA), State Right-to-Know, or other listed authorities. These are usually found in MSDS sections titled “Hazardous Identifications,” “Exposure Control/Personal Protection,” and “Regulatory Information.” If concentrations of other ingredients are available for any compounds identified as toxic or hazardous, then Service personnel would record this information in the Chemical Profile by trade name. MSDS(s) may be obtained from the manufacturer, manufacturer’s website or from an online database maintained by Crop Data Management Systems, Inc. (see list below).

E.7.6.9 Toxicological Endpoints

Toxicological endpoint data would be collected for acute and chronic tests with mammals, birds, and fish. Data would be recorded for species available in the scientific literature. If no data are found for a particular taxonomic group, then "No data available is references" would be recorded as the data entry. Throughout the Chemical Profile, references (including toxicological endpoint data) would be cited using parentheses (#) following the recorded data.

E.7.6.10 Mammalian LD50

For test species in the scientific literature, Service personnel would record available data for oral lethal dose (LD50) in mg/kg-bw (body weight) or ppm-bw. Most common test species in scientific literature are the rat and mouse. The lowest LD50 value found for a rat would be used as a toxicological endpoint for dose-based RQ calculations to assess acute risk to mammals (see Table 1 in Section 7.1).

E.7.6.11 Mammalian LC50

For test species in the scientific literature, Service personnel would record available data for dietary lethal concentration (LC50) as reported (e.g., mg/kg-diet or ppm-diet). Most common test species in scientific literature are the rat and mouse. The lowest LC50 value found for a rat would be used as a toxicological endpoint for diet-based RQ calculations to assess acute risk (see Table 1 in Section 7.1).

E.7.6.12 Mammalian Reproduction

For test species listed in the scientific literature, Service personnel would record the test results (e.g., Lowest Observed Effect Concentration [LOEC], Lowest Observed Effect Level [LOEL], No Observed Adverse Effect Level [NOAEL], No Observed Adverse Effect Concentration [NOAEC]) in mg/kg-bw or mg/kg-diet for reproductive test procedure(s) (e.g., generational studies [preferred], fertility, newborn weight). Most common test species available in scientific literature are rats and mice. The lowest NOEC, NOAEC, NOEL, or NOAEL test results found for a rat would be used as a toxicological endpoint for RQ calculations to assess chronic risk (see Table 1 in Section 7.1).

E.7.6.13 Avian LD50

For test species available in the scientific literature, Service personnel would record values for oral lethal dose (LD50) in mg/kg-bw or ppm-bw. Most common test species available in scientific literature are the bobwhite quail and mallard. The lowest LD50 value found for an avian species would be used as a toxicological endpoint for dose-based RQ calculations to assess acute risk (see Table 1 in Section 7.1).

E.7.6.14 Avian LC50

For test species available in the scientific literature, Service personnel would record values for dietary lethal concentration (LC50) as reported (e.g., mg/kg-diet or ppm-diet). Most common test species available in scientific literature are the bobwhite quail and mallard. The lowest LC50 value found for an avian species would be used as a toxicological endpoint for dietary-based RQ calculations to assess acute risk (see Table 1 in Section 7.1).

E.7.6.15 Avian Reproduction

For test species available in the scientific literature, Service personnel would record test results (e.g., LOEC, LOEL, NOAEC, NOAEL) in mg/kg-bw or mg/kg-diet consumed for reproductive test procedure(s) (e.g., early life cycle, reproductive). Most common test species available in scientific literature are the bobwhite quail and mallard. The lowest NOEC, NOAEC, NOEL, or NOAEL test results found for an avian species would be used as a toxicological endpoint for RQ calculations to assess chronic risk (see Table 1 in Section 7.1).

E.7.6.16 Fish LC50

For test freshwater or marine species listed in the scientific literature, Service personnel would record a LC50 in ppm or mg/L. Most common test species available in the scientific literature are the bluegill, rainbow trout, and fathead minnow (marine). Test results for many game species may also be available. The lowest LC50 value found for a freshwater fish species would be used as a toxicological endpoint for RQ calculations to assess acute risk (see Table 1 in Section 7.1).

E.7.6.17 Fish Early Life Stage (ELS)/Life Cycle

For test freshwater or marine species available in the scientific literature, Service personnel would record test results (e.g., LOEC, NOAEL, NOAEC, LOAEC) in ppm for test procedure(s) (e.g., early life cycle, life cycle). Most common test species available in the scientific literature are bluegill, rainbow trout, and fathead minnow. Test results for other game species may also be available. The lowest test value found for a fish species (preferably freshwater) would be used as a toxicological endpoint for RQ calculations to assess chronic risk (see Table 1 in Section 7.1).

E.7.6.18 Other

For test invertebrate as well as non-vascular and vascular plant species available in the scientific literature, Service personnel would record LC50, LD50, LOEC, LOEL, NOAEC, NOAEL, or EC50 (environmental concentration) values in ppm or mg/L. Most common test invertebrate species available in scientific literature are the honey bee and the water flea (*Daphnia magna*). Green algae (*Selenastrum capricornutum*) and pondweed (*Lemna minor*) are frequently available test species for aquatic nonvascular and vascular plants, respectively.

E.7.7 Ecological Incident Reports

After a site has been treated with pesticide(s), wildlife may be exposed to these chemical(s). When exposure is high relative to the toxicity of the pesticides, wildlife may be killed or visibly harmed (incapacitated). Such events are called ecological incidents. The EPA maintains a database (Ecological Incident Information System) of ecological incidents. This database stores information extracted from incident reports submitted by various Federal and state agencies and non-government organizations. Information included in an incident report is date and location of the incident, type and magnitude of affects observed in various species, use(s) of pesticides known or suspected of contributing to the incident, and results of any chemical residue and cholinesterase activity analyses conducted during the investigation.

Incident reports can play an important role in evaluating the effects of pesticides by supplementing quantitative risk assessments. All incident reports for pesticide(s) with the active ingredient and associated information would be recorded.

E.7.8 Environmental Fate

E.7.8.1 Water Solubility

Service personnel would record values for water solubility (Sw), which describes the amount of pesticide that dissolves in a known quantity of water. Sw is expressed as mg/L (ppm). Pesticide Sw values would be categorized as one of the following: insoluble less than 0.1 ppm, moderately soluble = 100 to 1,000 ppm, highly soluble greater than 10,000 ppm (U.S. Geological Survey 2000). As pesticide Sw increases, there would be greater potential to degrade water quality through runoff and leaching. Sw would be used to evaluate potential for bioaccumulation in aquatic species [see Octanol-Water Partition Coefficient (Kow) below].

E.7.8.2 Soil Mobility

Service personnel would record available values for soil adsorption coefficient (Koc [µg/g]). It provides a measure of a chemical's mobility and leaching potential in soil. Koc values are directly proportional to organic content, clay content, and surface area of the soil. Koc data for a pesticide may be available for a variety of soil types (e.g., clay, loam, sand). Koc values would be used in evaluating the potential to degrade groundwater by leaching (see Potential to Move to Groundwater below).

E.7.8.3 Soil Persistence

Service personnel would record values for soil half-life (t½), which represents the length of time (days) required for 50 percent of the deposited pesticide to degrade (completely or partially) in the soil. Based upon the t½ value, soil persistence would be categorized as one of the following: non-persistent less than 30 days, moderately persistent 30 to 100 days, and persistent greater than 100 days (Kerle et al. 1996).

Threshold for Approving PUPs:

If soil t½ 100 days or less, then a PUP would be approved without additional BMPs to protect water quality.

If soil t½ is greater than 100 days, then a PUP would only be approved with additional BMPs specifically to protect water quality. One or more BMPs such as the following would be included in the Specific Best Management Practices (BMPs) section *to minimize potential surface run-off and leaching that can degrade water quality:*

- *Do not exceed one application per site per year.*
- *Do not use on coarse-textured soils where the groundwater table is less than 10 feet and average annual precipitation greater than 12 inches.*
- *Do not use on steep slopes if substantial rainfall is expected within 24 hours or ground is saturated.*

Along with Koc, soil t½ values would be used in evaluating the potential to degrade groundwater by leaching (see Potential to Move to Groundwater below).

E.7.8.4 Soil Dissipation

Dissipation time (DT50) represents the time required for 50 percent of the deposited pesticide to degrade and move from a treated site; whereas, soil t½ describes the rate for degradation only.
As for t½, units of dissipation time are usually expressed in days. Field dissipation time would be the preferred data for use to estimate pesticide concentrations in the environment because it is based upon field studies compared to soil t½, which is derived in a laboratory. However, soil t½ is the most common persistence data available in the published literature. If field dissipation data is not available, soil half-life data would be used in a Chemical Profile. The average or representative half-life value of most important

degradation mechanism would be selected for quantitative analysis for both terrestrial and aquatic environments.

Based upon the DT50 value, environmental persistence in the soil also would be categorized as one of the following: Non-persistent less than 30 days, moderately persistent 30 to 100 days, and persistent more than 100 days.

Threshold for Approving PUPs:

If soil DT50 is 100 days or less, then a PUP would be approved without additional BMPs to protect water quality.
If soil DT50 is greater than 100 days, then a PUP would only be approved with additional BMPs specifically to protect water quality. One or more BMPs such as the following would be included in the Specific Best Management Practices (BMPs) section *to minimize potential surface run-off and leaching that can degrade water quality:*

- *Do not exceed one application per site per year.*
- *Do not use on coarse-textured soils where the ground water table is less than 10 feet and average annual precipitation is greater than 12 inches.*
- *Do not use on steep slopes if substantial rainfall is expected within 24 hours or ground is saturated.*

Along with Koc, soil DT50 values (preferred over soil t½) would be used in evaluating the potential to degrade groundwater by leaching (see Potential to Move to Groundwater below), if available.

E.7.8.5 Aquatic Persistence

Service personnel would record values for aquatic t½, which represents the length of time required for 50 percent of the deposited pesticide to degrade (completely or partially) in water.
Based upon the t½ value, aquatic persistence would be categorized as one of the following: nonpersistent less than 30 days, moderately persistent 30 to 100 days, and persistent more than 100 days (Kerle et. al. 1996).

Threshold for Approving PUPs:

If aquatic t½ is 100 days or less, then a PUP would be approved without additional BMPs to protect water quality.
If aquatic t½ is more than 100 days, then a PUP would only be approved with additional BMPs specifically to protect water quality. One or more BMPs such as the following would be included in the Specific Best Management Practices (BMPs) section *to minimize potential surface run-off and leaching that can degrade water quality:*

- *Do not exceed one application per site per year.*
- *Do not use on coarse-textured soils where the ground water table is less than 10 feet and average annual precipitation is more than 12 inches.*
- *Do not use on steep slopes if substantial rainfall is expected within 24 hours or ground is saturated.*

E.7.8.6 Aquatic Dissipation

Dissipation time (DT50) represents the time required for 50 percent of the deposited pesticide to degrade or move (dissipate); whereas, aquatic t½ describes the rate for degradation only. As for t½, units of

dissipation time are usually expressed in days. Based upon the DT50 value, environmental persistence in aquatic habitats also would be categorized as one of the following:
Non-persistent less than 30 days, moderately persistent 30 to 100 days, and persistent more than 100 days.

Threshold for Approving PUPs:

If aquatic DT50 is 100 days or less, then a PUP would be approved without additional BMPs to protect water quality.
If aquatic DT50 is more than 100 days, then a PUP would only be approved with additional BMPs specifically to protect water quality. One or more BMPs such as the following would be included in the Specific Best Management Practices (BMPs) section *to minimize potential surface run-off and leaching that can degrade water quality:*

- *Do not exceed one application per site per year.*
- *Do not use on coarse-textured soils where the groundwater table is less than 10 feet and average annual precipitation is greater than 12 inches.*
- *Do not use on steep slopes if substantial rainfall is expected within 24 hours or ground is saturated.*

E.7.8.7 Potential to Move to Groundwater

Groundwater Ubiquity Score (GUS) = log10(soil t ½) x [4 – log10(Koc)]. If a DT50 value is available, it would be used rather than a t ½ value to calculate a GUS score. Based upon the GUS value, the potential to move toward groundwater would be recorded as one of the following categories: extremely low potential less than 1.0, low-1.0 to 2.0, moderate-2.0 to 3.0, high-3.0 to 4.0, or very high more than 4.0.

Threshold for Approving PUPs:

If GUS is 4.0 or less, then a PUP would be approved without additional BMPs to protect water quality.
If GUS is more than 4.0, then a PUP would only be approved with additional BMPs specifically to protect water quality. One or more BMPs such as the following would be included in the Specific Best Management Practices (BMPs) section *to minimize potential surface run-off and leaching that can degrade water quality:*

- *Do not exceed one application per site per year.*
- *Do not use on coarse-textured soils where the ground water table is less than 10 feet and average annual precipitation is greater than 12 inches.*
- *Do not use on steep slopes if substantial rainfall is expected within 24 hours or ground is saturated.*

E.7.8.8 Volatilization

Pesticides may volatilize (evaporate) from soil and plant surfaces and move off-target into the atmosphere. The potential for a pesticide to volatilize is a function of its vapor pressure that is affected by temperature, sorption, soil moisture, and the pesticide's water solubility. Vapor pressure is often expressed in mm Hg. To make these values easier to compare, vapor pressure would be recorded by Service personnel in exponential form (I x 10-7), where I represents a vapor pressure index. In general, pesticides with I less than 10 would have low potential to volatilize; whereas, pesticides with I greater than 1,000 would have a high potential to volatilize (Oregon State University 1996). Vapor pressure values for pesticides are usually available in the pesticide product MSDS or the USDA Agricultural Research Service (ARS) pesticide database (see References).

Threshold for Approving PUPs:

If I is 1,000 or less, then a PUP would be approved without additional BMPs to minimize drift and protect air quality.
If I is more than 1,000, then a PUP would only be approved with additional BMPs specifically to minimize drift and protect air quality. One or more BMPs such as the following would be included in the Specific Best Management Practices (BMPs) section *to reduce volatilization and potential to drift and degrade air quality:*

- *Do not treat when wind velocities are less than 2 mph or more than 10 mph with existing or potential inversion conditions.*
- *Apply the large-diameter droplets possible for spray treatments.*
- *Avoid spraying when air temperatures are higher than 85oF.*
- *Use the lowest spray height possible above target canopy.*

E.7.8.9 Octanol-Water Partition Coefficient (Kow)

The octanol-water partition coefficient (Kow) is the concentration of a pesticide in octanol and water at equilibrium at a specific temperature. Because octanol is an organic solvent, it is considered a surrogate for natural organic matter. Therefore, Kow would be used to assess potential for a pesticide to bioaccumulate in tissues of aquatic species (e.g., fish). If Kow is greater than 1,000 or Sw is less than 1 mg/L AND soil t½ is greater than 30 days, then there would be high potential for a pesticide to bioaccumulate in aquatic species such as fish (U.S. Geological Survey 2000).

Threshold for Approving PUPs:

If there is not a high potential for a pesticide to bioaccumulate in aquatic species, then the PUP would be approved.
If there is a high potential to bioaccumulate in aquatic species (Kow greater than 1,000 or Sw less than 1 mg/L AND soil t½ is greater than 30 days), then the PUP would not be approved, except under unusual circumstances where approval would only be granted by the Washington Office.

E.7.8.10 Bioaccumulation/Bioconcentration

Bioconcentration is the physiological process where pesticide concentrations in tissue would increase in biota because they are taken and stored at a faster rate than they are metabolized or excreted. The potential for bioaccumulation would be evaluated through bioaccumulation factors BAFs) or bioconcentration factors (BCFs). Based upon BAF or BCF values, the potential to bioaccumulate would be recorded as one of the following: low–0 to 300, moderate–300 to 1,000, or high greater than 1,000 (Calabrese and Baldwin 1993).

Threshold for Approving PUPs:

If BAF or BCF is 1,000 or less, then a PUP would be approved without additional BMPs.
If BAF or BCF is greater than 1,000, then a PUP would not approved, except under unusual circumstances where approval would only be granted by the Washington Office.

E.7.9 Worst-Case Ecological Risk Assessment

E.7.9.1 Max Application Rates (acid equivalent)

Service personnel would record the highest application rate of an active ingredient (ae basis) for habitat management and cropland/facilities maintenance treatments in this data field of a Chemical Profile. These rates can be found in Table CP.1 under the column heading "Max Product Rate–Single Application (lbs/acre–AI on acid equiv basis)". This table would be prepared for a chemical profile from information specified in labels for trade name products identified in PUPs. If these data are not available in pesticide labels, then write "NS" for "not specified on label" in this table.

E.7.9.2 EECs

An estimated environmental concentration (ECC) represents potential exposure to fish and wildlife (birds and mammals) from using a pesticide. EECs would be derived by Service personnel using an EPA screening-level approach (EPA 2004). For each max application rate [see description under Max Application Rates (acid equivalent)], Service personnel would record 2 EEC values in a Chemical Profile; these would represent the worst-case terrestrial and aquatic exposures for habitat management and croplands/facilities maintenance treatments. For terrestrial and aquatic EEC calculations, see description for data entry under Presumption of Unacceptable Risk/Risk Quotients, which is the next field for a Chemical Profile.

E.7.9.3 Presumption of Unacceptable Risk/Risk Quotients

Service personnel would calculate and record acute and chronic risk quotients (RQs) for birds, mammals, and fish using the provided tabular formats for habitat management and/or cropland/facilities maintenance treatments. RQs recorded in a Chemical Profile would represent the worst-case assessment for ecological risk. See Section 7.2 for discussion regarding the calculations of RQs.

For aquatic assessments associated with habitat management treatments, RQ calculations would be based upon selected acute and chronic toxicological endpoints for fish and the EEC would be derived from Urban and Cook (1986) assuming 100 percent overspray to an entire 1-foot deep water body using the max application rate (ae basis [see above]).

For aquatic assessments associated with cropland/facilities maintenance treatments, RQ calculations would be done by Service personnel based upon selected acute and chronic toxicological endpoints for fish and an EEC would be derived from the aquatic assessment in AgDRIFT® model version 2.01 under Tier I ground-based application with the following input variables: max application rate (acid basis [see above]), low boom (20 inches), fine to medium/coarse droplet size, 20 swaths, EPA-defined wetland, and 25-foot distance (buffer) from treated area to water.

See Section 7.2.1.2 for more details regarding the calculation of EECs for aquatic habitats for habitat management and cropland/facilities maintenance treatments.

For terrestrial avian and mammalian assessments, RQ calculations would be done by Service personnel based upon dietary exposure, where the "short grass" food item category would represent the worst-case scenario. For terrestrial spray applications associated with habitat management and cropland/facilities maintenance treatments, exposure (EECs and RQs) would be determined using the Kanaga nomogram method through the EPA's Terrestrial Residue Exposure model (T-REX) version 1.2.3. T-REX input variables would include the following: max application rate (acid basis [see above]) and pesticide half-life (days) in soil to estimate the initial, maximum pesticide residue concentration on general food items for terrestrial vertebrate species in short (shorter than 20 cm tall) grass.

For granular pesticide formulations and pesticide-treated seed with a unique route of exposure for terrestrial avian and mammalian wildlife, see Section 7.2.1.1.2 for the procedure that would be used to calculate RQs.

All calculated RQs in both tables would be compared with Levels of Concern (LOCs) established by EPA (see Table 2 in Section 7.2). If a calculated RQ exceeds an established LOC value (in brackets inside the table), then there would be a potential for an acute or chronic effect (unacceptable risk) to federally listed (T&E) species and nonlisted species. See Section 7.2 for detailed descriptions of acute and chronic RQ calculations and comparison to LOCs to assess risk.

Threshold for approving PUPs:

If RQs are less than or equal to LOCs, then a PUP would be approved without additional BMPs.
If RQs are greater than LOCs, then a PUP would only be approved with additional BMPs specifically to minimize exposure (ecological risk) to bird, mammal, and/or fish species. One or more BMPs such as the following would be included in the Specific Best Management Practices (BMPs) section *to reduce potential risk to nonlisted or listed species:*

- *Lower application rate and/or fewer number of applications to RQs less than or equal to LOCs*
- *For aquatic assessments (fish) associated with cropland/facilities maintenance, increase the buffer distance beyond 25 feet so RQs less than or equal to LOCs.*

E.7.9.4 Justification for Use

Service personnel would describe the reason for using the pesticide based control of specific pests or groups of pests. In most cases, the pesticide label will provide the appropriate information regarding control of pests to describe in the section.

E.7.9.5 Specific Best Management Practices (BMPs)

Service personnel would record specific BMPs necessary to minimize or eliminate potential effects to non-target species and/or degradation of water quality from drift, surface runoff, or leaching. These BMPs would be based upon scientific information documented in previous data fields of a Chemical Profile. Where necessary and feasible, these specific practices would be included in PUPs as a basis for approval.

If there are no specific BMPs that are appropriate, Service personnel would describe why the potential effects to refuge resources and/or degradation of environmental quality is outweighed by the overall resource benefit(s) from the proposed pesticide use in the BMP section of the PUP. See Section 4.0 of this document for a complete list of BMPs associated with mixing and applying pesticides appropriate for all PUPs with ground-based treatments that would be additive to any necessary, chemical-specific BMPs.

E.7.9.6 Data Resources

Service personnel would record scientific resources used to provide data/information for a chemical profile. Use the number sequence to uniquely reference data in a chemical profile. The following on-line data resources are readily available for toxicological endpoint and environmental fate data for pesticides:

1. California Product/Label Database. Department of Pesticide Regulation, California Environmental Protection Agency.
(http://www.cdpr.ca.gov/docs/label/labelque.htm#regprods)

2. ECOTOX database. Office of Pesticide Programs, US Environmental Protection Agency, Washington, DC. (http://cfpub.epa.gov/ecotox/)

3. Extension Toxicology Network (EXTOXNET) Pesticide Information Profiles. Cooperative effort of University of California-Davis, Oregon State University, Michigan State University, Cornell University and University of Idaho through Oregon State University, Corvallis, Oregon. (http://extoxnet.orst.edu/pips/ghindex.html)

4. FAO specifications and evaluations for plant protection products. Pesticide Management Unit, Plant Protection Services, Food and Agriculture Organization, United Nations. (http://www.fao.org/WAICENT/FAOINFO/AGRICULT/AGP/AGPP/Pesticid/)

5. Human health and ecological risk assessments. Pesticide Management and Coordination, Forest Health Protection, US Department of Agriculture, US Forest Service. (http://www.fs.fed.us/foresthealth/pesticide/risk.htm)

6. Pesticide Chemical Fact Sheets. Clemson University Pesticide Information Center. (http://entweb.clemson.edu/pesticid/Document/Labels/factshee.htm)

7. Pesticide Fact Sheets. Published by Information Ventures, Inc. for Bureau of Land Management, Dept. of Interior; Bonneville Power Administration, U.S. Dept. of Energy; and Forest Service, US Department of Agriculture. (http://infoventures.com/e-hlth/pesticide/pestfac.html)

8. Pesticide Fact Sheets. National Pesticide Information Center. (http://npic.orst.edu/npicfact.htm)

9. Pesticide Fate Database. US Environmental Protection Agency, Washington, DC. (http://cfpub.epa.gov/pfate/home.cfm).

10. Pesticide product labels and material safety data sheets. Crop Data Management Systems, Inc. (CDMS) (http://www.cdms.net/pfa/LUpdateMsg.asp) or multiple websites maintained by agrichemical companies.

11. Registered Pesticide Products (Oregon database). Oregon Department of Agriculture. (http://www.oda.state.or.us/dbs/pest_products/search.lasso)

12. Regulatory notes. Pest Management Regulatory Agency, Health Canada, Ontario, Canada. (http://www.hc-sc.gc.ca/pmra-arla/)

13. Reptile and Amphibian Toxicology Literature. Canadian Wildlife Service, Environment Canada, Ontario, Canada. (http://www.cws-scf.ec.gc.ca/nwrc-cnrf/ratl/index_e.cfm)

14. Specific Chemical Fact Sheet – New Active Ingredients, Biopesticide Fact Sheet and Registration Fact Sheet. U.S Environmental Protection Agency, Washington, DC. (http://www.epa.gov/pestidides/factsheets/chemical_fs.htm)

15. Weed Control Methods Handbook: Tools and Techniques for Use in Natural Areas. The Invasive Species Initiative. The Nature Conservancy. (http://tnsweeds.ucdavis.edu/handbook.html)

16. Wildlife Contaminants Online. US Geological Survey, Department of Interior, Washington, D.C. (http://www.pwrc.usgs.gov/contaminants-online/)

17. One-liner database. 2000. US Environmental Protection Agency, Office of Pesticide Programs, Washington, D.C.

Chemical Profile

Date:			
Trade Name(s):		**Common Chemical Name(s):**	
Pesticide Type:		**EPA Registration Number:**	
Pesticide Class:		**CAS Number:**	
Other Ingredients:			

Toxicological Endpoints

Mammalian LD_{50}:	
Mammalian LC_{50}:	
Mammalian Reproduction:	
Avian LD_{50}:	
Avian LC_{50}:	
Avian Reproduction:	
Fish LC_{50}:	
Fish ELS/Life Cycle:	
Other:	

Ecological Incident Reports

Environmental Fate

Water solubility (S_w):	
Soil Mobility (K_{oc}):	
Soil Persistence ($t_{½}$):	
Soil Dissipation (DT_{50}):	
Aquatic Persistence ($t_{½}$):	
Aquatic Dissipation (DT_{50}):	
Potential to Move to Groundwater **(GUS score):**	
Volatilization (mm Hg):	
Octanol-Water Partition Coefficient (K_{ow}):	
Bioaccumulation/Biocentration:	**BAF:`** **BCF:**

Worst Case Ecological Risk Assessment

Max Application Rate **(ai lbs/acre – ae basis)**	**Habitat Management:** **Croplands/Facilities Maintenance:**
EECs	**Terrestrial (Habitat Management):** **Terrestrial (Croplands/Facilities Maintenance):** **Aquatic (Habitat Management):** **Aquatic (Croplands/Facilities Maintenance):**

Habitat Management Treatments:

Presumption of Unacceptable Risk		**Risk Quotient (RQ)**	
		Listed (T&E) Species	**Nonlisted Species**
Acute	Birds	[0.1]	[0.5]
	Mammals	[0.1]	[0.5]
	Fish	[0.05]	[0.5]
Chronic	Birds	[1]	[1]
	Mammals	[1]	[1]
	Fish	[1]	[1]

Cropland/Facilities Maintenance Treatments:

Presumption of Unacceptable Risk		**Risk Quotient (RQ)**	
		Listed (T&E) Species	**Nonlisted Species**
Acute	Birds	[0.1]	[0.5]
	Mammals	[0.1]	[0.5]
	Fish	[0.05]	[0.5]
Chronic	Birds	[1]	[1]
	Mammals	[1]	[1]
	Fish	[1]	[1]

Justification for Use:	
Specific Best Management Practices (BMPs):	
References:	

Table CP.1 Pesticide Name

Trade Name[a]	Treatment Type[b]	Max Product Rate – Single Application (lbs/acre or gal/acre)	Max Product Rate -Single Application (lbs/acre - AI on acid equiv basis)	Max Number of Applications Per Season	Max Product Rate Per Season (lbs/acre/season or gal/acre/season)

[a]From each label for a pesticide identified in pesticide use proposals (PUPs), Service personnel would record application information associated with possible/known uses on Service lands.
[b]Treatment type: H – habitat management or CF – cropland/facilities maintenance. If a pesticide is labeled for both types of treatments (uses), then record separate data for H and CF applications.

E.8 SPECIFIC WEED CONTROL PLANS

1. *Bromus tectorum* (cheatgrass, downy brome)

Priority: Medium: cheatgrass is widely distributed throughout the Protection Island, along roadways, and has invaded remnant native prairie and shrubland communities. Cheatgrass is prolific in dry upland habitat and competes with native plant species in especially disturbed soils such as those found in bluff and grassland habitat, both future restoration sites. It interferes with primary habitat management goals across the landscape, but the infestation is too large to eradicate with available technology.

Description: Cheatgrass is a cool season annual grass that grows from 4 - 30 inches tall, reproducing by seed. Leaf sheaths and flat blades are covered with dense soft hairs. Mature cheatgrass seed heads are slender; 2 - 6 inches long and usually droop to one side. It easily competes with more desirable perennial grasses for moisture because of its fall, winter semi-dormant, and early spring growth habit. Seeds mature in mid to late June and plants dry and cure by the end of June, leading to hazardous fire conditions.

Current Distribution on the Refuge: Cheatgrass is widely distributed throughout Protection Island and unknown on other refuge islands.

Measurable Objectives and Goal: Prevent competition with newly seeded native plants in habitat restoration sites and other disturbed soil areas.

Objectives:

a. Monitor all newly seeded areas and other disturbed sites (e.g., remediation areas, wildfire areas, road cuts) depleted of native perennial plants.

b. Seed disturbed sites with native species.

c. Control cheatgrass to reduce competition with native plants germinating in the spring. Cheatgrass will be kept to comprising less than 40% of the live vegetation ground cover and spreading beyond its original infestation area.

d. Maintain healthy stands of native perennial plants.

Control Options:

The chemical treatment of cheatgrass with an appropriate herbicide provides the most effective control. Currently, glyphosate (Roundup™, Roundup Pro™), Clethodim (Select™) and imazapic (Plateau™) are the herbicides used to control cheatgrass on the Refuge. The identified chemical control agents were selected on their versatility and selectivity in prairie restoration areas (Plateau™ and Select™) and complete control in areas requiring devegetation with minimal risk to groundwater contamination (Roundup™). Glyphosate is soil binding, inexpensive, and a low threat to groundwater quality. Imazapic (Plateau™) is used in dry upland sites with low leaching potential. This chemical can be broadcast in restoration areas where the establishment of native grasses and herbicide resistant native broadleafs are essential for restoration success. Clethodim (Select™) is considered as a selective herbicide for use in grasslands, restoration areas, fence lines and rights of way. Other agents indicated for cheatgrass control but not selected for use are quizalofop, fluazifop-p-butyl,sethoxydim, sulfometuron methyl, and metribuzin. Clethodim is considered less toxic to avian and other wildlife species than other selective grass herbicides (quizalofop, fluazifop-p-butyl, sethoxydim and metribuzin). Clethodim has a short half life in soil and the EPA considers the chemical a low threat to groundwater quality. Other chemicals will be added as needed and be approved at the required level. All chemicals will be used in accordance with label recommendations.

Mechanical control of cheatgrass also is conducted on the Refuge with mixed results. Mowing before seed ripening probably prevents some re-seeding, but oftentimes the plants produce new stems and seeds at the mowed height. Mowing after seed ripening will kill adult plants, but dropped seeds are already viable. Repeated mowing during the growing season may be the most effective mechanical treatment, but is very labor-intensive and only practical on small infestations. Mowing is not possible in areas where cheatgrass starts seeding at height too low for the mower, steep slopes, and inaccessible islands. Prescribed burns in the spring or fall also help to control cheatgrass by stimulating native perennial grass growth or top killing seedlings.

The cultural methods of plowing, discing, etc. often cause an initial flush of cheatgrass growth that is usually controlled with herbicides before seeding with native perennial species. After restoration, the maintenance of healthy native plant communities and the minimization of disturbance help to prevent the spread of cheatgrass back into the area.

Treatment Schedule: Cheatgrass should be sprayed in the fall or early spring when plants are less than 10 cm tall and actively growing, and non-target plants are dormant.

2. *Carduus nutans* (musk thistle)

Priority: Medium: musk thistle has a limited distribution throughout the Refuge along roadways, and has invaded remnant native prairie and shrubland communities. Musk thistle is prolific in dry upland habitat and competes with native plant species in disturbed soils such as those found in recently seeded habitat restoration sites. It interferes with primary habitat management goals across the landscape, and the infestation is not too large therefore this species is targeted for eradicate.

Description: Musk thistle is a biennial which grows up to 6 feet tall. Leaves are dark green, deeply lobed, spiny, and extend onto the stem. Flowers are 11/2 to 3 inches in diameter and are usually deep rose, violet or purple. Musk thistle spreads rapidly to form dense stands that crowd out desirable plants.

Current Distribution on the Refuge: Musk thistle is widely distributed throughout the Refuge at low densities but can be especially prolific in disturbed soils.

Measurable Objectives and Goal: Prevent competition with newly seeded native plants in habitat restoration sites, along roadways, and other disturbed soil areas.

Objectives:

a. Monitor all newly seeded areas, roadways, and other disturbed sites (e.g., remediation areas, wildfire areas) depleted of native perennial plants.

b. Seed disturbed sites with native species if ground cover is needed.

c. Control musk thistle to reduce competition with native plants germinating in the spring. Patches of musk thistle will be kept to less than one acre in area and less than 40% of live vegetation cover.

d. Maintain healthy stands of native perennial plants.

Control Options: Mechanical control of musk thistle has been successful in preventing seed production and subsequent spread. Musk thistle is mowed at flowering in habitat restoration sites, along roadways, and in disturbed areas undergoing remediation. Dense stands are often mowed twice when new flowers appear. Repeated mowing during the growing season may be the most effective mechanical treatment, but is very labor-intensive. Small infestations of musk thistle rosettes also are removed by hand digging when labor is available.

The biological control agent, *Rhinocyllus conicus* (seed head weevil) is established in Washington state, but has had limited effect on thistle control and a negative side effect of this bio-controls that it also attacks native thistle species. There are no known native thistle species occurring on any refuge unit. The larvae of this weevil eat the seeds in mature flower heads. This biocontrol is probably effective in reducing musk thistle seed production by up to 50% based on casual observation. Infestations of individual plants or widely dispersed individuals will be examined for the presence of the *Rinocyllus conicus* larvae and adults and left in place if infected. These infected plants can be used as farm plants for the insects with the harvested individuals relocated to larger thistle patches.

The chemical treatment of musk thistle with an appropriate herbicide also provides effective control. Currently, aminopyralid (Milestone), glyphosate (Roundup™, Roundup Pro™) glyphosate (Roundup™, Roundup Pro™, Rodeo™), metsulfuron methyl (Escort™) and imazapic (Plateau™) are the herbicides that could be used to control small musk thistle infestations on the Refuge. Aminopyralid is very selective, provides longer control and can be used at lower rates. Glyphosate is soil binding, inexpensive, with low groundwater contamination potential. Imazapic is used in dry upland sites with low leaching potential. Metsulfuron is extremely effective on thistle and common mullein plants. Imazapic and metsulfuron can be broadcast in restoration areas where native grasses and resistant native broadleafs are essential for restoration success. Other chemicals will be added as needed and be approved at the required level. All chemicals will be used in accordance with label recommendations.

The mechanical methods of plowing, discing, etc., often cause an initial flush of musk thistle rosettes that may be controlled with herbicides before seeding with native perennial species. After restoration, the maintenance of healthy native plant communities and the minimization of disturbance help to prevent the spread of musk thistle back into the area.

Treatment Schedule: Musk thistle should be repeatedly mowed at flowering to prevent seed production and/or sprayed in the rosette stage in fall or late spring during bolting or when desirable non-target plants are dormant. Spraying in the early summer when the plants have bolted or rosettes in the fall are also effective control methods other options will be used according to the label recommendations.

3. *Centaurea diffusa* (diffuse knapweed)

Priority: High: The spread of diffuse knapweed is an increasing problem in many areas in Washington. It is considered one of the most important rangeland weeds in North America. The State of Washington considers this species one of the top ten priority weeds targeted for control, particularly for preventing new infestations. Diffuse knapweed infests disturbed areas where it forms dense colonies in pastures, croplands, waste places, and rights-of-way. It is a prolific seed producer, fast spreading, and highly agonistic with native plants often out competing them.

Description: Diffuse knapweed grows as an annual or short-lived perennial forb. The diffusely branched stems of mature plants are 1 to 2 feet tall, rough to the touch, and tipped with numerous slender, white to purplish flower heads. Prominent yellow bracts with comb-like margin projections subtend the flower. The leaves are pinnately divided near the plant’s base; the leaf margins appear entire towards the inflorescence. Flowering occurs from July through September.

Current Distribution on the Refuge: No known infestations are present on any of the refuge islands.

Measurable Objectives and Goal: Prevent competition with newly seeded native plants in habitat restoration sites, along roadways, and other disturbed soil areas.

Objectives:

a. Monitor known infestation sites, newly seeded areas, roadways, and other disturbed sites (e.g., remediation areas, wildfire areas) depleted of native perennial plants.

b. Seed disturbed sites with native species.

c. Treat 100% of diffuse knapweed plants - targeting for elimination - to reduce competition with native plants and prevent establishment of knapweed and knapweed seed bank. Larger infestation patches will be mapped and measured using geographic information software and a global positioning system device. Patches will be treated to prevent increase in the infestation area.

d. Maintain healthy stands of native perennial plants.

Control Options: Hand pulling or digging is a feasible control of small infestations and individual plants. The taproot will be removed to at least 2 inches below the ground surface.

Insect species that target diffuse knapweed include the seedhead weevils (*Larinus minutus*), broad-nosed seedhead weevil *(Bangasternus fausti)* are not well established, and seed head fly (*Urophora affinis*), seed head fly (*Urophora quadrifasciata*), and root boring/gall beetle (*Sphenoptera jugoslavica*) are available for mass collections. These insects reduce seed production which assists in slowing or eliminating spread. Biological agent will be an option in areas that are prohibited to other forms of control and pending the availability of the insect. Biological control of diffuse knapweed on the Refuge has not been attempted in the past.

The chemical treatment of diffuse knapweed with an appropriate herbicide provides relatively effective control. Currently, aminopyralid (Milestone) glyphosate (Roundup™, Roundup Pro™) and imazapic (Plateau™) would be the herbicides used to control diffuse knapweed on the Refuge. Aminopyralid is very selective, provides longer control and can be used at lower rates. Glyphosate is soil binding, inexpensive, and a low threat to groundwater quality. Imazapic (Plateau™) is used in dry upland sites and on soils with low leaching potential. This chemical can be broadcast in restoration areas where the establishment of native grasses and herbicide resistant native broadleafs are essential for restoration success. Other recommended chemical treatments for diffuse knapweed are picloram, clopyralid, dicamba, and 2,4-D. The Refuge avoids the use of restricted use pesticides like picloram. Clopyralid is not recommended for use on permeable soils due to potential groundwater contamination. Dicamba has low toxicity for wildlife but is not recommended for use near water. Aquatic formulations of glyphosate currently serve for weed control near water. Other chemicals will be added as needed and be approved at the required level. All chemicals will be used in accordance with label recommendations.

Treatment Schedule: Hand removal will be conducted 2 to 3 times during the growing season, the first removal occurring early in the season (June) before bolt. Established areas too large to practically control by hand, or in areas prohibited to chemical control, will be mowed monthly to prevent floret emergence and seed production.

The release of seed head weevils will occur as the leaves of the plants appear in June to the budding stage. Control is less effective if seeds have already formed.

The application of aminopyralid, glyphosate or imazapic will occur once during the growing season (June - November). The most effective time of control is during the rosette or bolt stage before budding. Annual treatment is necessary as long as there is a viable seed source.

4. *Centaurea maculosa* (spotted knapweed)

Priority: High: The State of Washington considers this species one of the top ten priority weeds targeted for control. Spotted knapweed infests disturbed areas where it forms dense colonies in pastures, croplands, waste places, and rights-of-way. It is a prolific seed producer, fast spreading, and highly agonistic with native plants – often out-competing them. Populations enlarge by peripheral expansion of existing stands. Biodiversity, livestock and wildlife forage quality are reduced with infestations of spotted knapweed.

Description: Spotted knapweed is a biennial or short-lived perennial forb with a deep taproot. Plants reach 1 to 3 feet with one or more branched stems. The basal leaves vary in morphology from entire to pinnate and elliptical to oblanceolate. The principal stem leaves are pinnately divided. Flowers are primarily light purple (rarely white). Involucral bracts are stiff with a finely branched, dark tip. Flowering occurs from June through September.

Current Distribution on the Refuge: No known infestations are present on any of the refuge islands.

Measurable Objectives and Goal: Prevent competition with newly seeded native plants in habitat restoration sites, along roadways, and other disturbed soil areas.

Objectives:

a. Monitor known infestation sites, newly seeded areas, roadways, and other disturbed sites (e.g., restoration areas, wildfire areas) depleted of native perennial plants.

b. Seed disturbed sites with native species.

c. Treat and control 100% of spotted knapweed plants - targeting for elimination - to reduce competition with native plants and prevent establishment of knapweed and knapweed seed bank. Larger infestation patches will be mapped and measured using geographic information software and a global positioning system device. Patches will be treated to prevent increase in the infestation area.

d. Maintain healthy stands of native perennial plants.

Control Options: Hand pulling or digging is a feasible control of small infestations and individual plants. The taproot will be removed to at least 2 inches below the ground surface. Entire plants will be removed from the site to limit the source of available seeds.

Biological control of spotted knapweed is not effective in eliminating stands. Insect larvae are available that target flowers, roots, shoots, and leaves leading to reduced seed production. Two commonly used organisms that target spotted knapweed roots are the sulphur knapweed moth (*Agapeta zoegana)* and the knapweed weevil (*Cyphocleonus achates*). Biological control could be used in new and current infestations that cannot be controlled by hand or chemical treatment.

The chemical treatment of spotted knapweed with an appropriate herbicide provides relatively effective control. Currently, aminopyralid (Milestone), glyphosate (Roundup™, Roundup Pro™) and imazapic (Plateau™) would be the herbicides used to control spotted knapweed on the Refuge. Aminopyralid is very selective, provides longer control and can be used at lower rates. Other recommended chemical treatments for diffuse knapweed are picloram, clopyralid, dicamba, and 2,4-D. The Refuge avoids the use of restricted use pesticides like picloram. Clopyralid is not recommended for use on permeable soils due to potential groundwater contamination. Dicamba has low toxicity for wildlife but is not recommended for use near water. Aquatic formulations of glyphosate currently serve for weed control near water. Other chemicals will be added as needed and be approved at the required level. All chemicals will be used in accordance with label recommendations.

Treatment Schedule: Hand removal will be conducted 2 to 3 times during the growing season, the first removal occurring early in the season (June) before bolt. Established areas too large to practically control by hand, or in areas prohibited to chemical control, will be mowed monthly to prevent floret emergence and seed production.

Selected biological control insect(s) will be, if used, released during the optimal time for both insect and plant to provide the greatest effectiveness for controlling spotted knapweed.

Aminoryralid, glyphosate or imazapic will be applied once during the growing season (June - November). The most effective time of control is during the bolt to bud stage. Annual treatment is necessary as long as there is a viable seed source.

5. *Centaurea jacea x nigra* (Meadow Knapweed)

Priority: High: The State of Washington considers this species one of the top ten priority weeds targeted for control. Meadow knapweed invades open, disturbed areas. This species forms monotypic stands, suppressing the growth of other vegetation. Reproduction is primarily from seeds and crown.

Description: Meadow knapweed is a perennial growing from a woody root crown, with 20 to 40 inch tall upright stems. Its basal leaves can be up to six inches long and 1.25 inches wide, tapering at both ends. The stem leaves are lance-shaped, stalkless, and sometimes shallowly lobed, while the uppermost leaves are smaller and not lobed. The rose-purple to occasionally white flowers occur in solitary, oval, or almost globe-shaped flower heads at the ends of branches. The light to dark brown involucral bracts are roundish, with a torn, thin, papery margin, or a comb-like, fringed margin. More apparent on outer bracts, the fringes are about equal in width to the central body of the bract. Meadow knapweed flowers from July to September, producing ivory-white to light brown seeds that may or may not have a barely noticeable plume. However, because it is a hybrid, meadow knapweed traits are highly variable.

Current Distribution on the Refuge: No known infestations are present on any of the refuge islands.

Measurable Objectives and Goal: Prevent competition with newly seeded native plants in habitat restoration sites, along roadways, and other disturbed soil areas.

Objectives:

a. Monitor known infestation sites, newly seeded areas, roadways, and other disturbed sites (e.g., remediation areas, wildfire areas) depleted of native perennial plants.

b. Seed disturbed sites with native species.

c. Treat and control 100% of Meadow knapweed plants - targeting for elimination - to reduce competition with native plants and prevent establishment of knapweed and knapweed seedbank. Larger infestation patches will be mapped and measured using geographic information software and a global positioning system device. Patches will be treated to prevent increase in the infestation area.

d. Maintain healthy stands of native perennial plants

Control Options:

Removal of the above-ground tissue by mowing or hand-scything weakens the plant, reduces root growth, and prevents seed production, but will not eliminate the infestation.

Biological control with the seed head gall fly, *Urophora quadrifasciata,* has had fair success on meadow knapweed.

The reseeding of disturbed areas is effective in preventing the infestation of Russian knapweed

The chemical treatment of Meadow knapweed with an appropriate herbicide provides relatively effective control. Currently, aminopyralid (Milestone), glyphosate (Roundup™, Roundup Pro™) and imazapic (Plateau™) would be the herbicides used to control Meadow knapweed on the Refuge. Aminopyralid is very selective, provides longer control and can be used at lower rates. Glyphosate is soil binding, inexpensive, with low groundwater contamination potential. Glyphosate is a nonspecific herbicide and the use of it should be accompanied by seeding, planting, or use in areas where native vegetation is prolific. Imazapic (Plateau™) is used in dry upland sites and on soils with low leaching potential. This chemical can be broadcast in restoration areas where the establishment of native grasses and herbicide resistant native broadleafs are essential for restoration success. Other chemicals will be added as needed and be approved at the required level. All chemicals will be used in accordance with label recommendations.

Treatment Schedule: Top growth will be removed before bolting during the growing season (June - mid-August) to weaken Russian knapweed plants. Plants that re-emerge (mid-August to September) are smaller and more vulnerable to further top removal and herbicide effect.

Glyphosate will be applied once or twice during the growing season (June - November). Top-growth of Russian knapweed can be controlled by applying herbicide during the bud stage. Root control is achieved by timing applications to the late bud and fall growth stage. Other listed chemical will be used according to the label recommendations.

6. *Polygonum bohemicum* **(Bohemian knotweed)**

Priority: High: The State of Washington considers this species one of the top ten priority weeds targeted for control. The most common invasive knotweeds in western Washington, this species is a hybrid between giant and Japanese knotweed and shares characters of both parent species. It was introduced as an ornamental in its own right but has become very widespread in our region, especially along rivers and roadways. This plant spreads mostly by stem and root fragments and is usually found in disturbed areas such as flood zones and roadsides.

Currently, most Bohemian knotweed plants are males and therefore lack seeds. Recent findings have found that seed-bearing hybrids have appeared, probably indicating a back-cross with giant or Japanese knotweed. The existence of seeding hybrids may allow this plant to spread even more rapidly in the future.

Description: Plants are usually 6.5 to 10 feet tall. Stems are stout, cane-like, hollow between the nodes, somewhat reddish-brown and usually branched. The plants die back above ground at the end of the growing season. However, the dead reddish brown canes often persist throughout the winter. The stem nodes are swollen and surrounded by thin papery sheaths. Leaves can be either spade or heart-shaped, usually more heart-shaped lower down on the stems and more spade-shaped near the branch ends. This variability in leaf shape is one identifying character since the parent species generally have either heart-shaped or spade-shaped leaves.

One key identifying feature is the hairs on the leaf undersides especially along the midvein. Bohemian knotweed has hairs that are short and broad-based (triangular-shaped), compared with long and wavy in giant knotweed and reduced to barely noticeable bumps in Japanese knotweed.

The flowers are small, creamy white to greenish white, and grow in showy plume-like, branched clusters from leaf axils near the ends of the stems. Flower clusters are generally about the same length as the subtending leaf, unlike the shorter flower clusters found on giant knotweed and the longer clusters found on Japanese knotweed. Leaf and flower characters are most reliable when looking near the middle of a branch. The fruit is 3-sided, black and shiny

Current Distribution on the Refuge: Only known infestations are on the Dawley unit.

Measurable Objectives and Goal: Prevent competition with newly seeded native plants in habitat restoration sites, along roadways, and other disturbed soil areas.

Objectives:

a. Monitor known infestation sites, newly seeded areas, roadways, and other disturbed sites (e.g., remediation areas, wildfire areas) depleted of native perennial plants.

b. Seed disturbed sites with native species.

c. Treat and control 100% of Bohemian knotweed plants - targeting for elimination - to reduce competition with native plants and prevent establishment of knotweed and knotweed seedbank. Larger infestation patches will be mapped and measured using geographic information software and a global positioning system device. Patches will be treated to prevent increase in the infestation area.

d. Maintain healthy stands of native perennial plants

Control Options:

Knotweed is very difficult to eradicate once it has become established. It is, therefore, important to prevent new infestations and eradicate small patches before they spread. Mechanical and chemical control methods can be used on knotweed, often in conjunction with each other. If control is to be effective, the sites must be visited throughout several seasons to further control any new growth.

Removal of the above-ground tissue by mowing or hand-scything weakens the plant, but because of the extensive root system this method is ineffective as a control method especially on larger infestation.

The reseeding of disturbed areas is effective in preventing the infestation of Bohemian knotweed.

The chemical treatment of Bohemian knotweed by injection with an appropriate herbicide provides relatively effective control. Currently, imazaypr (Arsenal), and glyphosate (Roundup™, Roundup Pro™) would be the herbicides used to control Bohemian knotweed on the Refuge. Imazaypr is similar to glyphosate, has a very low toxicity to most animals, but does remain in the soil longer than glyphosate. Mixing two kinds of herbicides together often improves the effectiveness when compared with using each herbicide individually. By mixing the glyphosate and imazapyr together, we can reduce the total amount of herbicide used. Glyphosate is soil binding, inexpensive, with low groundwater contamination potential. Glyphosate is a nonspecific herbicide and the use of it should be accompanied by seeding, planting, or use in areas where native vegetation is lacking. Other chemicals will be added as needed and be approved at the required level. All chemicals will be used in accordance with label recommendations.

Treatment Schedule: Injection of the herbicide is best done at the end of summer August September just prior to seed set.

7. *Cirsium arvense* (Canada thistle)

Priority: Low to Medium: The priority for controlling this species is dependent upon location. The State of Washington considers this species widespread and detrimental to agriculture. Canada thistle can form monocultures, crowding out desirable species. Extensive horizontal roots give rise to shoots. This species infests roadsides, pastures, cropland, disturbed areas, and riparian areas. The dense growth pattern and spiny leaves of Canada thistle deters passage and consumption by wildlife.

Description: Canada thistle is a colony-forming perennial forb. Stems reach 1 to 4 feet with branching tops. Flowers are purple with spineless bracts. The leaves are irregularly lobed and tipped with tiny spines. Flowering occurs July through August.

Current Distribution on the Refuge: Canada thistle is widely distributed on the Protection, found in various soil types and vegetation communities. This species tends to invade re-seeded restoration areas.

Measurable Objectives and Goal: Prevent competition with newly seeded native plants in habitat restoration sites, along roadways, and other disturbed soil areas.

Objectives:

a. Monitor known infestation sites, newly seeded areas, roadways, and other disturbed sites (e.g., remediation areas, wildfire areas) depleted of native perennial plants.

b. Seed disturbed sites with native species.

c. Canada thistle control applied to keep infestations to less than 1 acre in area and weedy species comprising 40% or less of live vegetation cover.

d. Maintain healthy stands of native perennial plants.

Control Options: The nature of the Canada thistle infestation on Protection Island makes it impossible to control with simple hand methods. The removal of shoots by mowing is a viable option. The continued removal of above ground photosynthetic tissue has been shown to weaken plants and limit their spread through carbohydrate starvation.

Biological control offers many insects, a few nematodes, and the American Goldfinch have been reported to feed on various parts of Canada thistle. Most of these do very little damage. Three insects from Europe have been studied for biological control - *Altica carduorum* Guer (flea beetle), a leaf feeder, has not established itself well. Adults of the beetle *Ceutorhynchus litura* F. eat young thistle shoots, but do little damage. The fly, *Urophora cardui* L. is the most promising biological control agent. Eggs are laid in the terminal buds and galls develop which divert nutrients and stress the plant. Many microorganisms have been found associated with Canada thistle, but no potential biocontrol agents are known.

The chemical treatment of Canada thistle with an appropriate herbicide provides relatively effective control. Currently, aminopyralid (Milestone), glyphosate (Roundup™, Roundup Pro™, Rodeo®) and imazapic (Plateau ®) are the herbicides used to control Canada thistle on the Refuge. Aminopyralid is very selective, provides longer control, can be used at lower rates, and be applied near water. Glyphosate is soil binding, inexpensive, with low groundwater contamination potential. Glyphosate is a nonspecific herbicide and the use of it should be accompanied by seeding, planting, or use in areas where native vegetation is prolific. Imazapic (Plateau™) is used in dry upland sites and on soils with low leaching potential. This chemical can be broadcast in restoration areas where the establishment of native grasses and herbicide resistant native broadleafs are essential for restoration success. Other herbicides that are shown to be effective on Canada thistle are picloram, clopyralid, and 2,4-D. The Refuge avoids the use of restricted use pesticides like picloram. Clopyralid is not recommended for use on leachable soils. 2,4-D will be used on the Refuge with its effectiveness monitored and the use expanded to possibly replace imazapic in some capacities. As with all herbicides, 2,4-D has been detected in groundwater although the sources of contamination are associated with inappropriate use and spillage. Other chemicals will be added as needed and be approved at the required level. All chemicals will be used in accordance with label recommendations.

Treatment Schedule: Hand pulling or digging of plants in the rosette stage is effective for small infestations. Monthly mowing or scything of bolted plants in moist soil areas or areas with a high water table (riparian/wetlands) are effective in limiting spread.

The stem-and-shoot gadfly will be released in June through July for new and existing invaded wetland areas where chemical and mechanical controls are not feasible.

Chemical control will occur in spring and fall, 1-2 times per season (June-October), particularly in the fall when shoot to root translocation is highest. This species is sensitive to moisture content or drought stress. Application of pesticide should occur when moisture condition is higher.

8 *Cirsium vulgare* (bull thistle)

Priority: Low to Medium: The priority for controlling this species is dependent upon location. Bull thistle grows in moist to dry areas, particularly in loamy or clay soils. It is a rapidly proliferating transient species in disturbed, open sites. Native vegetation and wildlife habitat value are compromised by infestation.

Description: Bull thistle is a biennial forb with a rosette forming the first year. A short tap root supports a 2 to 5 foot many-branched stem during the second year. The leaves are pinnatley lobed, prickly, with a cottony underside. The involucre of the light purple flower is covered with long spines. Flowering occurs from July through September.

Current Distribution on the Refuge: Bull thistle has not produced major infestations on the Refuge.

Measurable Objectives and Goal: Prevent competition with newly seeded native plants in habitat restoration sites, along roadways, and other disturbed soil areas.

Objectives:

a. Monitor known infestation sites, newly seeded areas, roadways, and other disturbed sites (e.g., remediation areas, wildfire areas) depleted of native perennial plants.

b. Seed disturbed sites with native species.

c. Control Bull thistle to reduce competition with native plants by preventing seed production and keeping infestations to less than 1 acre and less than 40% of live vegetation cover.

d. Maintain healthy stands of native perennial plants.

Control Options: Small stands of Bull thistle will be mowed, scythed, or hand cut to remove the bolted but not flowered stem. Hand cutting will include removing the stem and root crown.

The bull thistle seedhead gall fly (*Urophora stylata*) is effective in reducing stand density. Control of seed production is effective where the population of gall flies is high. This control method is not recommended for small infestations.

The chemical treatment of Bull thistle with an appropriate herbicide provides relatively effective control. Currently, aminopyralid (Milestone), glyphosate (Roundup™, Roundup Pro™, Rodeo™) and imazapic (Plateau™) are the herbicides used to control Bull thistle on the Refuge. Aminopyralid is very selective, provides longer control, can be used at lower rates. Glyphosate is soil binding, inexpensive, and a low threat to groundwater quality. Imazapic (Plateau™) is used in dry upland sites and on soils with low leaching potential. This chemical can be broadcast in restoration areas where the establishment of native grasses and herbicide resistant native broadleafs are essential for restoration success. Other chemicals will be added as needed and be approved at the required level. All chemicals will be used in accordance with label recommendations.

Treatment Schedule: Mechanical and hand removal will occur during bolt but before flowering (late June - July). Late bolting plants need removal before flowering to prevent seed formation.

Herbicides will be applied 1 -2 times during the growing season (April - November). Application will occur during the rosette stage or after mowing or scything.

9. *Convolvulus arvensis* (field bindweed)

Priority: Low to Medium: Field bindweed is highly competitive species with prodigious powers of regeneration from roots and rhizomes. Bindweed can survive a wide range of environmental conditions, but disturbed soil is a necessity for invasion. Bindweed is a threat to the regeneration of native vegetation.

Description: Field bindweed is perennial forb growing as a climbing and prostrate vine that forms dense mats. The taproot is deep, forming an extensive root system. The leaves are sagittate; flowers are bell-shaped and pink to white. Blooming occurs from June until frost.

Current Distribution on the Refuge: Bindweed is widely spread on Protection Island and unknown on other islands.

Measurable Objectives and Goal: Prevent competition with newly seeded native plants in habitat restoration sites, along roadways, and other disturbed soil areas.

Objectives:

a. Monitor known infestation sites, newly seeded areas, roadways, and other disturbed sites (e.g., remediation areas, wildfire areas) depleted of native perennial plants.

b. Seed disturbed sites with native species.

c. Control field bindweed to reduce competition with native plants by keeping any infestation at less than 40% of live vegetation cover.

d. Maintain healthy stands of native perennial plants.

Control Options: Mechanical and hand methods of control are impractical and ineffective due to the species' distribution and ability to regenerate from severed roots and rhizomes.

The chemical treatment of field bindweed with an appropriate herbicide provides relatively effective control. Currently, glyphosate (Roundup™, Roundup Pro™) and imazapic (Plateau™) are the herbicides used to control field bindweed on the Refuge. Glyphosate is soil binding, inexpensive, and a low threat to groundwater quality. Imazapic (Plateau™) is used in dry upland sites and on soils with low leaching potential. This chemical can be broadcast in restoration areas where the establishment of native grasses and herbicide resistant native broadleafs are essential for restoration success. Other herbicides indicated for field bindweed control are picloram, dicamba, and 2,4-D. The uses of restricted use pesticides like picloram are avoided at the Refuge. Dicamba has low wildlife toxicity but is not for use near water. Aquatic formulations of glyphosate fill that niche. 2,4-D will be used at the Refuge. Its effectiveness will be monitored and the herbicide will be considered as a replacement for imazapic in some situations. As with all herbicides, 2,4-D has been detected in groundwater although the sources of contamination are associated with inappropriate use and spillage. Other chemicals will be added as needed and be approved at the required level. All chemicals will be used in accordance with label recommendations.

The field bindweed moth (*Tyta luctuosa*) and the field bindweed mite (*Aceria malherbae*) have not been used to control field bindweed at the Refuge. These agents have not established well in the Pacific Northwest.

Treatment Schedule: Herbicides will be applied one to two times during the growing season (June - November). The period of highest chemical effectiveness is in the early flowering stage. Invaded sites will be monitored to determine the local variation in conditions that lead to the plants' flowering time. Multiple year applications may be necessary.

The field bindweed moth and field bindweed mite would be released to heavily infested bindweed sites during the early growing season (June through August). The release of bioagents will be dependent on the insects' availability.

10 *Hypericum perforatum* (St. Johnswort)

Priority: Low to medium: St. Johnswort invades disturbed sites along roadsides, over-grazed pastures and range, and waste places. It prefers dry, sandy to gravelly soil. St. Johnswort forms a deep, laterally spreading root system that forms new plants vegetatively from root buds. Dense growth of these plants inhibits regeneration of native species.

Description: St. Johnswort is a perennial shrub-like forb. The stems produce numerous branches and reach 1 to 3 feet high. Leaves are up to one inch long, opposite, entire, and contain numerous transparent dots. Flowers are yellow arranged in open, flat-topped cymes.

Current Distribution on the Refuge: St. Johnswort has not been identified on any of the Refuge islands.

Measurable Objectives and Goal: Prevent competition with newly seeded native plants in habitat restoration sites, along roadways, and other disturbed soil areas.

Objectives:

a. Monitor known infestation sites, newly seeded areas, roadways, and other disturbed sites (e.g., remediation areas, wildfire areas) depleted of native perennial plants.

b. Seed disturbed sites with native species.

c. Treat 100% of St. Johnswort plants - targeting for elimination - to reduce competition with native plants and stop the spread of infestations.

d. Maintain healthy stands of native perennial plants.

Control Options: Small infestations of new plants can be pulled by hand or dug out.

Glyphosate (Roundup® and Roundup Pro®) is effective in controlling St. Johnswort. Glyphosate is soil binding, inexpensive, and a low threat to groundwater quality. Other herbicides indicated for effective St. Johnswort control are picloram and 2,4-D. The use of restricted use pesticides such as picloram is avoided on the Refuge. 2,4-D is planned for use on the Refuge to control various broadleaf noxious weeds and its use for St Johnswort control could be considered in the future. As with all herbicides, 2,4-D has been detected in groundwater although the sources of contamination are associated with inappropriate use and spillage. Other chemicals will be added as needed and be approved at the required level. All chemicals will be used in accordance with label recommendations.

Biological control of St. Johnswort with the Klamath weed beetle (*Chrysolina quadrigemia*) has been very effective in North America. Two foliage beetles, *Chrysolina hyperici* and *C. quadrigemina* were released in California from 1945 to 1946, and established within two years. A root-boring beetle *Agrilus hyperici* and a leaf bud gall-forming midge *Zeuxidiplosis giardi* were released in 1950 to help the *Chrysolina* spp. Recently released in the state and established is the moth *Aplocera plagiata.* Due to the success of these beetles in controlling St. Johnswort, their continued use for established and new infestations is the preferred method of control.

Treatment Schedule: Removal and disposal of plants will be done in early spring (before flower formation).

Spot spraying with glyphosate (Roundup® and Roundup Pro®) before flowering can be an effective control method if repeated applications are made. Bolting and flowering occur early and continue through late summer (June - September). Patches need to be monitored for newly sprouted plants throughout the summer.

The release of Klamath weed beetles will be made in July to new or non-beetle infested areas. Beetles (if available) established in an area on the Refuge will be harvested and used as colonizers.

11. *Linaria genistifolia* (dalmatian toadflax)

Priority: High: Dalmation toadflax is an aggressive, colony-forming invasive. This species is opportunistic in invading disturbed sites, but it can also press into established vegetation communities in good condition. Native communities and restored sites may be jeopardized by the creeping expansion of Dalmation toadflax adventitious root buds. Competition between natives and toadflax may make the community more vulnerable to other invasive species. Dalmation toadflax produces a toxic substance and is unpalatable to livestock and wildlife.

Description: Dalmation toadflax is a perennial forb reaching up to 3 feet in height. Reproduction is by seed and underground root stalks. Leaves are alternate and variable in shape - ovate to lanceolate. Leaves and stems are robust, glaborous with whitish or bluish cast. Flowers grow at the axils of the upper leaves. The spurred-flower is yellow with an orange center. Flowers bloom late June through October.

Current Distribution on the Refuge: Currently, no islands are known to have any infestation, but Dungeness Spit has a small patch located on Graveyard spit. That site has been treated for several years by hand-pulling.

Measurable Objectives and Goal: Prevent competition with newly seeded native plants in habitat restoration sites, along roadways, and other disturbed soil areas.

Objectives:

a. Monitor known infestation sites, newly seeded areas, roadways, and other disturbed sites (e.g., remediation areas, wildfire areas) depleted of native perennial plants.

b. Seed disturbed sites with native species.

c. Treat 100% of Dalmation toadflax plants - targeting for elimination - to reduce competition with native plants.

d. Maintain healthy stands of native perennial plants.

Control Options: Hand pulling individual plants before seed set decreases seed production. Scything or mowing of stands before seed set is also effective. These methods do not kill the plant, but over time will with repeated pulling, the population will be reduced.

The chemical treatment of dalmation toadflax with an appropriate herbicide provides relatively effective control. Currently, glyphosate (Roundup™, Roundup Pro™) and imazapic (Plateau™) are the herbicides used to control Dalmation toadflax on the Refuge. Glyphosate is soil binding, inexpensive, and a low threat to groundwater quality. Glyphosate is appropriate for spot treatments, but its broad specificity precludes broadcast applications. Imazapic (Plateau™) is used in dry upland sites and on soils with low leaching potential. This chemical can be broadcast in restoration areas where the establishment of native grasses and herbicide resistant native broadleafs are essential for restoration success. Other chemicals will be added as needed and be approved at the required level. All chemicals will be used in accordance with label recommendations.

Biological control using *Calophasia lunula*, a defoliating moth, is well-established in Washington and reportedly provides good control.

Treatment Schedule: The removal of above ground portions of the plant before seed set will be done in April through July. The seeds are long-lived; annual removal of plants for up to ten years is necessary to deplete the seed bank.

Applications of glyphosate and imazapic will be made one to two times per growing season (April - November). Fall applications are particularly effective in decreasing the available stored carbohydrates in the roots.

12. *Linaria vulgaris* (yellow toadflax)

Priority: High: Yellow toadflax is an aggressive, colony-forming invasive. This species is opportunistic in invading disturbed sites, but it can also press into established vegetation communities in good condition. Native communities and restored sites may be jeopardized by the creeping expansion of yellow toadflax adventitious root buds. Competition between natives and toadflax may make the community more vulnerable to other invasive species. Yellow toadflax produces a toxic substance and is unpalatable to livestock and wildlife.

Description: Yellow toadflax is a perennial forb, 1 to 2 feet, with pale green, alternate, linear leaves. The base of the branched stem is woody. Stems and leaves are pale green. Flowers are spurred and yellow with an orange center.

Current Distribution on the Refuge: No known infestations exist on Refuge lands.

Measurable Objectives and Goal: Prevent competition with newly seeded native plants in habitat restoration sites, along roadways, and other disturbed soil areas.

Objectives:

a. Monitor known infestation sites, newly seeded areas, roadways, and other disturbed sites (e.g., remediation areas, wildfire areas) depleted of native perennial plants.

b. Seed disturbed sites with native species.

c. Treat 100% of yellow toadflax plants - targeting for elimination - to reduce competition with native plants.

d. Maintain healthy stands of native perennial plants.

Control Options: Hand pulling individual plants before seed set decreases seed production. Scything or mowing of stands before seed set is also effective. These methods do not kill the plant.

The chemical treatment of yellow toadflax with an appropriate herbicide provides relatively effective control. Currently, glyphosate (Roundup™, Roundup Pro™) and imazapic (Plateau™) are the herbicides used to control yellow toadflax on the Refuge. Glyphosate is soil binding, inexpensive, and a low threat to groundwater quality. Glyphosate is appropriate for spot treatments, but its broad specificity precludes broadcast applications. Imazapic (Plateau™) is used in dry upland sites and on soils with low leaching potential. This chemical can be broadcast in restoration areas where the establishment of native grasses and herbicide resistant native broadleafs are essential for restoration success. Other chemicals will be added as needed and be approved at the required level. All chemicals will be used in accordance with label recommendations.

Treatment Schedule: The removal of above ground portions of the plant before seed set will be done in April through July. The seeds are long-lived; annual removal of plants for up to ten years is necessary to deplete the seed bank.

Applications of glyphosate and imazapic will be made one to two times per growing season (April - November). Fall applications are particularly effective in decreasing the available stored carbohydrates in the roots.

13 *Onopordum ancanthium* (Scotch thistle)

Priority: Low to Medium: Scotch thistle aggressively invades disturbed and moist areas. This thistle, due to its size and spinous leaves, presents a passage barrier. Infestation decreases the value and area of wildlife habitat. Scotch thistle seeds have a water-soluable germination inhibitor that facilitates its own propagation and expansion along irrigation canals and other wet areas. Scotch thistle reproduces by seed.

Description: Scotch thistle is biennial forb that grows to 12 feet high. Leaves are large, green, and spiny. Fine hairs give the leaves a cottony appearance. First-year rosettes are 10 to 12 inches in diameter. Leaves of the mature plant may be two feet in length with a prominent white mid-rib. Flower heads are numerous and terminal. Flowers are 1 to 2 inches in diameter, pale purple to red in color.

Current Distribution on the Refuge: No known infestations exist on Refuge lands.

Measurable Objectives and Goal: Prevent competition with newly seeded native plants in habitat restoration sites, along roadways, other disturbed soil areas, and riparian and other moist areas.

Objectives:

a. Monitor known infestation sites, riparian and moist areas, newly seeded areas, roadways, and other disturbed sites (e.g., remediation areas, wildfire areas) depleted of native perennial plants.

b. Seed disturbed sites with native species.

c. Control Scotch thistle to reduce competition with native plants by keeping infestations to less than 1 acre and less than 40% of live vegetation cover.

d. Maintain healthy stands of native perennial plants.

Control Options: Mechanical treatment will include hand pulling or cutting of individual plants and small stands. The taproot will be cut 1-2 inches below the ground surface. Scything and mowing will be options for larger stands. The removal of the top material before flower production decreases the number of seeds available for spreading and propagation. Preventing flowering by mechanical means in conjunction with herbicide application for root killing is most effective in eliminating and controlling Scotch thistle.

The chemical treatment of Scotch thistle with an appropriate herbicide provides relatively effective control. Currently, aminopyralid (Milestone), glyphosate (Roundup™, Roundup Pro™), imazapic (Plateau™), and metsulfron methyl (Escort®) are the herbicides used to control Scotch thistle on the Refuge. Aminopyralid is very selective, provides longer control and can be used at lower rates. Glyphosate is soil binding, inexpensive, and a low threat to groundwater quality. Glyphosate is appropriate for spot treatments, but its broad specificity precludes broadcast applications. Imazapic (Plateau™) is used in dry upland sites and on soils with low leaching potential. This chemical can be broadcast in restoration areas where the establishment of native grasses and herbicide resistant native broadleafs are essential for restoration success. Metsulfuron methyl is very effective for thistle and mullein control and is the preferred treatment in restoration areas with a high infestation level. Other chemicals will be added as needed and be approved at the required level. All chemicals will be used in accordance with label recommendations.

Treatment Schedule: Mechanical treatment will target plants before flowering (April to mid-June).

Herbicides will be applied before bolting in the spring (April to June), possibly in conjunction with mechanical control, or to rosettes in fall (September -November).

14. *Spartina anglica* (cordgrass, Common)

Priority: High: The State of Washington considers this species one of the top ten priority weeds targeted for control, particularly for preventing new infestations. Cordgrass is an aggressive species that regenerates from large rootstocks. Excessive proliferation of cordgrass can lower the groundwater level, reduce the amount of surface water, reduce habitat for wildlife dependent on open water, reduce bird use by as much as 50%, reduce and interfere with water flow through drainages.

Description: Cordgrass is a perennial grass with stems reaching 7 feet. The stems have a waxy coating. Leaves are flat, 1/4 to 3/4 inch wide. The leaves lack auricles and have ligules that consist of a fringe of hairs. The leaf blades, which may be flat or inrolled, are 5 to 12 mm broad and may be persistent or falling. The flowers occur in numerous, erect, contracted panicles, which consist of closely overlapping spikelets in two rows on one side of the rachis. Reproduction is by seed, rhizomes, tillering, and rhizome fragments. The panicle is 3 to 8 inches long, initially compact but opening upon maturity.

Current Distribution on the Refuge: Common cordgrass' only known infestation is on graveyard spit on Dungeness NWR.

Measurable Objectives and Goal: Prevent competition with newly seeded native plants and established native communities in disturbed moist soil, riparian, and wetland environments.

Objectives:

a. Monitor known infestation sites - riparian, wetland, and moist areas for significant adverse effects on water flow and wildlife habitat.

b. Seed disturbed sites with native species.

c. Control common cordgrass to reduce competition with native plants and significantly altering the environment. Treatment applied to keep infestation to less than 40% of live vegetation cover and prevent infestations from increasing in area.

d. Maintain healthy stands of native perennial plants.

Control Options: Mowing infestations can contain growth, limit seed set, and eventually kill the plants. To be effective, clones must be mowed repeatedly, beginning with initial spring green-up and continued until fall die-back. For clones under 10 feet in diameter, one to three mowings during the growing season may be effective. Larger clones need to be mowed nine to ten times over two seasons for eradication. In some cases, mowing will be required for a third or fourth year (Spartina Task Force 1994).

Chemical control with glyphosate (Rodeo®) would be used on the Refuge for effective control of common cordgrass. Glyphosate is soil binding, inexpensive, a low threat to groundwater quality, and used to target numerous weed species. This chemical formulation is approved for aquatic application. All chemicals will be used in accordance with label recommendations.

Treatment Schedule: Data from herbicide trials in Willapa Bay suggest chemical control is best performed when the plants carbohydrate stores are lowest. Treatment will be conducted 1 to 2 times per season - once in the summer (June - August) and/or once in the spring (May) (Norman and Patten 1995).

15 *Rubus armeniacus* (Himalayan blackberry) and *Rubus laciniatus* (Evergreen blackberry)

Priority: High: Although widespread in Washington and control in not required, these species are highly invasive and difficult to control. Therefore it is important to protect wilderness areas as well as areas being restored to native vegetation.

Description: A robust, thicket forming shrub with stout arching canes with large stiff thorns. They can grow up to 15 feet tall; canes to 40 feet long. They bloom in the spring and the flowers are small, white to pinkish with five petals and Himalayan blackberry leaves are palmately compound with large, rounded to oblong, toothed leaflets usually in groups of 5 on main stems, while Evergreen blackberry (also known as cut-leaf blackberry) has deeply incised leaflets. They can be distinguished from the native trailing blackberry (*Rubus ursinus*) by its tall, arching reddish-brown canes, much more robust plants, rounder leaflets (or deeply incised leaflets for evergreen blackberry), and larger fruits and flowers

Current Distribution on the Refuge: No known infestations exist on any refuge lands.

Measurable Objectives and Goal: Prevent further spread into newly seeded native restoration sites, along other ditches or other disturbed soil areas.

Objectives:

a. Monitor known infestation sites, newly seeded areas, roadways, and other disturbed sites (e.g., remediation areas, wildfire areas) depleted of native perennial plants.

b. Seed disturbed sites with native species.

c. Treat 100% of blackberry plants - targeting for elimination - to reduce competition with native plants.

d. Maintain healthy stands of native perennial plants.

Control Options: Mechanical control includes hand pulling of small infestations, mowing or herbicide larger patches.

The chemical treatment of blackberries with an appropriate herbicide provides relatively effective control. Currently, glyphosate (Roundup™, Roundup Pro™), would be used on the Refuge. Glyphosate is soil binding, inexpensive, and a low threat to groundwater quality. Glyphosate is appropriate for spot treatments. Metsulfuron methyl is very effective for thistle, mullein control and blackberry is the preferred treatment in restoration areas with a high infestation level. This chemical can be broadcast in restoration areas where the establishment of native grasses and herbicide resistant native broadleafs are essential for restoration success. Other chemicals will be added as needed and be approved at the required level. All chemicals will be used in accordance with label recommendations.

Cultural control of blackberries is an important control method. The key to controlling spread is by decreasing seed production in established patches, and/or preventing the cane tips or nodes from touching the ground to produce “daughter’ plants. Methods that assist in these control strategies are minimizing soil disturbance, maintaining healthy native vegetation, control seed formation with a combination of mechanical and chemical techniques.

Treatment Schedule: The pulling can be done anytime. Mowing or cutting midsummer allow plant to grow back 18 inches then treat with herbicide is the preferred method.

Chemical application will occur during the Fall (Sept Oct.).

16. **Hedera helix (English Ivy)**

Priority: Low: Although widespread in western Washington and control in not required, this specie is highly invasive but fortunately not too difficult to control. Therefore it is important to protect wilderness areas as well as areas being restored to native vegetation.

Description: Evergreen vine that can trail along the ground or grow veritcally up trees, fences, walls and hillsides. Most common type of growth lacks flowers and has dull green, lobed leaves with light veins that grow alternately along trailing or climbing stems. Leaf shape and size varies between varieties from deeply to shallowly lobed and from small, narrow leaves to large, broadly shaped leaves. Mature form of growth has shiny, unlobed leaves that grow in dense, whorl-like clusters and produce umbrella-like groups of small yellow-green flowers in the fall, followed by dark purple-black berries in the late winter or early spring.

Current Distribution on the Refuge: Only known infestations exist on Matia Island.

Measurable Objectives and Goal: Prevent further spread into newly seeded native restoration sites, along other ditches or other disturbed soil areas.

Objectives:

a. Monitor known infestation sites, newly seeded areas, roadways, and other disturbed sites (e.g., remediation areas, wildfire areas) depleted of native perennial plants.

b. Seed disturbed sites with native species.

c. Treat 100% of ivy plants - targeting for elimination - to reduce competition with native plants.

d. Maintain healthy stands of native perennial plants.

Control Options: Mechanical control includes hand pulling and cutting of vines or herbicide larger patches.

The chemical treatment of ivy with an appropriate herbicide provides relatively effective control. Currently, glyphosate (Roundup™, Roundup Pro™), would be used on the Refuge. Glyphosate is soil binding, inexpensive, and a low threat to groundwater quality. Glyphosate is appropriate for spot treatments. Other chemicals will be added as needed and be approved at the required level. All chemicals will be used in accordance with label recommendations.

Cultural control of ivy is an important control method. The key to controlling spread is by decreasing seed production in established patches, and/or preventing the vegetative spreading of the plants. Methods that assist in these control strategies are minimizing soil disturbance, maintaining healthy native vegetation, control seed formation with a combination of mechanical and chemical techniques.

Treatment Schedule: The pulling can be done anytime. Mowing or cutting midsummer allow plant to grow back 18 inches then treat with herbicide is the preferred method. Cutting vines and treating stems with herbicide or foliar in spring are good alternatives.

Chemical application will occur during the Spring or Fall.

Other Future species

Oxeye Daisy (*Leucanthemum vulgare), and* Spurge Laurel (*Daphne laureola)*

These are species currently not known to occur on the Refuge but are known to occur in surrounding areas. These include Purple Loosestrife (*Lythrum salicaria)*, Russian knapweed **(***Centaurea repens***),** Garlic Mustard (*Alliaria petiolata*), Japanese Knotweed (*Polygonum cuspidatum),* and Lawnweed *(Soliva sessilis).* Others may be added as additional information becomes available and new invaders are documented.

Table 1. Summary of invasive plant species and possible control methods to be used, Washington Maritime National Wildlife Complex Refuge.

Species	Priority	Mechanical	Biological	Chemical	Cultural
Blackberries	**Low-Medium**	**X**		**X**	
Bull thistle	**Low-Medium**	**X**		**X**	
Canada thistle	**Low to Medium**	**X**	**Stem-and-shoot gallfly (*Urophora cardui*)**	**X**	
Cheatgrass	**Medium**	**X**		**X**	**X**
Dalmatian and yellow toadflax	**High**	**X**		**X**	
Diffuse, spotted, Russian, and meadow knapweed	**High**	**X**	**Broad-nosed seedhead weevil (*Bangasternus fausti)*** **Sulphur knapweed moth (*Agapeta zoegana*)** **Knapweed weevil (*Cyphocleonus achates*)** **Knapweed flowerhead weevil (*Larinus minutus*)**	**X**	
Field bindweed	**Low to Medium**		**Field bindweed moth (*Tyta luctuosa*)** **Field bindweed mite (*Aceria malherbae*)**	**X**	
Scotch Broom	**High**	**X**		**X**	

Leafy spurge	**High**		**Brown-legged spurge flea beetle (*Apthona lacertosa*)** **Amber spurge flea beetle (*A. flava*)**	**X**	
Musk thistle	**Medium**	**X**	**Seed head weevil (*Rhinocyllus conicus*)** **Musk thistle weevil (*Trichosirocalus horridus*)**	**X**	
Common cordgrass	**Medium to High**	**X**		**X**	
Russian knapweed	**High**	**X**		**X**	
Scotch thistle	**Medium to High**	**X**		**X**	
St. Johnswort	**Medium to High**		**Klamath weed beetle (*Chrysolina quadrigemia*)**		

E.9 Non-native Mammal Control

The animals referred to under this category are the non-native predators (rats, red fox, dogs, and cats) and the herbivore (European rabbit). All of these can be controlled using one or methods. Currently, only rabbits are known to exist on a limited number of islands and in low numbers, but expanding. For initial population control traps would be the preferred method followed by poison bait. Either method would be used to eradicate the population in the quickest, most humane, and least impact to other potential non-target animals.

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Appendix F. Area Beaches

F. Introduction

This appendix is a table which lists facilities and approved activities for beach areas in the vicinity of the refuges. Because beach access within the San Juan Islands NWR is extremely limited and trespassing creates wildlife disturbance issues, these beaches offer alternatives for those seeking additional facilities and other wildlife and non-wildlife dependant recreation opportunities.

Beaches in the Vicinity of San Juan Islands NWR & Protection Island NWR

Beach Name	Shore Length (approx. linear feet)	Toilets	Mooring Buoys	Dock	Boat Ramp	Picnic Tables	Picnicking	Beachcombing / Tide Pooling	Walking / Hiking	Mountain Biking / Bicycling	Swimming / Wading	Scuba Diving	Shellfish Harvesting	Fishing	Paddling	Birding	Wildlife Viewing	Other
Agate Beach County Park ***San Juan County Parks, Lopez Island***	580	▪				▪	▪	▪	▪			▪						
American Camp - 4th of July Beach ***National Park Service, San Juan Island***	2,640	▪				▪	▪	▪	▪		▪			▪	▪			
American Camp - South Beach ***National Park Service, San Juan Island***	10,560	▪				▪	▪	▪	▪					▪	▪			
Beach 407 ***WA DNR, Quimper Peninsula***	5,016												▪					
Beach 409 ***WA DNR, Quimper Peninsula***	1,584												▪					
Beach 410 ***WA DNR, Miller Peninsula***	2,640												▪					
Beach 411 ***WA DNR, Miller Peninsula***	25,660												▪					
Blackie Brady Memorial Day Park ***San Juan County Parks, Lopez Island***	6						▪	▪	▪									
Cattle Point Picnic Area ***WA DNR, San Juan Island***	2,795	▪				▪	▪	▪	▪					▪		▪	▪	
Clark Island Marine State Park ***WA State Parks, Clark Island***	10,560	▪	▪			▪	▪	▪				▪	▪	▪		▪		
Crescent Beach ***San Juan County Land Bank, Orcas Is.***	1,161							▪										
Deception Pass State Park ***WA State Parks, Whidbey Is. Fidalgo Is.***	77,000	▪			▪	▪	▪	▪	▪	▪	▪	▪		▪	▪	▪		▪
Eagle Cove Public Access ***San Juan County Parks, San Juan Is.***	15,840						▪	▪			▪	▪						▪
East Olga County Park ***San Juan County Parks, Orcas Island***	633						▪	▪										
Eastsound Waterfront Park ***San Juan County Land Bank, Orcas Is.***	475					▪	▪	▪										
English Camp - Garrison Bay ***National Park Service, San Juan Island***	7,920	▪		▪		▪	▪		▪				▪		▪			▪
Fisherman Bay Preserve ***San Juan County Land Bank, Lopez Is.***	9,820	▪		▪	▪	▪	▪			▪			▪	▪	▪			▪

Beach Name	Shore Length (approx. linear feet)	Toilets	Mooring Buoys	Dock	Boat Ramp	Picnic Tables	Picnicking	Beachcombing / Tide Pooling	Walking / Hiking	Mountain Biking / Bicycling	Swimming / Wading	Scuba Diving	Shellfish Harvesting	Fishing	Paddling	Birding	Wildlife Viewing	Other
Fort Casey State Park ***WA State Parks, Whidbey Island***	10,560	▪			▪	▪	▪	▪	▪			▪		▪	▪	▪		▪
Fort Ebey State Park ***WA State Parks, Whidbey Island***	26,400	▪			▪	▪	▪	▪		▪	▪			▪	▪	▪		▪
Jackson Beach ***Port of Friday Harbor, San Juan Island***	4,300	▪			▪	▪	▪	▪			▪			▪	▪			▪
Jones Island Marine State Park ***WA State Parks, Jones Island***	25,000	▪	▪	▪			▪	▪	▪			▪	▪	▪	▪			
Joseph Whidbey State Park ***WA State Parks, Whidbey Island***	3,115	▪			▪	▪	▪	▪		▪					▪	▪		▪
Lime Kiln Point State Park ***WA State Parks, San Juan Island***	2,534	▪				▪	▪		▪							▪	▪	▪
Mud Bay County Park ***San Juan County Parks, Lopez Island***	200							▪	▪				▪					
Obstruction Pass Marine Park ***WA State Parks, Orcas Island***	450	▪	▪			▪	▪		▪		▪			▪				
Odlin County Park ***San Juan County Parks, Lopez Island***	3,960	▪	▪	▪	▪	▪	▪	▪	▪		▪	▪	▪	▪	▪			▪
Olga Marine State Park ***WA State Parks, Orcas Island***	60														▪			
Otis Perkins County Park ***San Juan County Parks, Lopez Island***	21					▪	▪	▪	▪			▪						
Patos Island Marine State Park ***WA State Parks, Patos Island***	23,760	▪	▪			▪	▪	▪	▪					▪				
Rueben Tart Park ***San Juan County Parks, San Juan Is.***	870	▪					▪					▪				▪		
San Juan County Park ***San Juan County Parks, San Juan Is.***	2,470	▪	▪		▪	▪	▪	▪			▪	▪		▪	▪			▪
Shaw Island Cnty Park - South Beach ***San Juan County Parks, Shaw Island***	4,593	▪			▪	▪	▪	▪	▪		▪		▪	▪		▪		
Spencer Spit State Park ***WA State Parks, Lopez Island***	7,840	▪	▪			▪	▪	▪	▪				▪	▪	▪	▪		▪
Sucia Island Marine State Park ***WA State Parks, Sucia Island***	77,700	▪	▪	▪		▪	▪	▪	▪		▪	▪	▪	▪	▪	▪		▪
Third Lagoon ***San Juan County Land Bank, SJ Is.***	ND								▪							▪		
Upright Channel Recreation Area ***WA DNR, Lopez Island***	11,600	▪	▪			▪	▪	▪					▪					▪

ND = No Data

Sources: Lucas 2004, Mueller and Mueller 1995, National Park Service 2007, San Juan County Land Bank 2007, San Juan County Parks 2005, Washington Department of Natural Resources 2007, Washington State Department of Ecology 2007, Washington State Parks and Recreation Commission 2007b

Appendix G. Implementation

I. Overview

Implementation of the preferred alternative of the CCP will require increased funding, which will be sought from a variety of sources. This plan will depend upon additional Congressional allocations, partnerships and grants. There are no guarantees that additional federal funds will be made available to implement any of these projects. Other sources of funds will need to be obtained, both public and private. Activities and projects identified will be implemented as funds become available.

The CCP proposes several projects to be implemented over the next fifteen years. Most of these projects are included in the Refuge Operational Needs System (RONS - new staff), or Service Asset Maintenance and Management System (SAMMS - deferred maintenance projects) which are used to request funding from Congress. Currently, a large backlog of maintenance needs exists for Protection Island and San Juan Islands Refuges. In 2009, the deferred maintenance backlog for Protection Island was $1,156,000, with more projects needing to be added. An attempt at reducing this backlog needs to be addressed and is included here in the analysis of funding needs. Prioritized staffing needs identified in the RONS will be necessary to implement the CCP to meet Refuge goals and objectives and legal mandates.

Annual revenue sharing payments, associated with Protection Island NWR in Clallum and Jefferson Counties, will continue. Total payments made in 2008 were $228 for three acres in Clallum County and $49,425 for 317 acres in Jefferson County. Land associated with the San Juan Islands NWR is public domain. Payment In Lieu of Taxes for these acres are made by the Bureau of Land Management to Island, San Juan, Skagit, and Whatcom Counties.

Monitoring activities will be conducted on a percentage of all new and existing projects and activities to document wildlife populations and changes across time, habitat conditions and responses to management practices. For more details see the monitoring section at the end of this appendix.

II. Costs to Implement the CCP

The following sections detail both one-time and recurring costs for various projects, by alternative. One-time costs reflect the initial costs associated with a project, whether it is purchase of equipment, contracting services, construction, a research project, etc. Recurring costs reflect the future operational and maintenance costs associated with the project. The following tables primarily document projects with a physically visible, trackable “on-the-ground” component, such as structures, habitat restoration, research, and monitoring and surveys. The scope and costs for “administrative” activities such as MOUs, reporting, and establishment of partnerships are difficult to estimate in advance and thus are not accounted for in the tables below.

A. One-time costs

One-time costs are project costs that have a start-up cost associated with them, such as purchasing a new vehicle for wildlife and habitat monitoring, or designing and installing an interpretive sign. Some are full project costs for those projects that can be completed in three years or less. One-time costs can include the cost of temporary or term salary associated with a short-term project. Salary for existing and new positions, and operational costs, are reflected in operational (or recurring) costs.

Funds for one-time costs will be sought through increases in Refuge base funding, special project funds, and grants. Projects listed below in Table G-1 show one-time costs, such as those associated with building and facility needs including offices, public use facilities, road improvements, and new signs. One-time costs are also associated with projects such as habitat restoration, invasive plant and animal control, and research. New research projects, because of their short-term nature, are considered one-time projects and include costs of contracting services or hiring a temporary for the short-term project. Some project costs are taken from 2009 RONS or SAMMS proposals; others are not yet in any project database and their costs have been estimated, particularly if the scope of the project is unknown at this time due to lack of baseline data.

Table G-1. One Time Costs (in thousands) for Research and Assessments; Inventories, Surveys, and Monitoring; Habitat Management and Restoration, Facilities and Public Use-Related Actions

Project Description	Priority	Unit	Alt A	Alt B	Alt C	Potential Fund Source
Research						
Pre and post deer removal study of auklet habitat an vegetation on PI	H	Proj.	0	40	40	1261
Pre and post habitat restoration glaucous-winged gull breeding success study	H	Study		30	30	1261, Grants
Research grassland restoration methodologies in Puget Trough ecosystem	H	Proj.	0	35	35	1261
Conduct island-wide rhinoceros auklet breeding success studypre and post habitat restoration	H	Proj.	0	75	75	1261
Hydrological studies on Protection (wetland restoration phase 1), Smith and Matia Islands	M	Study	0	25	25	1261 RONS FY10-1740, 2061
Seabird demographic studies	M	Study		175	175	1261, Grants
Marine mammal demographic studies	M	Study	0	100	100	1261, Grants
Geomorphologic	L	Study	0	10	10	1261, Grants

study of Smith/Minor and Protection Islands						
Subtotal (thousands)			**0**	**490**	**490**	
Surveys and assessments						
Establish plant herbariums and digital photographic library for habitats	M	Proj.	0	20	10	1261 RONS FY08-4913, 6020
Research, design, and implement GIS-based inventory and monitoring programs for plants and wildlife on PI and SJI	H	Proj.	0	45	45	1261 RONS FY08-4913,6020
Conduct biodiversity assessments (base line inventories)	H	# inventories	0	148	120	1261 RONS FY08-4839, 4913, 6020
Conduct forest health assessment	L	Proj.	0	25	25	1260 RONS FY08-6137
Survey occupied, formally occupied and Aids To Navigation sites for presence of contaminants	L	Proj.	0	80	80	1261
Subtotal (thousands)			**0**	**318**	**280**	
Habitat management and restoration						
Restore PI grasslands to native grasses	H	acres	0	70	30	1261 RONS FY08-5973
Restore PI strand to native species	H	acres	0	15	5	1261 RONS FY08-5973
Subtotal (thousands)			**0**	**85**	**35**	
Regulatory and enforcement						
support new positions stationed in the San Start up costs needed to Juans (boat, vehicle, office equipment, office rent)	H		0	250	250	1261,1263
Subtotal (thousands)			**0**	**250**	**250**	

Facilities						
Design, fabricate and install new "island" boundary and area closed signs	H		0	30	30	1262, 1263
Develop site plan for infrastructure-PI	H	Proj.	0	20	20	1261
Remove & replace caretaker cabin-PI	H	Proj.	0	350	350	1262 SAMMS 2007705142
Replace caretaker cabin septic system-PI	H	Proj.	0	20	20	1262 SAMMS 2009943883
Remove & replace research bunkhouse-PI	H	Proj.	0	550	550	1262 SAMMS 2008867129
Replace research bunkhouse septic system-PI	H	Proj.	0	20	20	1262 SAMMS 2009943880
Remove & replace office -PI	M	Proj.	0	200	200	1262 SAMMS 88101548
Replace office septic system-PI	M	Proj.	0	20	20	1262 SAMMS 2009943886
Remove toxic PI marina pilings	H	Proj.	87	87	87	1262, refuge contaminate funds
Construct and replace nontoxic PI marina pilings	H	5 at $2000 each	86	86	86	1262 SAMMS 2009917570
Establish photovoltaic system for PI	H	Proj.	16	150	150	1262 SAMMS 2009924800
Replace water distribution system PI	M	Proj.	0	384	384	1262 SAMMS 2009943301
Replace boat launch ramp at PI	L	Proj.	0	65	65	1262 SAMMS 2008867122
Remove fire cache and two abandoned residences on PI	H	Proj.	0	150	150	1262
Remove human generated debris form Smith and Minor islands	M	Proj.	0	100	100	1262, partner w/USCG
Subtotal (thousands)			**189**	**2,232**	**2,232**	
Public use						
Design construct and install interpretive panels for PI and SJI	H		0	120	90	1263 SAMMS 97122612, 2009917578
Develop SJI NWR brochure, rack cards, posters and video	H		0	80	80	1263 RONS FY10-2056

Develop cultural outreach an educational material	M		0	10	10	1263
Subtotal (thousands)			**0**	**210**	**180**	
Total of all one time project costs			**189**	**3,585**	**3,467**	

B. Annual Operational (recurring) costs

Operational costs reflect Refuge spending of base funds allocated each year. These are also known as recurring costs and are usually associated with day-to-day operations and projects that last longer than three years. Operational costs use base funding in Service fund code 1260.

Table G-2 displays projected annual operating costs under the CCP. The CCP will require increased funding for new or expanded public uses and facilities, habitat restoration and conservation activities, and new monitoring needs. This table includes such things as salary and operational expenditures such as travel, training, supplies, utilities and maintenance costs. Project costs listed in Table G-2 include permanent and seasonal staff needed year after year to accomplish each project; these staffing costs are not isolated in this table but are included as part of the entire project cost.

Table G-2. Annual operational (recurring) costs

Activity Description	CCP Goals	Alt A Cost est (K)	Alt B Cost est (K)	Alt C Cost est (K)	Potential fund source
Surveys and assessments: Aerial phographic surveys; boat-based and land survey and assessments; joint wildlife surveys with WDFW; implement GIS-based inventory and monitoring programs for plants and wildlife; mammalian predator and invasive species monitoring; monitor biodiversity trends; provide administrative and material support for all biological activities.		63.8	150	120	
Research: Facilitate and cooperate in specific research projects to benefit refuge resources.		7.5	22.3	22.3	
Habitat management and restoration: inventory, remove, control and prevent new establishment of invasive plants and treat infestations with IPM; periodic		31.6	94.3	80.1	

mowing and burning of grassland and spit restoration areas.					
Regulatory and enforcement actions: Patrol islands, enforce regulations and educate visitors to the sensitivity of wildlife resources; replace boundary and regulatory signage as needed; conduct outreach.		46.7	73.0	65.8	
Public use opportunities and education: Provide funding for and manage a variety of both on-refuge and off-refuge interpretive and education programs; maintain Protection Island and San Juan Islands NWR interpretive panels located both on and off-refuge to offer interpretation through self-guided experience; conduct and manage volunteer environmental education stewardship projects; manage college level environmental studies program; initiate volunteer interpretation program including logistical and financial support.		43.3	180.3	168.6	
Facilities maintenance: Maintain and make minor repairs on interpretive panels, regulatory signage; maintain Protection Island infrastructure and facilities; maintain boats, vehicles, tractor,equipment and tools for use as needed		61.0	87.9	68.6	
Total Recurring Costs by Alternative		**253.9**	**607.8**	**525.4**	

C. Maintenance costs

The maintenance need over the next 15 years is defined as funds needed to repair or replace buildings, equipment, and facilities. Maintenance includes preventative maintenance; cyclic maintenance; repairs; replacement of parts, components, or items of equipment; adjustments, lubrication, and cleaning (non-janitorial) of equipment; painting; resurfacing; rehabilitation; special safety inspections; and other actions to assure continuing service and to prevent breakdown. Maintenance costs include the maintenance “backlog”—maintenance needs that have come due but are as yet unfunded, as well as the increased maintenance need associated with new facilities.

The facilities associated with San Juan Islands and Protection Island NWRs that require maintenance include trails, interpretive panels, regulatory signs, roads, water delivery system, buildings, dock and marina. Major equipment includes boats, vehicles, tractors, ATVs, and generators. Approximately 60% of operational (non-project) maintenance funding for the

Washington Maritime NWR Complex is expended on the two refuges covered under this CCP (also see Table G-2) ; the other approximately 40% is used to maintain the majority of facilities, including buildings and equipment, which are located on the other three Complex Refuges and are not included in this Implementation Plan. One time costs for buildings and associated infrastructure replacement for Protection Island and replacement of island boundary and regulatory signs are identified in Table G-1

D. Staffing

Current (2009) staffing and proposed staffing are shown in Table G-3. Current positions below serve all six refuges within the Washington Maritime NWR Complex; because there is no separate budget for the individual refuges, we have chosen to present the entire Complex staff in table G-3. Approximately 40% of current Complex staff time is expended on the two refuges covered under this CCP; the other approximately 60% of staff time is expended on the other four refuges in the Complex. Two of the four new positions (Wildlife Refuge Manager and Park Ranger (.5 FTE)) will work full time on San Juan islands NWR. The Wildlife Biologist is anticipated to work 70% of the time on San Juan Islands and Protection Island NWRs and the Supervisory Park Ranger 50% of the time.

Table G-3. Current and Proposed Staffing

Current Position	GS & grade	Annual Salary cost (K)	Annual Salary (K) x 40%	RONS project #
Project Leader	GS- 0485-12	123.0	49.2	N/A
Deputy Project Leader	GS-0485-11	86.8	34.7	N/A
Wildlife Biologist	GS-0486-11	89.5	35.8	N/A
Park Ranger (LE)	GS-0025-09	71.8	28.7	N/A
Maintenance Worker	WG-4749-08	78.9	31.5	N/A
Office Automation Clerk	GS-0326-04	43.6	17.4	N/A
Proposed Position			**Annual Salary X (%)**	
Wildlife Refuge Manager	GS-0485-11	78.9	(100%) 78.9	FY08-4801
Supervisory Park Ranger (Visitor Services)	GS-0025-11	78.9	(50%) 39.5	FY08-5190
Wildlife Biologist	GS-0486-9	65.2	(70%) 45.6	FY08-4839
Park Ranger (.5FTE)	GS-0025-9	32.9	(100%) 32.9	FY08-4827
Total current annual and proposed staffing cost for Protection Island & San Juan Islands NWRs			**394.2**	

* source for cost estimates:

[1] = FY 2009 FTE Utilization Table for Washington Maritime NWR Complex

[2] = OPM General Schedule FY 2009 plus 40% benefits

GS: General Schedule Federal Employee

WG: Wage Grade Scale

Table G-4 shows differing staff costs by alternative. The Alternative A column shows the current estimated 40% expenditure on these two refuges, in FY09 dollars. Alternative B and C columns reflect costs associated with increased staff and % time identified by alternative.

Table G-4. Annual Costs, Annual Salary and Benefits, Associated w/Staff by Alternative

Staff-Refuge Operations	**FTE**	**Staff Position**	**Annual Salary (K)**	**Alt A (K)**	**Alt B (K)**	**Alt C (K)**
Refuge Manager *	1.0	GS-485-12	123.0	49.2	61.5	35.2
Deputy Ref Manager *	1.0	GS-485-11	86.8	34.7	52.0	40.5
Wildlife Biologist *	1.0	GS-486-11	89.5	35.8	22.0	22.0
Park Ranger & Vol Coordr *	1.0	GS-025-9	71.8	28.7	38.7	33.0
Maintenance Worker *	1.0	WG-4749-8	78.9	31.5	42.0	36.0
Office Auto Clerk *	1.0	GS-326-4	43.6	17.4	17.4	17.4
Refuge Manager (1)	1.0	GS-485-9/11	78.9	0	78.9	78.9
Wildlife Biologist (2)	1.0	GS-486-7/9	65.2	0	45.6	45.6
Sup Park Ranger - VSS(3)	1.0	GS-025-11	78.9	0	39.5	39.5
Park Ranger - (4)	.5	GS-025-7/9	32.9	0	32.9	32.9
Totals	9.5		**749.5**	**197.3**	**430.5**	**381.0**

Costs are based on FY 2009 FTE utilization plans for Washington Maritime NWR Complex and OPM General Schedule FY 2009 plus 40% benefits. For new positions ( ) took step one grade plus 40%.

Tables G-3 and G-4 show a 3.5 full-time-equivalent (FTE) increase in staffing over current levels. Proposed additions include Wildlife Refuge Manager, Wildlife Biologist, Supervisory Park Ranger (Visitor Services Specialist) and Park Ranger.

The Refuge Manager position is proposed to be stationed in the San Juan Archipelago and will be responsible for all refuge programs on San Juan Islands NWR. This position will be a "dual function" position meaning the individual will have law enforcement capabilities to enhance visitor safety and resource protection. Stationing this position in the San Juans will result in continuous Service presence interacting with local government, Federal and State agencies present in the San Juans, local NGOs, user groups, citizens and visitors.

The Wildlife Biologist will work with the Complex Wildlife Biologist in coordination and implementation of the overall biological program in the San Juan Islands NWR and assist as needed with the biological program on other refuges in the Complex. This position will facilitate increased coordination with other Federal and State agencies, Tribes, and will greatly improve the Complex's ability to address the biological complexity of these two Refuges. This position is anticipated to devote 70% of its time to Protection Island and San Juan Islands NWRs

The Supervisory Park Ranger will serve as a visitor services specialist to guide the public use program of the Complex including environmental education, interpretation, outreach, and volunteer program. This position will facilitate informing the public about the refuges in the Complex, educating and interpreting the public on marine dependent wildlife species and the impacts of such issues as human disturbance, loss of habitat, marine debris, ocean acidification and global climate change. This position is anticipated to spend approximately 50% of its time on San Juan Islands and Protection Island NWR projects

The Park Ranger will be a ½ full time equivalent and will provide seasonal assistance to the Refuge Manager during those times of the year that these two Refuges are most vulnerable to human disturbance. Interacting, educating and interpreting to residents, visitors and user groups is anticipated to reduce disturbance incidents and give the public an appreciation of the needs of wildlife species in the area and the importance of the National Wildlife Refuges in meeting those needs.

E. Budget summary

Table G-5 summarizes the data from tables G-1 and G-2and displays the overall funding need for the Washington Maritime NWR Complex to implement the CCP in full.

Table G-5, Budget Summary – One-time projects and annual funding needs for Protection Island and San Juan Islands NWR as identified in the CC

Budget Category	Alt A		Alt B		Alt C	
	One time cost (K)	Annual recurring cost (K)	One time cost (K)	Annual recurring cost (K)	One Time Cost (K)	Annual recurring cost (K)
Research	-	7.5	490.0	22.3	490.0	22.3
Surveys and assessments	-	63.8	318.0	150.0	280.0	120.0
Habitat management and restoration	-	31.6	85.0	94.3	35.0	80.1
Regulatory and enforcement actions	-	46.7	250.0	73.0	250.0	65.8
Public use opportunities and education	-	43.3	210.0	180.3	180.0	168.6
Facilities and maintenance	-	61.0	2,232.0	87.9	2,232.0	68.6
Totals	**-**	**253.9**	**3,585.0**	**607.8**	**3,467.0**	**525.4**

Partnership Opportunities

Partnerships are an important component of the implementation of this CCP and are reflected in the goals, objectives, and strategies identified in Chapter 2. The Refuges location (Olympic Peninsula and San Juan Archipelago) facilitates many opportunities for partnerships. Current and past partners include federal and state agencies, Tribes, non-governmental organizations, schools volunteers, and individuals.

Coordinated partnerships efforts will focus on habitat restoration, land protection, environmental education, fish and wildlife monitoring, outreach, and quality wildlife-dependent recreation. Refuge Complex staff will work to strengthen existing partnerships and will actively look for new partnerships to assist in achieving the goals, objectives, and strategies in this CCP/WSP/EA.

U.S. Coast Guard

The Coast Guard maintains aids to navigation on 17 refuge islands within San Juan Islands NWR (See Appendix A). The Service has worked with USCG to schedule service of these aids during periods of low wildlife use (See Appendix F). In addition the Service will work with USCG on debris removal from Smith Island when they abandon their facilities there.

National Oceanic and Atmospheric Administration

National Oceanic and Atmospheric Administration – Fisheries conducts research and monitors marine mammals in the Salish Sea. These activities are managed under a Special Use Permit when conducted on Refuge lands and have involved Steller sea lions, and elephant and harbor seals.

Washington Department of Fish and Wildlife (WDFW)

WDFW's management responsibilities including lands and waters, fish and wildlife, threatened and endangered species and other programs, frequently overlap with USFWS resources and responsibilities. WDFW and other state agencies are in a unique position to greatly assist the Complex in protecting sensitive seabirds and pinnipeds from human disturbance in close proximity to the Refuges. WDFW and the Complex share mutual interests in species management, wildlife surveys, developing joint research projects, and education and outreach programs. WDFW has been closely involved with the Complex in waterfowl surveys, pinniped surveys, black oystercatcher and pigeon guillemot surveys, forage fish spawning beach surveys and review of Complex projects in the marine environment (Protection Island marina entrance dredging and creosote bulkhead removal).

WDFW and the Service have a unique relationship regarding the management of Protection Island. WDFW is the managing agency on the 48 acre Zella M. Schultz Seabird Sanctuary while the Service manages the remainder of the island. A Memorandum of Understanding (MOU) between the Service and WDFW formalizes both parties commitment to the protection and enhancement of the wildlife resources of Protection Island and ensures that each agency's management approach is compatible and complimentary. (See Appendix F)

Washington Department of Natural Resources (WDNR)

WDNR is the agency that manages State-owned aquatic lands. On November 22, 1988, WDNR issued a withdrawl order for "The bedlands of navigable water owned by the state of Washington, surrounding Protection Island extending waterward 600 feet from the line of extreme low water,…" (Withdrawl Order 88 017). Under this withdrawl order these bedlands "shall be reserved and withdrawn from conflicting uses…" In January 1994 the Service received a 20 year lease for all the tidelands of the second class surrounding Protection Island (Aquatic Lands Lease No. 20-013245). "Lessee shall have use of the Property only for the specified purposes of a portion of the National Wildlife Refuge System…" This 340 acre tideland lease is due to expire on December 31, 2013. The withdrawl and lease have been critical in the Service's ability to manage these areas for the benefit of the islands wildlife and to protect against human disturbance. The Service is working with WDNR on renewal of this lease and expanding this partnership to the San Juan Islands NWR.

Washington State Parks (WSP)

The Service has had a long term relationship with WSP. In 1959 WSP and the Service entered into a 10-year agreement for the State to develop and operate facilities on Turn, Matia , and Jones Islands. Jones Island was transferred to the State in 1982. A MOU was established in 1983 repalcing the original 1959 agreement. This agreement was updated in 1987 and 2010 and outlines the Service and State responsibilities in general and specifically for Matia and Turn Islands. The MOU will be updated again upon finalization of this CCP to reflect any changes required. Washington State Parks manages the camping program and facilities, composting toilets, and mooring buoys at Turn and Matia Islands and a seasonal dock at Matia Island and conducts law enforcement activities associated with their use. The Service will continue to work with State Parks to ensure these activities support wildlife dependent recreation and expand our interpretation and environmental education capabilities.

Washington Department of Ecology

One of Washington Department of Ecology's programs is spill prevention, preparedness, and response. This program focuses on prevention of oil spills to Washington State waters and land, as well as planning for an effective response to oil and hazardous substance spills whenever they occur. The Service will continue it's partnership with DOE in support of a Response Tug at Neah Bay; maintenance of a regional contingency plan that guides how spills are managed in the Northwest; and in the development and periodic review of Geographic Response Plans.

The Whale Museum

The service has long partnered with the Whale Museum in Friday Harbor. The Museum promotes stewardship of whales and the Salish Sea ecosystem through education and research. The Whale Museum's Soundwatch Boater Education Program has partnered with the Service for close to 15 years. The boundary waters of the U.S. San Juan and Canadian Gulf Islands are one of the highest density whale watching areas in the world. Boating traffic is high in the whale watching season on May through September. This program was developed to respond to traffic and its effects on marine species. While this program primarily educates whale watching boaters in proper watching protocol it has also taken on the additional effort of San Juan NWR patrols. They educate boaters in the vicinity of Refuge islands about island closures and requested 200 yard buffers to avoid disturbance and hand out refuge maps. Soundwatch also assists the Service by providing information and brochures at marinas, marine parks and visitor areas likely to reach boaters and commercial eco-tourism operators in San Juan County.

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Port Townsend Marine Science Center

The Port Townsend Marine Science Center is an educational and scientific organization promoting coastal education and conservation. They offer off refuge education and interpretation for Protection Island NWR through their wildlife cruises. A spring bird migration cruise is offered in April; Protection Island puffin cruises in July and August; and fall migration cruises in October and November. Naturalists from the Marine Science Center serve as on board interpreters and provide commentary on local birds, mammals, geology, history and weather.

Recently the Service has collaborated with the Marine Science Center studying marine debris. Bolus from glaucous-winged gulls on Protection Island are collected and given to the Marine Science Center. Students dissect the bolus and look for marine debris (plastics).

Islands' Oil Spill Association

Islands' Oil Spill Association is a non-profit, community-based oil spill response organization that provides prompt, effective, local oil spill response and prevention throughout San Jaun County and is the only oil spill response organization in the San Juan Islands. The Refuge has worked with IOSA to place rock anchor bolts on Fortress, Crab, and Blind Islands to attach oil booms to protect the island's and associated bay's resources, should the need arise.

The Nature Conservancy (TNC)

The Service has partnered with TNC on conducting baseline vegetative surveys for many of the islands within the Refuge. TNC also manages lands in the San Juan Islands and the Service has worked with them at the Yellow – Low island complex. Yellow Island is a TNC property and Low Island a Refuge island. The waters surrounding them are a marine protected area administered by the University of Washington and closed to salmon and rock fish fishing. Working with the Yellow Island caretaker the Service has permitted the installation of informational signage on Low Island regarding this closure. The Yellow Island caretaker interacts with boaters who come too close or trespass on Low Island and informs them of the island's closed to public use status and disturbance effects.

San Juan County Marine Resource Committee (SJMRC)

The Service has worked with SJMRC for a number of years as the Refuge islands and their resources are important components of the marine ecosystem of the San Jauns.
The Service participated in the development of the SJMRC's Marine Stewardship Plan which includes actions to reduce seabird disturbance. Refuge staff participates in Marine Managers Workshops hosted by the SJMRC that draw resource managers together to assist the SJMRC with action items in the Plan and provide information on issues and work planned by each group for the coming year.

Corinthian Yacht Club of Bellingham

The Corinthians have conducted an annual Matia Island clean up for a number of years as a club project. The club has worked with the Service and Washington State Parks on this project which has included marine debris removal, wilderness trail maintenance, English ivy removal, and campground "spring cleaning".

Effectiveness Monitoring

Effectiveness monitoring refers to monitoring and evaluation used to determine whether or not implemented strategies are effective in making progress toward meeting CCP objectives. Careful monitoring of progress toward meeting CCP objectives provides informed support for sound decision-making regarding refuge resource management and is critical to the application of adaptive management principles. Monitoring tasks would be implemented as their associated objectives/strategies are implemented. Monitoring techniques identified below may change based on funding and personnel availability as well as in response to advancements in monitoring methods.

Effectiveness Monitoring for Habitat Objectives under Goals 1-5

Note: $ = can accomplish with existing refuge funding; $$ = some additional funding needed; $$$ = significant funding needed such as a special grant.

Obj. #	Effectiveness Measures	Method	Reliability	Time Factors	Cost Factors	Personnel	Links to Regional monitoring efforts
1.1, 2.1, 2.2	Presence/absence or % cover non-native and native vegetation	Line intercept transect method	Excellent, standard method	1-2 days during the non-breeding season of birds or use by seals	$	Staff, volunteers, research partners	
1.1, 2.1, 2.2, 3.1, 4.1	Disturbance to seabird nesting habitat and other BIDEH on PI from deer.	Island-wide survey of deer/season/habitat type); observations of deer in auklet and gull colonies/24-hr period (% time spent in the colonies and direct impacts observed); degree of wear in deer trails; investigate slope failure and determine possible causes; Conduct deer exclosure studies	Good to excellent	7-10 days per season	$$	Staff, volunteers, research partners	none

Obj. #	Effectiveness Measures	Method	Reliability	Time Factors	Cost Factors	Personnel	Links to Regional monitoring efforts
		in savannah and forested habitats.					
1.1, 2.1, 2.2, 3.1, 4.1	Presence/absence of rats, rabbits, or other mammalian predators on PI	Look for signs (scat, tracks, fur, etc). If suspected, set up more formal survey methods such as rat boxes, track plates, or cameras.	Good	Can routinely look for signs while doing other work on the island.	$ to look for signs $$ to conduct a more formal survey.	Staff, volunteers	none
1.1,1.2 1.3,	# of islands free of debris	Shoreline and trail surveys	excellent	PI-2X per year (Sp Fall) SJ-Smith/Minor Islands annually, Matia and Turn-2X per year, other accessible islands 1X/5year on rotational basis	$ $$ $	Staff and volunteers	Staff and volunteers
1.2	Spit length, increasing measured at mean low tide	Photo point, marker stake	Excellent	2-3 years	$	Staff	none
1.2,1.3,	Presence/absenc	Look for signs (scat, tracks,	Good	Can routinely look	$ to	Staff,	none

Obj. #	Effectiveness Measures	Method	Reliability	Time Factors	Cost Factors	Personnel	Links to Regional monitoring efforts
3.2, 3.3, 4.2, 5.1, 5.2	e of rats, rabbits, or other mammalian predators on SJI	fur, etc). If suspected, set up more formal survey methods such as rat boxes, track plates, or cameras.		for signs while doing other work on the island.	look for signs $$ to conduct a more formal survey.	volunteers	
1.2	# of elephant and harbor seals on PI	Elephant and harbor seal census by boat	Good	Breeding and molt periods	$	Biologist, Boat Operator	WDFW, NOAA
1.2	# of pigeon guillemot and black oystercatcher nests in the driftwood on PI and Smith	Area nest searches	Fair	2-3 days annually	$$	Staff, volunteers, research partners	None
1.3	# of breeding seabirds and oystercatchers per refuge island	Boat Surveys	Good	1 Survey/Season – All Islands 2-3 Surveys/breeding season – Turn/Matia	$	Biologist, 1 volunteer, Boat Operator	Some applicability with the California Current Seabird

Obj. #	Effectiveness Measures	Method	Reliability	Time Factors	Cost Factors	Personnel	Links to Regional monitoring efforts
							Monitoring Plan (under development)
1.3	# of prickly pear cactus populations	GPS, photo	Excellent	Annually	$	Staff, volunteers	None
1.3,	# of trespass incidents on Turn and Matia along shorelines	Boat surveys	Good	Annually, anytime working in the area particularly April-September	$	Staff, volunteers	none
1.3	# of marine mammals flushed by people from any rookery islands	incidental observations	Fair		$	Staff, partners, volunteers	Sound Watch, NOAA, WDFW
2.1	Miles of road, # of buildings, # of other structures	Measure , count	Excellent	As needed for data called and to add or delete property	$	staff	none
2.1	Degree of slope and friability of soil		Good	Pre and post restoration	$$	Staff, volunteers	None
2.1, 2.2	# of burrows per square meter	Measure number and density of rhinoceros auklet burrows in restoration plots compared to adjacent control plots.	Excellent	Before and after structural removal vegetation establishment	$$	Biologist, research partners	None

Obj. #	Effectiveness Measures	Method	Reliability	Time Factors	Cost Factors	Personnel	Links to Regional monitoring efforts
2.1, 2.2	# of plants, patches, or presence/absence of scotch broom and other invasive shrubs on bluffs.	Boat and land surveys with binoculars if they are higher	Fair to Good from Boat, Excellent on land	Annually as part of other surveys or maintenance projects, if nothing planned for the particular island then once every 3 years	$	Staff, volunteers	none
2.1	Bluffs have 50% vegetative cover for rainy season	Photo and boat surveys	Good	Annually	$	Staff, volunteers	none
3.1, 4.1	% cover of invasive vegetation or native vegetation	line intercept	Excellent	Monitor before and/or after bird breeding season.	$	Staff, volunteers	none
3.1, 3.2, 3.3, 4.1, 4.2	% cover of trees and/or shrubs	Line intercept, aerial photos	Excellent	5-10 years??	$	Staff, volunteers	none
3.1, 3.2, 3.3	% cover of native and non-native grasses and forbs.	Line intercept transects or quadrats	Excellent	TBD	$$	Staff, volunteers	State of Washington, TNC, USFWS
3.1, 3.3	Presence/absence or % cover of butterfly host	GPS, Point counts and Line intercept transect method	Excellent	Annually	$	Staff, volunteers, WDFW	Butterfly recovery plan

Obj. #	Effectiveness Measures	Method	Reliability	Time Factors	Cost Factors	Personnel	Links to Regional monitoring efforts
	plant species						Island silver spot??
3.1, 3.3, 4.1	Map acres restored and % cover of targeted native species within restored areas	GPS/GIS, Line intercept transects	Excellent	TBD	$$	Staff, volunteers	none
3.1, 3.2, 3.3	Presence/absence of rare/endemic plant populations	GPS, Point counts and Line intercept transect method	Excellent	Annually	$	Staff, volunteers,	Golden paintbrush recovery plan
3.1, 3.2, 3.3, 4.1	Presence/absence of targeted species	Walking surveys, GPS, researchers and caretaker plant identification training	Good to Excellent	Annually	$	Staff, volunteers	none
4.1, 4.2	# of eagles nesting on PI and eagle territories encompassing islands in the SJI NWR	TBD	TBD				Bald Eagle Delisting Monitoring Plan
4.2	Acres of Dry Douglas Fir Forest	Line intercept, aerial photos	Excellent	5-10 years??	$	Staff, volunteers	
4.2	Acres of old-	Line intercept, aerial photos	Excellent	5-10 years??	$	Staff,	

Obj. #	Effectiveness Measures	Method	Reliability	Time Factors	Cost Factors	Personnel	Links to Regional monitoring efforts
	growth					volunteers	
5.1, 5.2	Presence/ absence of aquatic invasive animals or plants such as green crabs, bullfrogs, purple loosestrife and spartina	GPS, Point counts and Line intercept transect method and crab pots , calling frog survey	Excellent, standard method	Annually	$	staff, volunteers	none
5.1, 5.2	Hydrological study completed	Yes/no	excellent	TBD	$$	Hydrologist	None

Effectiveness Monitoring *for Visitor Services and Wilderness Objectives under Goals 6-8*

Note: $ = can accomplish with existing refuge funding; $$ = some additional funding needed; $$$ = significant funding needed such as a special grant.

Obj. #	Effectiveness Measures	Method	Reliability	Time Factors	Cost Factors	Personnel	Links to Regional monitoring efforts
6.1	% of visitors who know they are on a wildlife refuge and that wildlife come first	Visitor contacts and tracking	Fair	Annual, ongoing	$$	SJI NWR staff. complex staff, volunteers, partners	
6.1	% of visitors who know there are	Visitor contacts and tracking	Fair	Annual, ongoing	$$	SJI NWR staff,	

Obj. #	Effectiveness Measures	Method	Reliability	Time Factors	Cost Factors	Personnel	Links to Regional monitoring efforts
	other Refuge islands in the San Juan Archipelago and why they are closed					complex staff, volunteers, partners	
6.1	% of violations	Observation, # Violation Notices and % change over time	Fair	5 Years	$$$	State and Federal Law Enforcement personnel, SJI NWR staff. complex staff, volunteers, partners	USFWS uniform crime reporting system, State Parks incident and violation tracking
6.1	# of violations	Observation, # Violation Notices	Fair	Annual,, ongoing	$$$	State and Federal Law Enforcement personnel, SJI NWR staff. complex staff, volunteers	USFWS uniform crime reporting system, State Parks incident and violation tracking

Obj. #	Effectiveness Measures	Method	Reliability	Time Factors	Cost Factors	Personnel	Links to Regional monitoring efforts
						, partners	
6.2	% of visitors who know they are in an old growth forest on Matia Island	Visitor contacts and tracking	Fair	Annual,, ongoing	$$	SJI NWR staff. complex staff, volunteers , , partners	FWS uniform crime reporting system, Washington State Parks incident tracking
6.2	% of visitors that can name at least one species associated with old growth island habitat	Visitor contacts and tracking	Fair	Annual, ongoing	$$	SJI NWR staff. complex staff, volunteers , , partners	
6.2	% of visitors that can name at least one species associated with shoreline habitat	Visitor contacts and tracking	Fair	Annual, ongoing	$$	SJI NWR staff, complex staff, volunteers , partners	
6.2	% of refuge visitors who know that humans and pets disturb wildlife and their habitat and can identify at least one negative impact of such	Visitor contacts and tracking	Fair	Ongoing	$$	State and Federal Law Enforcement personnel, SJI NWR staff. complex	

Obj. #	Effectiveness Measures	Method	Reliability	Time Factors	Cost Factors	Personnel	Links to Regional monitoring efforts
	disturbance					staff, volunteers, partners, visitors	
6.3	Number of habitat enhancement stewardship projects completed annually	Quantify number of projects &,assess success through monitoring	Very good	Annual	$$-$$$	SJI NWR staff, complex staff, academic institution staff, partners	Academic program requirements, possible project specific regional monitoring efforts
6.3	Number of stewardship project participants that can identify at least 3 adverse impacts of invasive species, marine debris and/or human caused wildlife disturbances	Pre and post project assessments	Very good	Project specific	$	SJI NWR staff, complex staff, academic institution staff, partners	
6.4	Number of student research projects conducted	Counting	Very Good	5Years	$$	SJI NWR staff, complex staff,	Possible project specific

Obj. #	Effectiveness Measures	Method	Reliability	Time Factors	Cost Factors	Personnel	Links to Regional monitoring efforts
						academic institution staff, partners	
6.4	% of projects that contribute to both student and refuge knowledge	Pre and post project assessments	Good	5Years	$$	SJI NWR staff, complex staff, academic institution staff, partners	Possible project specific
7.1	% of visitors to the area who know there is a National Wildlife Refuge in the San Juan Archipelago and know the conservation mission of the National Wildlife Refuge System	Contacts, tracking, and/or OMB approved survey	Good	Annual, ongoing, OPM survey 3 times during plan life (15 years)	$$$	SJI NWR staff, complex staff, volunteers , partners, graduate student, contractor,	
7.1	% of visitors to the area who know that refuge islands provide key habitat for	Contacts and tracking	Good	Annual, ongoing	$	SJI NWR staff, complex staff, volunteers	

Obj. #	Effectiveness Measures	Method	Reliability	Time Factors	Cost Factors	Personnel	Links to Regional monitoring efforts
	seabirds and marine mammals and how to observe wildlife without causing disturbance					, partners	
7.1	% of Visitors to the area who know when and where the best wildlife viewing opportunities are and how to maximize those opportunities through minimizing disturbance	Contacts and tracking	Fair	Annual, ongoing	$$	SJI NWR staff, complex staff, volunteers , partners	
7.2	% of government and tribal officials and local citizens who know of the San Juan Islands NWR and that it provides key habitat for a variety of wildlife including seabirds and marine mammals	Contacts and tracking, possible social research project and/or OMB approved survey	Very Good	Annual, ongoing, may need to allow time for OMB approval for social research project	$$	SJI NWR staff, complex staff, volunteers , partners, graduate student	
7.2	% of government and tribal officials	Contacts and	Very Good	Annual,	$$	SJI NWR	

Obj. #	Effectiveness Measures	Method	Reliability	Time Factors	Cost Factors	Personnel	Links to Regional monitoring efforts
	and local citizens who understand the conservation mission of the National Wildlife Refuge System	tracking, possible social research project and/or OMB approved survey		ongoing, may need to allow time for OMB approval for social research project		staff, complex staff, volunteers, partners, graduate student	
7.3	% of area boaters who know Protection Island is a NWR	Contacts and tracking, possible social research project and/or OMB approved survey	Fair	Annual, ongoing, may need to allow time for OMB approval for social research project	$-$$	SJI NWR staff, complex staff, volunteers, partners, graduate student	USFWS uniform crime reporting system, State Parks incident and violation tracking
7.3, 8.2	% of pilots who maintain a 2,000 foot minimum ceiling above refuge islands	Observation and tracking	Fair	Annual, ongoing	$-$$	SJI NWR staff, complex staff, volunteers, partners	USFWS uniform crime reporting system, State Parks incident and violation tracking
7.3	% of area boaters who know why it is important to maintain a 200 yard disturbance	Contacts and tracking, possible social research project and/or OMB approved survey	Fair	Annual, ongoing, may need to allow time for OMB	$-$$	SJI NWR staff, complex staff, volunteers	

Obj. #	Effectiveness Measures	Method	Reliability	Time Factors	Cost Factors	Personnel	Links to Regional monitoring efforts
	buffer around Protection Island NWR			approval for social research project		, partners, graduate student	
7.3	% of area boaters who know which rocks, islands, and islets are part of the San Juan Islands NWR	Contacts and tracking, possible social research project and/or OMB approved survey	Fair	Annual, ongoing, may need to allow time for OMB approval for social research project	$-$$	SJI NWR staff, complex staff, volunteers, partners, graduate student	
7.3	% of area boaters know why it is important to maintain a 200 yard disturbance buffer (or as close to 200 yards as possible) around refuge islands in the San Juan Islands NWR	Contacts and tracking, possible social research project and/or OMB approved survey	Fair	Annual, ongoing, may need to allow time for OMB approval for social research project	$-$$	SJI NWR staff, complex staff, volunteers, partners, graduate student	
7.3	% of area boaters know that wildlife comes first in Refuges	Contacts and tracking, possible social research project and/or OMB	Fair	Annual, ongoing, may need to allow time	$-$$	SJI NWR staff, complex staff,	

Obj. #	Effectiveness Measures	Method	Reliability	Time Factors	Cost Factors	Personnel	Links to Regional monitoring efforts
		approved survey		for OMB approval for social research project		volunteers, partners, graduate student	
7.4	Number of Refuge interpretive products or programs created that focus primarily on interpretation of cultural and/or paleontological resources	Quantify number of Refuge interpretive products that focus primarily on cultural and/or paleontological resources	Very Good	Annual, ongoing	$$-$$$	SJI NWR staff, complex staff, volunteers, partners, contractor	None
7.4	All appropriate Refuge educational products include interpretation of cultural and paleontological resources	Quantify number of products and % of products that interpret cultural resources and paleontological resources	Very good	Annual, ongoing	$$-$$$	SJI NWR staff, complex staff, volunteers, partners, contractor	None
8.1	Total number of signs installed consistent with minimum requirement	Inspect and count all signs	Very good	Annually visit ¼ of the islands	$	SJI NWR staff, volunteers,	

Obj. #	Effectiveness Measures	Method	Reliability	Time Factors	Cost Factors	Personnel	Links to Regional monitoring efforts
	analysis.						
8.2	Survey for visitor numbers or boats during peak visitation periods	Boat or land based observations	Good	Annually	$	Refuge staff,	none
8.2	Reduction of non-wilderness intrusions on wilderness islands	Assess wilderness quality through observation, possible OMB approved survey, possible audio/video recording	Good	Monthly, annual, ongoing	$$	SJI NWR staff, volunteers, partners, contractor, graduate student	Wilderness Act requirements
8.3	# of visitors know that the refuge is also a wilderness area	Possible OMB approved survey	Good	Within 3 years after interpretative panels are installed	$$	SJI NWR staff, volunteers, partners, contractor, graduate student	none

Appendix H – Wilderness

This appendix includes a number of items related to management of wilderness lands and review of non-wilderness lands to determine their suitability for wilderness designation.

The following elements are included:

1. **Wilderness Stewardship Plan (WSP) Components within CCP/WSP/EA**
2. **Wilderness Reviews**
3. **Minimum Requirement Analysis-Signs**
4. **Minimum Requirement Analysis- Research, Monitoring, and Management**

H.1 Wilderness Stewardship Plan (WSP) Components within CCP/WSP/EA

U.S. Fish and Wildlife Service policy (Part 610, Wilderness Stewardship) provides guidance for managing, as well as planning for management of, wilderness areas within national wildlife refuges. 610 FW 3 Exhibit 1 outlines the required components of a Wilderness Stewardship Plan, which is required for every wilderness area under USFWS management.

610 FW 3 describes a Wilderness Stewardship Plan (WSP) as a step-down management plan that guides the preservation, stewardship and use of a particular wilderness area. The policy states that where the majority of a refuge is designated wilderness, we may prepare a detailed CCP that incorporates the required elements of a WSP rather than preparing a separate WSP." This CCP incorporates the required elements of a WSP.

Location of WSP components within Protection Island and San Juan Islands National Wildlife Refuges Comprehensive Conservation Plan, San Juan Island Wilderness Stewardship Plan, and Associated Environmental Assessment are described by the following wilderness stewardship plan outline.

Wilderness Stewardship Plan Outline
(Exhibit 1, 610 FW 3)
1.1. Introduction.

A. Information on wilderness establishment for the San Jaun Islands Wilderness Area, including contents of pertinent laws, date(s) of establishment, and boundary or other legal changes, can be found in ***Chapter 1.*** Pertinent committee report discussion and special provisions can be found in other supporting documentation including congressional hearing records and all other documents relating to wilderness designation, which are available at the Complex office and incorporated by reference into this CCP/ EA/WSP.

B. The goals and objectives for the establishment of these wilderness areas, and their relationship to the refuge's purposes and Refuge System mission and goals, are summarized in ***Chapter 1, section 1.2. 1.6, and 1.7.***

1.2. Description of the Wilderness Area.

A. The legal and narrative descriptions of the wilderness area is contained in chapter 3 section 3.3 (topography)

B. Maps displaying Service refuge boundaries, wilderness area boundaries, and other relevant legal, administrative, and natural boundaries are located within **Chapter 1** ***(see Figures 1.1, 1.2, 1.3).***

C. Descriptions of baseline wilderness resource conditions existing at the time of designation, including a description of the wilderness area, natural conditions, cultural resources and values, stewardship activities, existing facilities, and public use levels and activities are contained in the original San Jaun Islands Wilderness Proposal document which located at refuge office. Current wilderness resource conditions are contained in **Chapter 3** (Physical Environment), **Chapter 4** (Refuge Biology and Habitat), and **Chapter 5** (Social and Economic Environment).

1..3. Interagency and Tribal Coordination and Public Involvement. A description of coordination with States, other Federal agencies, and tribes, as well as a summary of public involvement activities, are contained in **Chapter 1, section 1.12**. **Appendix K** (not specific to wilderness) includes greater detail on agency, tribal and public involvement as well as a summary and analysis of comments received and how the plan responds to them.

1.4. Stewardship.

A. A description of stewardship strategies (administrative, natural and cultural resources, public recreation, interpretation and education, and commercial services) required to adequately administer the area can be found in **Chapter 2, Goal 8.**

B. Minimum requirement analyses (MRAs) and documentation of National Environmental Policy Act (NEPA) compliance for all refuge management activities and commercial services necessary to administer the area are found in this appendix**.**

C. Not Applicable: Descriptions of how we will manage existing private rights, existing rights-of-way, activities associated with valid mineral rights, and congressionally authorized uses to protect wilderness values.

D. Not Applicable: An explanation of how we will coordinate with adjoining wilderness units so that the wilderness character and natural and cultural resources and values are managed in a complementary manner that minimizes the impediments to visitors traveling from one wilderness area to another.

1.5. Research. Descriptions of past and current research are found in **Chapter 5**, and identification of research needs, are discussed in **Chapter 2, Goal 9**. Other potential areas of research are mentioned throughout **Chapter 4.** Appropriateness Finding for Research are in **Appendix I.** Compatibility determinations for research, including wilderness-specific stipulations, are in **Appendix J**. An MRA for an activity directly related to a specific research project on San Juan Islands NWR is found in this appendix. All the aforementioned documents include discussion of relevant partnerships, funding, and staffing requirements, also included in a larger discussion within **Appendix G**.

1.6. Funds and Personnel. A discussion of staff and funds needed to administer the wilderness is included in **Appendix G, Staffing, Funding, and Partnerships.**

1.7. Monitoring. To determine if we are meeting our wilderness stewardship objectives and other refuge management objectives in wilderness, a WSP is required to identify monitoring requirements; associated protocols; partnership, funding, and staffing needs; indicators of change in resource conditions; standards for measuring that change; and desired conditions or thresholds that will trigger management actions to reduce or prevent impacts on the wilderness. Monitoring requirements are listed in **Chapter 2*; Goal 3 Objective 3.2; Goal 4 Objective 4.2; Goal 5 Objective 5.2; Goal 6 Objective 6.1, 6.3, 6.4; and Goal 8***

Objective 8.2. Specific details with regard to protocols, indicators of change and standards for measuring change, and desired conditions and thresholds triggering management actions will be detailed in a step-down Wilderness Monitoring plan following completion and approval of this CCP.

1.8. Implementation Schedule. A schedule of implementation, prioritization of action items, staff assignments, and funding requirements to adequately administer the area is contained in **Appendix G, Staffing, Funding, and Partnerships.**

1.9. Appropriateness and Compatibility Determinations are found in **Appendices I and J.**

1.10. Review and Approval.

1.11. Appendix. All of the supporting documentation below (A. – F.) is available at the Complex office and incorporated by reference into this CCP:

A. A copy of the legislation establishing, modifying the boundary of, or making other changes to the wilderness areas. Relevant legislation is also summarized in **Chapter 1, Section 1.6 and 1.7**.

B. Wilderness study reports for San Juan Islands Wilderness.

C. Wilderness Proposal for San Juan Islands Wilderness (1971)

D. NEPA documentation for wilderness establishment.

E. Public hearing record from the wilderness study and record of review of comments received from States, other Federal agencies, tribes, and the public:

F Congressional hearing record.

G. Congressional committee report accompanying the authorizing legislation.

H.2 Wilderness Reviews

2.1 *Policy* for Wilderness Reviews

A wilderness review is the process used to determine whether or not to recommend lands or waters in the National Wildlife Refuge System to Congress for designation as wilderness. The Service is required by policy to conduct a wilderness review for each refuge as part of the CCP process (Part 602 FW 3.4 C.(1) (c)). This review includes the re-evaluation of refuge lands existing during the initial 10-year review period of The Wilderness Act of 1964, as amended (16 U.S.C. 1131-1136) as well as new lands and waters added to the NWRS since 1974. NWRS policy on Wilderness Stewardship (610 FW 1-5) includes guidance for conducting wilderness reviews (610 FW 4 – Wilderness Review and Evaluation). Lands or waters that meet the minimum criteria for wilderness are identified in a CCP and further evaluated to determine whether they merit recommendation to the U.S. Congress for inclusion in the National Wilderness Preservation System (NWPS).

2.2 Criteria for Evaluating Lands for Possible Inclusion in the National Wilderness Preservation System

According to the Wilderness Act of 1964, as amended (16 USC 1131-1136), "An area of wilderness is further defined to mean in this Act an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value."

Criterion 3 is further defined in Section 3(c) of the Act as 1) a roadless area of 5,000 contiguous acres or more, or 2) a roadless island. Roadless is defined as the absence of improved roads suitable and maintained for public travel by means of 4-wheeled, motorized vehicles that are intended for highway use.

2.3 The Wilderness Review Process

A wilderness review is the process of determining whether the Service should recommend NWRS lands and waters to Congress for wilderness designation. The wilderness review process consists of three phases: wilderness inventory, wilderness study, and wilderness recommendation.

<u>Wilderness Inventory</u>
The inventory is a broad look at a refuge to identify lands and waters that meet the minimum criteria for wilderness - size, naturalness, and outstanding opportunities for solitude or primitive and unconfined type of recreation. All areas meeting the criteria are preliminarily classified as Wilderness Study Areas (WSAs). If WSAs are identified, the review proceeds to the study phase.

<u>Wilderness Study</u>
During the study phase, WSAs are further analyzed:

1) for all values of ecological, recreational, cultural, economic, symbolic
2) for all resources, including wildlife, vegetation, water, minerals, soils
3) for existing and proposed public uses
4) for existing and proposed refuge management activities within the area,
5) to assess the Refuge's ability to manage and maintain the wilderness character in perpetuity, given the current and proposed management activities. Factors for evaluation may include, but are not limited to staffing and funding capabilities, increasing development and urbanization, public uses, and safety.

We evaluate at least an "All Wilderness Alternative" and a "No Wilderness Alternative" for each WSA to compare the benefits and impacts of managing the area as wilderness as opposed to managing the area under an alternate set of goals, objectives, and strategies that do not involve wilderness designation. We may also develop "Partial Wilderness Alternatives" that evaluate the benefits and impacts of managing portions of a WSA as wilderness.

In the alternatives, we evaluate:

1) the benefits and impacts to wilderness values and other resources
2) how each alternative will achieve the purposes of the Wilderness Act and the NWPS

3) how each alternative will affect achievement of refuge purpose(s) and the refuge's contribution toward achieving the Refuge System mission
4) how each alternative will affect maintaining and, where appropriate, restoring biological integrity, diversity, and environmental health at various landscape scales
5) other legal and policy mandates
6) whether a WSA can be effectively managed as wilderness by considering the effects of existing private rights, land status and service jurisdiction, refuge management activities and refuge uses and the need for or possibility of eliminating Sec 4 (c) prohibited uses

Wilderness Recommendation
If the wilderness study demonstrates that a WSA meets the requirements for inclusion in the National Wilderness Preservation System, a wilderness study report should be written that presents the results of the wilderness review, accompanied by a Legislative Environmental Impact Statement (LEIS). The wilderness study report and LEIS that support wilderness designation are then transmitted through the Secretary of Interior to the President of United States, and ultimately to the United States Congress for action. Refuge lands recommended for wilderness consideration by the wilderness study report will retain their WSA status and be managed as "… wilderness according to the management direction in the final CCP until Congress makes a decision on the area or we amended the CCP to modify or remove the wilderness recommendation" (610 FW 4.22B). When a WSA is revised or eliminated, or when there is a revision in "wilderness stewardship direction, we include appropriate interagency and tribal coordination, public involvement, and documentation of compliance with NEPA" (610 FW 3.13).

The following constitutes the inventory phase of the wilderness review for the Protection and San Juan Islands National Wildlife Refuges.

2.4 Previous Wilderness Reviews

A wilderness review was conducted for the San Juan Island refuges in 1971, and all were designated wilderness with the exception of Smith, Minor, Turn and a small portion of Matia Islands. Protection Island has not previously been reviewed for wilderness.

2.5 Lands Considered Under This Wilderness Review

All Service-owned lands within the San Juan Islands and Protection Island (in fee title) National Wildlife Refuge not already within wilderness was considered during this wilderness review.

2.6 Wilderness Inventory

2.6.1 Unit Size: Roadless areas meet the size criteria if any one of the following standards apply:

- An area with over 5,000 contiguous acres solely in FWS ownership.
- A roadless island of any size. A roadless island is defined as an area surrounded by permanent waters or an area that is markedly distinguished from the surrounding lands by topographical or ecological features.
- An area of less than 5,000 contiguous Federal acres that is of sufficient size as to make practicable its preservation and use in an unimpaired condition, and of a size suitable for wilderness management.

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

Protection Island

Protection Island NWR is 364 acres and was established in 1982. It is located at the mouth of Discovery Bay in the Strait of Juan de Fuca. The island first described in the early 1790's by explorers has a varied history beginning in the mid-1800. That history includes farming, research, military, and urban development. The last included the construction of an air strip, roads, marina, and homes by the developers. Protection Island does not meet the roadless island requirements for an island wilderness area. The Service is required, by written agreement, to maintain these roads and other infrastructure that were built as part of the development for the extended users still allowed to use the island.

2.6.2 Naturalness and Wildness: the area generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable

This criterion must be evaluated in the context of current natural conditions and societal values and expectations without compromising the original intent of the Wilderness Act. It is well recognized that there are few areas remaining on the planet that could be truly classified as primeval or pristine, with even fewer, if any, existing in the conterminous United States. Likewise, few areas exist that do not exhibit some impact from anthropogenic influences, be it noise, light, or air pollution; water quality or hydrological manipulations; past and current land management practices; road or trails, suppression of wildfires; invasions by non-native species of plants and animals; or public uses. While allowing for the near-complete pervasiveness of modern society on the landscape, the spirit of the Wilderness Act is to protect lands that still retain the wilderness qualities of: 1) natural, 2) untrammeled, 3) undeveloped. These three qualities are cornerstones of wilderness character. For areas proposed or designated as wilderness, wilderness character must be monitored to determine baseline conditions and thereafter be periodically monitored to assess the condition of these wilderness qualities. Proposed and designated wilderness areas by law and policy are required to maintain wilderness character through management and/or restoration in perpetuity.

Defining the first two qualities (natural and untrammeled) requires a knowledge and understanding of the ecological systems which are being evaluated as potential wilderness. Ecological systems are comprised of three primary attributes – composition, structure, function. Composition is the components that make up an ecosystem, such as the habitat types, native species of plants and animals, and abiotic (physical and chemical) features. These contribute to the diversity of the area. Structure is the spatial arrangement of the components that contribute to the complexity of the area. Composition and structure are evaluated to determine the naturalness of the area. Function is the processes that result from the interaction of the various components both temporally and spatially, and the disturbance processes that shape the landscape. These processes include but are not limited to predator-prey relationships, insect and disease outbreaks, nutrient and water cycles, decomposition, fire, windstorms, flooding, and both general and cyclic weather patterns. Ecological functions are evaluated to determine the wildness or untrammeled quality of the area.

The third quality assessment is whether an area is undeveloped. Undeveloped refers to the absence of permanent structures such as roads, buildings, dams, fences, and other man-made alterations to the landscape. Exceptions can be made for historic structures or structures required for safety or health considerations, providing they are made of natural materials and relatively unobtrusive on the landscape.

General guidelines used for evaluating areas for wilderness potential during this wilderness inventory process include:

1. The area should provide a variety of habitat types and associated abiotic features, as well as a nearly complete complement of native plants and wildlife indicative of those habitat types. Non-native and invasive species should comprise a negligible portion of the landscape.

2. The area should be spatially complex (vertically and/or horizontally) and exhibit all levels of vegetation structure typical of the habitat type, have an interspersion of these habitats, and provide avenues for plant and wildlife dispersal.

3. The area should retain the basic natural functions that define and shape the associated habitats including but not limited to flooding regimes, fire cycles, unaltered hydrology and flowage regimes, basic predator-prey relationships including herbivory patterns.

4. Due to their size, islands may not meet the habitat guidelines in 1. and 2. above. Islands should, however, exhibit the natural cover type with which it evolved and continue to be shaped and modified by natural processes. Islands should be further analyzed during the study portion of the review, if they provide habitat for a significant portion of a population, or key life cycle requirements for any resources of concern, or listed species.

5. Potential wilderness areas should be relatively free of permanent structures or man-made alterations. Areas may be elevated to the study phase if existing structures or alterations can be removed or remediated within a reasonable timeframe, and prior to wilderness recommendation to the Secretary of the Interior.

Protection Island

Protection Island is 364 acres and was established in 1982. It is located at the mouth of Discovery Bay in the Strait of Juan de Fuca and is closed to the public to protect nesting sea birds and harbor seals. The island first described in the early 1790's by explorers has a varied history beginning in the mid-1800. That history includes farming, research, military, and urban development. The last included the construction of an air strip, roads, marina, and homes by the developers. Several of the former residences are occupied by the FWS, volunteer caretaker and seasonal researchers under Special Use Permit. One lifetime private user still maintains a residence.

The island habitat is grassland/savanna, forest and woodland, shoreline habitat varies from sandy to rocky, and a small remnant brackish wetland remains. Much of the vegetative cover, particularly the grassland, is non-native and there is a great need for habitat restoration throughout the island. This restoration and all current maintenance require the use of mechanical equipment such as tractors, ATV's, and boats. The in-holding agreements cover various lengths of time. Some will be expiring in 2011, but one is a life-time use. The Service uses volunteers as resident caretakers, whose presence is critical to help protect the sensitive wildlife from human disturbance. Due to the greatly altered landscape, long term human structures, extensive infrastructure and legally required agreements to maintain this infrastructure requiring mechanical equipment we have determined Protection Island does not satisfy minimum wilderness suitability criteria for 'naturalness and wildness' standards for wilderness designation.

The Service maintains all refuge islands in the San Juan NWR as closed to the public with the exception of Matia and Turn Island.

Matia Island.

This unit of the refuge is 145 acres and was created in 1937. The entire island is already in wilderness designation with the exception of the five acre Rolf Cove campground area, which is owned by the USFWS, but managed by the Washington State Parks and Recreation Commission under a Memorandum of Understanding (MOU). The island habitat consists of grassland/savanna, herbaceous bald, forest and woodland, a small freshwater wetland, and shoreline that varies from sandy to rocky. Most of the island is dominated by native vegetation, but there is increasing non-native vegetative cover around the campsite areas. The campground offers six campsites, floating dock, a sandy beach, one picnic site and a compositing toilet. Washington State Parks and Recreation Commission maintains the toilet by removing the compost material with a small tractor. The entire island is closed to the public except for the campground area, and the 1.2 mile trail the loops through the wilderness area. There are no interpretative signs on this trail but there are other permanent regulatory signs that are visible from the trail where it nears the outer edges of the island. Just off shore of the island and outside the jurisdiction of the Service, there is moorage for watercraft. Here engine-driven electric generators are allowed as well as other mechanical equipment. Considering there are permanent structures, mechanical equipment use, permitted off-shore activities producing noise and light pollution that affect the wilderness experience we have determined that this part of Matia island does not satisfy minimum wilderness suitability criteria for ‘naturalness and wildness’ standards for wilderness designation.

Turn Island.

This unit, owned by the Service, is 35 acres but is also managed cooperatively with Washington State Parks and Recreation Commission under MOU. The island habitat is grassland/savanna, forest and woodland, and shoreline habitat varies from sandy to rocky. There is year round camping and boat moorage available for motorboats and other watercraft are allowed to land on the island. There are permanent interpretative and regulatory signs along the .9-mile trail and island perimeter. The campground offers thirteen campsites, a sandy beach, picnic site and two compositing toilets. Washington State Parks and Recreation Commission maintains the toilets by removing the compost material with a small tractor. Just off shore of the island and outside the jurisdiction of the Service, there is moorage for watercraft. Here visitors can use engine-driven electric generators as well as other mechanical equipment. This island is less than two-miles from the town of Friday Harbor on San Juan Island and has the highest visitation of all the open refuge islands. The refuge proposes to increase interpretation development of Turn Island to education the public about the refuge, the National Wildlife Refuge System, and the many issues that threaten islands’ habitats and wildlife. Because of the high use due to the proximity to Friday Harbor, permanent structures, the permitted use of power equipment just off-shore and using power equipment on the island, we have determined Turn Island does not satisfy minimum wilderness suitability criteria for ‘naturalness and wildness’ standards for wilderness designation.

Smith and Minor Islands.

These units are 65 acres and were established in1914 as an over lay to the U.S. Coast Guard’s primary jurisdiction for aids to navigation. A lighthouse was built in 1857 on Smith Island, and the station was staffed from 1858 to the 1957 when it was abandoned due to erosion which threatened the structure. In the 1930’s Minor Island was used as a naval bombing area by the United States military with aircraft from nearby Whidby Island Naval Air Station. Smith Island habitat is grassland/savanna, forest and woodland, a small brackish wetland, and shoreline that varies from sandy to rocky. There are several permanent structures (residence, maintenance shop, cistern and helicopter landing pad) build by the U.S. Coast Guard. Two towers (weather and communications) are also on the island and are serviced and maintained by USCG and NOAA using motorized equipment. Minor Island habitat is coastal sand strand and a concrete engine room and aids to navigation light are located there. Considering the past use of the islands and evidence of inadequate fuel storage (historic pictures), there is concern of possible soil contamination. Additionally, because of past military use as a bombing area, there is a concern regarding the potential for unexploded ordinance. These units do not meet the 'naturalness and wildness' standards for wilderness designation.

H.3 Minimum Requirement Analysis - Signs

San Juan Islands Wilderness Area

San Juan Islands NWR and Wilderness contain the majority of the seabird nesting colonies and pinniped haul-out sites in the Northern portion of the Salish Sea and the San Juan Archipelago. Black oystercatchers and pigeon guillemot nest along island shore lines. Pelagic, double-crested, and Brandt's cormorants, glaucous–winged and glaucous-winged/western gulls nest at more upland sites and bald eagles nest in refuge trees.
Steller and California sea lions haul-out on refuge islands and harbor seals use the islands for pupping and hauling-out. Elephant seals have recently used islands in the southern portion of the refuge to breed. The Washington Maritime NWR Complex proposes to install signs appropriate with management actions within the San Juan Islands Wilderness. There is a need to determine (1) if this action is necessary in wilderness and, (2) if so, what is the minimum required activity (tools and techniques).

Step 1: Determine if any administrative action is <u>necessary.</u>

Briefly describe the situation that may prompt action:

San Juan Islands NWR is a network of 83 islands, rocks, and reefs and all are protected under the Wilderness Act with the following exceptions: Smith and Minor Island, the Washington State Park managed campground on Matia, and all of Turn Island. Additionally, all the islands are closed to the public due to the sensitive wildlife that utilizes these island habitats, and safety concerns for approaching the islands. These islands are managed under the administration of the Washington Maritime NWR Complex.

The complex proposes to install closure information signs that are needed to keep the public off of the closed islands for public safety and to protect wildlife. These signs will be compatible with the surroundings, and as small as possible as stated in 610 FW 2.5D(5). Since these signs are all along waterways they will also need to meet any Coast Guard or State requirements

Management actions for this wilderness area include installation and maintenance of informational and interpretive signs at a variety of off-site locations adjacent to wilderness, such as Turn Island, a non-wilderness island within the refuge, trailhead to Matia Island wilderness trail, state parks, and marinas. On all the islands within the refuge trespass is a serious and recurring problem, necessitating the placement of boundary and regulatory signs above the intertidal zone. Installation of these signs is necessary for informing the public which of the 172 islands in San Juan County are refuge islands, the sensitivity of these areas and that they are closed to public access. These signs are located out of necessity just within the boundaries of the wilderness which begin on these islands at mean high tide.

To determine if administrative action is <u>necessary</u>, answer questions A-F.

A. Describe Options Outside of Wilderness

Is action necessary within wilderness? **Yes**

The management actions for these closed wilderness areas includes placing signs and information about the refuge outside of the wilderness areas. This information will be located at public access points such as marinas, equipment rental facilities, watercraft education centers, and wildlife tour operator offices. There are limitations to the effectiveness of any management action. Therefore, this action is necessary within the wilderness since not all boaters read posted information; boaters coming to the refuge from other ports or launch locations that don't have this information, including international travelers; the signs act as a prevention against the threat of invasive species introductions; due to the marine conditions, jurisdictional ownerships, and topography of the islands it is not feasible to place the signs just outside the wilderness boundary.

B. Describe Valid Existing Rights or Special Provisions of Wilderness Legislation

Is action necessary to satisfy valid existing rights or a special provision in wilderness legislation (the Wilderness Act of 1964 or subsequent wilderness laws) that allows consideration of the Section 4(c) prohibited uses? **Yes**

Special Provision – from The Wilderness Act of 1964, as amended (16 U.S.C. 1131-1136) Section 4(b): Except as otherwise provided in this Act, each agency administering any area designated as wilderness shall be responsible for preserving the wilderness character of the area and shall so administer such area for such other purposes for which it may have been established as also to preserve its wilderness character. Except as otherwise provided in this Act, wilderness areas shall be devoted to the public purposes of recreational, scientific, educational, conservation, and historical use.

Prohibited Uses – from The Wilderness Act of 1964, as amended (16 U.S.C. 1131-1136) Section 4(c): "Except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act (including measures required in emergencies involving the health and safety of persons within the area), there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure (i.e. signs) as stated in 610 FW 2.5D(5) or installation within any such area."

C. Describe Requirements of Other Legislation

Is action necessary to meet the requirements of other laws? **Yes**

The National Wildlife Refuge System Administration Act of 1966, as amended, in section 4(a)(4)(B) directs the FWS to (1) provide for the conservation of fish, wildlife, and plants, and their habitats within the NWRS; (2) ensure the biological integrity, diversity, and environmental health of the NWRS are maintained (see 610 FW 3); and (3) monitor the status and trends of fish, wildlife, and plants in each refuge. These requirements cannot be fully met through conducting research and monitoring actions outside the proposed wilderness area.

Executive Order 13112 directs federal agencies to: "subject to the availability of appropriations, and within Administration budgetary limits, use relevant programs and authorities to: (i) prevent the introduction of invasive species; (ii) detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner; (iii) monitor invasive species populations accurately and reliably; (iv) provide for restoration of native species and habitat conditions in ecosystems that have been invaded; (v) conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species; and (vi) promote public education on invasive species and the means to address them".

D. Describe Other Guidance

Is action necessary to conform to direction contained in agency policy, unit and wilderness management plans, species recovery plans, or agreements with tribal, state and local governments or other federal agencies? **Not Applicable**

E. Wilderness Character

Is action necessary to preserve one or more of the qualities of wilderness character including untrammeled, undeveloped, natural, outstanding opportunities for solitude or a primitive and unconfined type of recreation, or unique components that reflect the character of this wilderness area?

Untrammeled: Yes

San Juan Islands Wilderness resource values include supporting a great variety of sea bird species and important haulout areas for pinnipeds. The sea bird habitat includes areas for nesting and roosting, as well as migration stopover for many other bird species (San Juan Wilderness Proposal 1976). The vegetation habitat of the dry Douglas fir and the dry prairie grasslands are becoming increasingly rare in the whole Salish Sea area due to development and other impacts such as invasive species (WDFW, 2005) Protecting the untrammeled character of these wilderness areas requires protecting the flora and fauna that exists there during any season, and the ecological processes that supports the native diversity. The threat of invasive species poses serious ecological harm whether to the plant or animal community. Therefore, initiation of management actions to control and where possible eliminate, trespassing would also reduce a secondary potential negative effect of invasive species introduction, which is critical to protecting these wilderness areas.
On Matia there is a trail that loops through the wilderness part of the island right from the campground. Spur trails and human built structures have been built in the wilderness area by the public. This highlights the importance of the management need to place signs to better inform the public.

Undeveloped: Yes

The undeveloped islands, rocks, and reefs within the San Juan Island Wilderness provide a dramatic natural setting within the San Juan archipelago. The area is a popular destination for visitor and residents to observe the varied and abundant wildlife. Many communities, on the larger nearby islands, have expanded services to accommodate the increased use of the area. Many of the refuge islands are short distances away from these developed areas which provide many points of access to view the refuge. Providing the public with refuge information and interpretive signage to encourage their participation in the protection of this valuable resource is of the utmost importance.

Natural: Yes

Many of the islands and rocks within the San Juan Islands Wilderness are located adjacent to inhabitated islands, an area receiving ever-increasing pressure for residential housing, commercial development and recreation. Efforts to minimize trespassing violations, by using signs to inform the public, of the wilderness ecological systems (plant and animal species and communities) are necessary to maintain the natural character of these islands. Because the "natural" quality also refers to the abundance, distribution, or number of invasive non-indigenous species, there is a need to protect these islands from invasive species.

Outstanding opportunities for solitude or a primitive and unconfined type of recreation:
Not Applicable

Explain: All rocks, reefs, and islands within the San Juan Island NWR, with the exception to the open camping areas on Matia and all of Turn Island, are closed to public entry to protect sensitive wildlife and habitat.

Other unique components that reflect the character of this wilderness: **No**

F. Describe Effects to the Public Purposes of Wilderness

Is action necessary to support one or more of the public purposes for wilderness (as stated in Section 4(b) of the Wilderness Act) of recreation, scenic, scientific, education, conservation, and historical use?

Recreation: **No**

All rocks, reefs, and islands within the San Juan Island NWR, with the exception to the open camping and trail areas on Matia and all of Turn Island, are closed to public entry to protect sensitive wildlife and habitat.

Scenic: **Yes**

The control of trespassing and possible introduction of invasive species, and the subsequence preservation of seabird and pinniped colonies will maintain the scenic value of the wilderness.

Scientific: **Not Applicable:**

Education: **Yes:**

Education about the sensitivity and the importance of undisturbed habitats within these wilderness areas is necessary for the continued protection of these island habitats. As residential and commercial development of the area continues to grow, it is important that the communities support the closed nature of the refuge. The educational information about the refuge needs to "open" the refuge to the public but from a distance. A win-win situation would be that the public understands and supports the refuge and that because of their efforts results in greater abundance of the wildlife for viewing in the area for everyone.

Conservation: **Yes**

These areas cannot be successfully conserved, including its wilderness values, without management actions within the wilderness areas. The USFWS cannot fully meet its affirmative responsibilities for refuge purposes, endangered and threatened species, invasive species, wilderness management objectives, and the NWRS mission without reducing trammeling, protection for critical sea bird and seal habitat, and controlling invasive species.

Historical use: No

Step 1 Decision: Is any administrative action necessary in wilderness? Yes

Explain: Although a large effort will be made to reach the public with information outside the wilderness area, there is still a large group of visitors to the area that would not be exposed to the educational efforts due to other points of entry. These additional entry points are private property, watercraft arriving from other areas in the state or even internationally via Canada. The placement of signs on the islands would be kept to a minimum in numbers and size, but cannot be totally eliminated. These signs are needed to not only keep the public off of the islands but try to maintain the 200 foot buffer around the islands. The buffer is to prevent the "take or harassment", under the Marine Mammal Protection Act of 1972 and the Endangered Species Act 1973, of pinniped haulout/pupping sites and other listed wildlife species. Although additional signage and information is planned outside the wilderness area, not all boaters would be exposed to that information. Therefore, to ensure that all trespassing and other potential violations are mitigated signs are necessary. Safety is another reason to keep the public from approaching these islands, due to rocky shorelines, submerged hazards, currents and other variables.

If action is necessary, proceed to Step 2 to determine the minimum activity.

Step 2: Determine the minimum activity/tools.

Description of Alternatives

For each alternative, describe what methods and techniques will be used, when the activity will take place, where the activity will take place, what mitigation measures are necessary, and the general effects to the wilderness resource and character.

Alternative # 1: No Management Activity
Under alternative #1 no management activity whatsoever is conducted in wilderness. Some expected results are describe under Step 1 above.

Effects:

Wilderness Character

"Untrammeled" Repeated trespassing leading to trammeling and introduction of invasive species would begin the degradation of the wilderness and increase the disturbance to the sensitive wildlife using the islands.

"Undeveloped" Maximized. There would be no further installation of signs, but the introduction of "home made structures" being brought or built on the island would likely increase.

"Natural" Minimized. Invasive species continue to displace native species.

"Outstanding opportunities for solitude or a primitive and unconfined type of recreation" Other unique components that reflect the character of this wilderness

Heritage and Cultural Resources N/A

Maintaining Traditional Skills N/A

Special Provisions N/A

Economic and Time Constraints N/A

Additional Wilderness-specific Comparison Criteria N/A

Safety of Visitors, Personnel, and Contractors N/A

Alternative # 2: No Generally Prohibited Uses

Description:

Sign Placement
Alternative #2 the placement of signs is conducted in wilderness. Some expected results are described under Step 1 above.

Effects:

Wilderness Character

"Untrammeled" Maximized. Less trespassing would lead to reduced trammeling and the risk of introduction of invasive species. There would also be a reduction of the disturbance to the sensitive wildlife using the islands.

"Undeveloped" Minimized. There would be a minimum installation of signs to inform the public about the island status and their responsibilities, but the introduction of "home made structures" being brought or built on the island could likely be eliminated.

"Natural" Maximized. With the public viewing from an approved distance the invasion of non-native species could be eliminated from displacing native species.

"Outstanding opportunities for solitude or a primitive and unconfined type of recreation"
Only Matia Island is open to the public that has any wilderness areas and the limited number of signs placed in wilderness will not affect the solitude or primitive wilderness experiences of visitors.

Heritage and Cultural Resources N/A

Maintaining Traditional Skills N/A

Special Provisions N/A

Economic and Time Constraints N/A

Additional Wilderness-specific Comparison Criteria N/A

Safety of Visitors, Personnel, and Contractors: N/A

Alternative # 3: Installation of Refuge Signs Utilizing Some Generally Prohibited Uses

Description:

A few generally prohibited uses may be necessary to facilitate installation of signs by the USFWS. In order to protect sensitive island habitat, minimize disturbance to wildlife, and for human safety purposes, it would be necessary to erect sign structures and the use of some motorized equipment (i.e. post hole auger, portable power supply, portable power tools, and chain saw) may be necessary.

Effects:

Wilderness Character

"Untrammeled" – Same as Alternative 2 plus: There is some wildlife disturbance associated with installation activities using power supplies and tools. The distance to wildlife and timing are carefully considered to minimize impacts to wildlife. Installation and routine maintenance by refuge staff will occur only a few days annually resulting in negligible impacts to wilderness values.

"Undeveloped" – Same as Alternative 2 plus: Refuge signs will be limited in number and placed just within wilderness boundaries in an effort to minimize development impacts.

"Natural" – Same as Alternative 2 plus: These signs will result in a minimal negative effect to the wilderness viewshed.

"Outstanding opportunities for solitude or a primitive and unconfined type of recreation" – Only Matia Island is open to the public that has any wilderness areas and the limited number of signs placed in wilderness will not affect the solitude or primitive wilderness experiences of visitors.

Heritage and Cultural Resources – N/A

Maintaining Traditional Skills – N/A

Special Provisions – N/A

Economic and Time Constraints – N/A

Additional Wilderness-specific Comparison Criteria – N/A

Safety of Visitors, Personnel, and Contractors – N/A

Step 2 Decision: What is the Minimum Activity?

Selected alternative:

The option selected is Alternative # 3.

Rationale for selecting this alternative (including documentation of safety criterion, if appropriate):

Installation of signs identifying refuge islands and informing the public that they are closed to public use (except for Matia Island) prevents human trespass and subsequent disturbance of seabirds and marine mammals. Use of power equipment will minimize staff presence on-site, thus reducing staff exposure to the volatility of the marine environment.

NEPA Compliance and Public Review: This MRA was prepared in association with the Protection Island and San Juan Islands National Wildlife Refuges Draft Comprehensive Conservation Plan; San Juan Islands Wilderness Plan; and associated Environmental Assessment (CCP/WSP/EA). It was made available for public review and comment at the same time as the Draft CCP/WSP/EA.

List any Wilderness Act Section 4(c) uses approved in this alternative:

1. temporary structure or installation (Signs)
2. motorized equipment (Chain saw, generator, compressor)

Record and report any authorizations of Wilderness Act Section 4(c) uses according to agency procedures.

References:

Speich, S.M., and T.R. Wahl. 1989. Catalog of Washington seabird colonies. U.S. Fish and Wildlife Service, Service Biological Report 88(6). 510 pp.

USFWS (U.S. Fish and Wildlife Service). 2005a. Regional seabird conservation plan, Pacific Region. U.S. Fish and Wildlife Service, Migratory Bird and Habitat Programs. Pacific Region, Portland, OR. 261 pp.

H.4 Minimum Requirement Analysis – Research, Monitoring, and Management

San Juan Islands Wilderness Area

San Juan Islands NWR and Wilderness contain the majority of the seabird nesting colonies and pinniped haul-out sites in the Northern portion of the Salish Sea and the San Juan Archipelago. Black oystercatchers and pigeon guillemot nest along island shore lines. Pelagic, double-crested, and Brandt's cormorants, glaucous–winged and glaucous-winged/western gulls nest at more upland sites and bald eagles nest in refuge trees.
Steller and California sea lions haul-out on refuge islands and harbor seals use the islands for pupping and hauling-out. Elephant seals have recently used islands in the southern portion of the refuge to breed. The Washington Maritime NWR Complex proposes to conduct research, monitoring, and appropriate management actions within the San Juan Islands Wilderness. There is a need to determine (1) if this action is necessary in wilderness and, (2) if so, what is the minimum required activity (tools and techniques).

Research, monitoring, and management actions conducted by the Washington Maritime NWR Complex staff and their agents, including Washington Department of Fish and Wildlife, NOAA, universities and colleges, contribute to regional, national, and international conservation efforts for these marine-dependent species. Access to wilderness areas by USFWS employees or their agents is highly regulated and minimized. The refuge wilderness is closed to all public access (except for the wilderness trail on Matia Island) to protect sensitive wildlife from disturbance and to prevent trampling and destruction of habitats.

Research and monitoring programs that are not conducted by Refuge staff or their designated agents are not covered under this Minimum Requirements Analysis (MRA). These non-Service activities will require separate analyses, once specific projects are proposed. Regulatory and informational signage is used for public use management. The construction and placement of wilderness signs is addressed in a separate MRA.

Step 1: Determine if any administrative action is <u>necessary.</u>

Briefly describe the situation that may prompt action:

Research and monitoring are essential to document the life-history requirements and needs of seabirds and pinnipeds, monitor population trends, determine anthropogenic and natural events that effect the populations and develop appropriate management strategies and actions. Failure to conduct adequate research and monitoring would leave refuge wildlife populations vulnerable to adverse impacts and undetected population declines that may be preventable or mitigated if detected sooner.

Research on refuge lands is inherently valuable to the USFWS because it expands scientific information available for resource management decisions. Scientific findings gained through these projects provide important information regarding life-history needs of species and species groups. Some research proposes to address wildlife conservation issues, such as understanding the causes of reduced or declining seabird and/or pinniped populations and addressing response of habitat/wildlife to disturbance from public uses adjacent to wilderness. Other research has broader applicability, such as using a suite of seabird species as indicators of ocean health conditions, and to document change in the larger marine environment and associated impacts associated with climate change and global warming. Projects may be species-specific or refuge-specific, or may evaluate the relative contribution of the refuge to larger landscape (e.g., ecoregion, region, flyway, national, and international) issues and trends.

The management strategy for San Juan Islands Wilderness is to allow natural processes to occur unimpaired by human actions except for the maintenance of the trail on Matia Island and treatment of invasive species. Maintenance would include the removal of any vegetation that impacts the use of the trail. Monitoring is crucial for early detection and development of management strategies to control these invasive species. Invasive mammals that reach the islands can quickly impact nesting birds, destroying whole seabird colonies. Invasive plants eliminate native vegetation, alter native flora communities, and can eliminate breeding habitat for burrow-nesting seabird species. Since seabirds, pinnipeds, and native plants are the primary natural resource components of the San Juan Islands Wilderness, declines or losses of populations would significantly reduce the wilderness character and result in the loss of wilderness public purposes including scientific, educational, and conservation. A rapid aggressive approach to the control or eradication of invasive species is necessary to maintain biological integrity and wilderness character.

To determine if administrative action is necessary, answer questions A-F.

B. Describe Options Outside of Wilderness

Is action necessary within wilderness? **Yes**

While much of the research and monitoring occurs physically outside of wilderness (e.g., from boats or aircraft), the subjects of the research and monitoring are within wilderness. The majority of the seabird nesting colonies and pinniped haul-out and pupping sites in Washington State marine waters are National Wildlife Refuge lands and wilderness. Opportunities to research or monitor these species outside wilderness are extremely limited; therefore conducting this species-specific research on Service lands and within wilderness is essential. Currently, the USFWS allows pinniped research by NOAA, WDFW, and Cascadia Research Collective (under contract to both), through a Special Use Permit. This research includes monitoring of Steller sea lions and elephant seals, radio tagging harbor seals, tracking, and retrieval of shed tags, collection of samples for DNA and contaminant analysis, and necropsies. Radio receivers are used when tags are installed to ensure working condition and to locate shed tags.

Tools and temporary facilities that might be used to conduct research and monitoring include: remote sensing equipment, blinds, temporary access equipment (i.e. ladder), weather station, solar array, telemetry equipment.

Detection and monitoring of harmful invasive or non-native plant and animal species is critical to accomplish both Refuge and wilderness purposes, goals, and objectives. Although some methods of detecting and monitoring these species (e.g., overflights, remote sensing) from outside of the wilderness areas exist, these off-site methods may not yield the needed information in a timely or efficient manner. Invasive plant and animal control methods from outside wilderness exist (e.g., mechanical and aerial spraying, release of biological controls, quarantine protocols), but these methods may unnecessarily trammel the wilderness area and other non-target habitats (e.g., pesticide drifting within wilderness and resulting death of target and non-target organisms), resulting in a loss of naturalness. The USFWS cannot meet its affirmative responsibilities under E.O. 13112 to monitor for, detect and rapidly control, or research invasive species solely from outside the wilderness area, nor can native ecosystems already impacted by invasive species be solely restored from outside the wilderness area.

B. Describe Valid Existing Rights or Special Provisions of Wilderness Legislation

Is action necessary to satisfy valid existing rights or a special provision in wilderness legislation (the Wilderness Act of 1964 or subsequent wilderness laws) that allows consideration of the Section 4(c) prohibited uses? **Yes**

Special Provision – from The Wilderness Act of 1964, as amended (16 U.S.C. 1131-1136) Section 4(b): Except as otherwise provided in this Act, each agency administering any area designated as wilderness shall be responsible for preserving the wilderness character of the area and shall so administer such area for such other purposes for which it may have been established as also to preserve its wilderness character. Except as otherwise provided in this Act, wilderness areas shall be devoted to the public purposes of recreational, scientific, educational, conservation, and historical use.

Prohibited Uses – from The Wilderness Act of 1964, as amended (16 U.S.C. 1131-1136) Section 4(c): "Except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act (including measures required in emergencies involving the health and safety of persons within the area), there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area."

C. Describe Requirements of Other Legislation

Is action necessary to meet the requirements of other laws? **Yes**

The National Wildlife Refuge System Administration Act of 1966, as amended, in section 4(a)(4)(B) directs the FWS to (1) provide for the conservation of fish, wildlife, and plants, and their habitats within the NWRS; (2) ensure the biological integrity, diversity, and environmental health of the NWRS are maintained (see 610 FW 3); and (3) monitor the status and trends of fish, wildlife, and plants in each refuge. These requirements cannot be fully met through conducting research and monitoring actions outside the proposed wilderness area.

Research is a specialized use (603 FW1) and, therefore, it is not considered a priority public use by NWRS policy. However, two provisions of the National Wildlife Refuge Improvement Act of 1997 are to "maintain biological integrity, diversity and environmental health" and to conduct "inventory and monitoring."

The USFWS and NOAA Fisheries, along with all other federal agencies, have affirmative responsibilities under the Endangered Species Act of 1973 to conserve endangered and threatened species at Section 2(c)(1). Federal agencies are also responsible for cooperating with the States to the maximum extent practicable in conserving listed species, under Section 6(a). The USFWS currently authorizes NOAA and WDFW, acting as an agent of the USFWS and following the conditions of a Special Use Permit, to enter the Refuge wilderness area to conduct research on threatened Steller sea lions and non listed harbor and elephant seals.

Executive Order 13112 directs federal agencies to: "subject to the availability of appropriations, and within Administration budgetary limits, use relevant programs and authorities to: (i) prevent the introduction of invasive species; (ii) detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner; (iii) monitor invasive species populations accurately and reliably; (iv) provide for restoration of native species and habitat conditions in ecosystems that have been invaded; (v) conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species; and (vi) promote public education on invasive species and the means to address them".

D. Describe Other Guidance

Is action necessary to conform to direction contained in agency policy, unit and wilderness management plans, species recovery plans, or agreements with tribal, state and local governments or other federal agencies? **Yes**

Currently refuge staff are not actively conducting research, however it is anticipated that in the next 15 years there would be additional seabird research related to the recently completed Pacific Region Seabird Conservation Plan (USFWS 2005a). The Service currently authorizes NOAA and WDFW, via a Special Use Permit, to enter the refuge wilderness area to conduct research on threatened Steller sea lions and non-listed harbor and elephant seals.

The USFWS's Research and Management Studies policy (4 RM 6) and Appropriate Refuge Uses policy (603 FW1.10D(4)) indicate priority for scientific investigatory studies that contribute to the enhancement, protection, use, preservation, and management of native wildlife populations and their habitat as well as their natural diversity. Projects that contribute to refuge-specific and/or wilderness management, where applicable, would be given a higher priority over other requests.

E. Wilderness Character

Is action necessary to preserve one or more of the qualities of wilderness character including untrammeled, undeveloped, natural, outstanding opportunities for solitude or a primitive and unconfined type of recreation, or unique components that reflect the character of this wilderness area?

Untrammeled: Yes

San Juan Islands Wilderness values include supporting nesting seabirds and bald eagles and hundreds of pinnipeds, and functioning as a botanical reserve for native plants. Protecting the untrammeled character of these wilderness areas requires protecting the flora and fauna found within them, and the ecological system in which these species and communities exist. Introduced plant species pose serious ecological problems, forming vast monospecific zones, lowering biodiversity, outcompeting native plants, and eliminating habitat for nesting seabird species. Mammalian predators have the potential for devastating impacts to nesting seabirds within San Juan Islands Wilderness. The Complex staff has concluded that maintenance of the untrammeled quality necessitates removal of selected plants and animals when it is determined that their presence is negatively impacting the wilderness ecological system and processes in a manner that will cause irreversible harm to the native species. Initiation of management actions to control, and where possible eliminate, invasive species requires monitoring to document infestations and evaluate success of control actions.

Undeveloped: Yes

The undeveloped refuge rocks, reefs, and islands within San Juan Islands Wilderness provide a dramatic natural setting in the San Juan Archipelago. Hundreds of thousands of annual visitors to the San Juan Archipelago appreciate the scenic natural beauty and the ecological values associated with the abundant marine wildlife populations these wilderness areas protect. All of San Juan Islands Wilderness is closed to public access (except for the wilderness trail on Matia Island) at all times to prevent disturbance to sensitive seabirds and pinnipeds and to prevent destruction of native plants and habitats.

In some cases, refuge management or research activities may require the use of temporary structures or equipment to prevent impacts to the wildlife and habitat while conducting the activities. These actions have the potential to degrade the undeveloped quality because they involve generally prohibited uses; however, the desired information is essential and cannot be obtained from a location outside of wilderness, and the methods used are the minimum tool necessary to accomplish the objective safely and successfully. The impossibility of conducting the specific research or management activity by another means renders it necessary to utilize these tools to preserve the undeveloped quality of the wilderness areas.

Natural: **Yes**

Many of the rocks and islands within San Juan Islands Wilderness are located immediately adjacent to the larger islands in the Archipelago, an area receiving ever-increasing pressure for residential housing and commercial development. Monitoring the wilderness ecological systems (plant and animal species and communities) and evaluating impacts from internal and external forces is critical for attempting to maintain conditions substantially free from the effects of modern civilization. Because the “natural” quality also refers to the abundance, distribution, or number of invasive non-indigenous species, there is a need to monitor the natural quality of these wilderness areas with respect to invasive species, and develop management strategies to control them. Control of plant and animal invasive species, with the intent of manipulating habitats and correcting conditions resulting from human influence, is necessary to preserve the natural quality of these wilderness areas.

Outstanding opportunities for solitude or a primitive and unconfined type of recreation: **Yes**

Matia Island is open to the public via a State operated public use site. A single trail system from this site allows the public to access a small part of the wilderness habitat. All the other rocks, reefs, and islands within the San Juan Islands Wilderness areas are closed to public entry to protect sensitive wildlife and habitat.

Other unique components that reflect the character of this wilderness: **No**

F. Describe Effects to the Public Purposes of Wilderness

Is action necessary to support one or more of the public purposes for wilderness (as stated in Section 4(b) of the Wilderness Act) of recreation, scenic, scientific, education, conservation, and historical use?

Recreation: **Yes**

Monitoring the impacts of public use at Matia Island will be needed to ensure that the area retains its wilderness character and values.

Scenic: **Yes**

Control of invasive plant and animal species and the subsequent preservation of seabird and pinniped colonies will maintain the scenic value of the wilderness.

Scientific: **Yes**

Scientific research is necessary to support management actions to protect wilderness values and achieve refuge purposes. Examples include studying health and life-history parameters of threatened Steller sea lions, development of non-intrusive survey methods for nesting seabirds, and study of best control methods for pest plants and animals. Research supplies necessary information to determine population status and trend for sensitive and listed species. Results of the research project will be published and shared with the scientific community.

Education: **Yes:**

Education about the sensitivity of the wildlife and habitats within these wilderness areas is necessary for their continued protection and to garner support to further their protection and management. For example, education about the effects of disturbance and invasive species on these wilderness resources, information gained through research and monitoring and encapsulated in regulatory and interpretive signage, may encourage the public to change their behaviors while visiting the Archipelago and cause them to be less likely to trespass on rocks and islands. The results of research projects will be incorporated into the Complex's environmental education and interpretation program.

Conservation: Yes

This area cannot be successfully conserved, including its wilderness values, without administrative action within the wilderness area. The USFWS cannot fully meet its affirmative responsibilities for endangered and threatened species, invasive species, refuge purposes, wilderness management objectives, and the NWRS mission without monitoring impacts of research, controlling invasive species to reduce trammeling and assisting in endangered species recovery to recover naturalness.

Historical use: No

Step 1 Decision: Is any administrative action necessary in wilderness? **Yes**

Research, monitoring, and management of vulnerable refuge wildlife and habitats are actions necessary to achieve and document progress towards fulfillment of the purposes of these refuges as ". . . a preserve and breeding ground for native birds and animals"; ". . . as a refuge and breeding ground for wild birds and animals"; maintain the wilderness wildlife values on the refuges; and help to fulfill the mission of the National Wildlife Refuge System.

If action is necessary, proceed to Step 2 to determine the minimum activity.

Step 2: Determine the minimum activity/tools.

Description of Alternatives

For each alternative, describe what methods and techniques will be used, when the activity will take place, where the activity will take place, what mitigation measures are necessary, and the general effects to the wilderness resource and character.

Alternative # 1: No Management Activity

Under alternative #1 no management activity whatsoever is conducted in wilderness. Some expected results are describe under Step 1 above.

Alternative # 2: No Generally Prohibited Uses

Description:

Research, Monitoring and Management
Alternative #2 would involve the elimination of low level aerial surveys, and temporary facilities and equipment used for research and monitoring.

Effects:

Wilderness Character

"Untrammeled"– Minimal human manipulation. Many rocks and islands are difficult to access for monitoring and invasive species control. Without access and management to control invasive species, the unchecked increase in invasives is likely to negatively impact the wilderness ecological system and processes in a manner that will cause irreversible harm to the native species.

"Undeveloped" – Minimized. There would be no temporary placement of facilities or motorized or mechanical equipment. The ability of the USFWS to conduct research, monitoring, and management activities would be greatly diminished through reduction of tools (i.e. remote sensing equipment, blinds, temporary access equipment (i.e. ladder), weather station, and telemetry equipment).

"Natural" – Minimized. Wildlife disturbance from USFWS activities would be less than in Alternative #3. The ability of the USFWS to conduct research, monitoring, and management activities would be diminished, threatening the integrity and biological diversity of the refuges. Information gathered would be limited and the ability to effectively monitor and document seabird and pinniped population trends would be compromised. Undetected wildlife population declines and the subsequent failure to reverse those declines would negatively impact the wildlife and other values of the refuge wilderness areas.

"Outstanding opportunities for solitude or a primitive and unconfined type of recreation" – Matia Island retains its current public use trail. All other areas remain closed to public entry.

Heritage and Cultural Resources – N/A

Maintaining Traditional Skills - N/A

Special Provisions – N/A

Economic and Time Constraints – N/A

Additional Wilderness-specific Comparison Criteria – N/A

Safety of Visitors, Personnel, and Contractors – N/A

Alternative # 3: Research, Monitoring, and Management Utilizing Some Generally Prohibited Uses

Description:

Research

Refuge Complex staff is not currently conducting independent research within the refuge wilderness areas, primarily due to limited staff and funding. It is anticipated that in the next 15 years increases in staff and funding will allow refuge staff to conduct important research projects on the highest priority species and issues. Research being conducted by refuge agents includes threatened Steller sea lion and other pinniped studies by NOAA Fisheries and WDFW, and black oystercatcher research led by WDFW. These research projects are controlled through Special Use Permits that contain various restrictions and stipulations to ensure that impacts to wildlife and habitats are kept to a minimum. The following is a set of criteria that will be used, in part, to determine if research will be permitted to occur within refuge wilderness areas.

Research Criteria:

- Research that focuses on conservation, management, and protection of refuge species of concern such as seabirds and pinnipeds, control or eradication of invasive plants and animals, and research that provides an understanding of island ecology, ecosystem function and climate change impacts.
- Research will be conducted by USFWS employees or their agents.
- Prohibited uses, per Section 4(c) of the Wilderness Act, will not occur unless they are necessary to meet minimum requirements for the administration of these areas.
- Disturbance to wildlife will be minimized and not adversely affect populations.

The Refuge Manager occasionally receives requests from universities and others to conduct additional research within the refuge wilderness areas. Each of these situations is considered on a case-by-case basis and is evaluated to determine expected benefits of the research to knowledge and/or management of refuge flora and fauna as well as possible impacts to the resources, habitats and wilderness character resulting from research activities. This type of research is covered under a Compatibility Determination (see Appendix J) and prospective non-USFWS researchers will be required to prepare a separate MRA for proposed activities within the wilderness areas. The Wilderness Act does not allow outside researchers and others who are not direct agents of the USFWS to gain exemptions to the prohibited uses provisions (Section 4(c) of the Act).

Several generally prohibited uses may be necessary to facilitate critical research being conducted by agents of the USFWS. In order to protect sensitive island habitat, minimize disturbance to wildlife, and for human safety purposes, it may occasionally be necessary to erect temporary unobtrusive structures such as a blinds, remote sensing and monitoring equipment, etc., and use of chain saw and power auger may be necessary.

Monitoring

Monitoring is conducted by refuge staff and refuge agents in order to determine wildlife population status and trends; document wildlife disturbances; document the occurrences of invasive species; and evaluate the results of control actions. Most monitoring occurs from off-refuge and outside of the wilderness area from boats. This is done to minimize disturbance to wildlife and to the wilderness area. Seabird and pinniped trend surveys are conducted using fixed-wing and rotary-winged aircraft generally at an altitude of 1,000 feet or more, but occasionally as low as 500 feet one to three times a year. On some occasions, refuge staff and agents will enter the refuge wilderness area to obtain data on seabirds, pinnipeds and other wildlife and/or survey for invasive species. The wilderness rocks, reefs, and islands are accessed from small boats at sea. At some locations, effective monitoring can require utilization of several generally prohibited uses including construction of temporary unobtrusive structures such as a boardwalk or remote video monitoring system. Use of some motorized equipment such as chain saw and power auger may be necessary.

In all cases the minimum activity and tools will be used to accomplish the work in fulfilling the purposes of the refuge and to protect the wilderness character and value. Currently, only a minimum amount of monitoring is being conducted by the refuge due to limited staff and funding. It is anticipated that within 15 years of the completion of the Comprehensive Conservation Plan increases in staff and funding will allow refuge staff to initiate and maintain important seabird monitoring projects in accordance with the Regional Seabird Conservation Plan (USFWS 2005a) and monitoring of the highest priority species.

Management
The management strategy for San Juan Islands Wilderness is to allow natural processes to occur unimpaired by human actions. The exception to this management strategy is the treatment of invasive species. Refuge staff and agents will conduct a rapid and aggressive approach to control or eradicate invasive plants and animals. Invasive mammals can quickly eliminate entire colonies of nesting seabirds. Invasive plants eliminate native vegetation and can alter native flora communities. The spread of some invasive plants such as ice plant (*Carpobrotus chilensis*) can eliminate breeding habitat for burrow-nesting seabird species.

Invasive plant and non-native predator control or eradication will be accomplished using integrated pest management techniques. Control of native mammalian predators will be undertaken according to a yet to be developed step-down management plan. No generally prohibited tools will be used to control invasive species within these wilderness areas. Chain saws maybe used to maintain trail on Matia Island

Effects:

Wilderness Character

"Untrammeled" – There is some wildlife disturbance associated with permitted research and monitoring activities and occasional unauthorized public entry into the wilderness. The distance to wildlife, timing, and frequency of efforts are all carefully considered to minimize impacts to wildlife while maximizing the data obtained.

"Undeveloped" – The majority of the monitoring is conducted with the observers located outside of the wilderness area viewing from small boats. During the infrequent visits to some of the rocks and islands in the wilderness area for monitoring and/or research purposes wildlife disturbance is minimized, sensitive habitats are protected and no permanent structures or equipment are erected. In a very limited number of cases it may be necessary to erect temporary facilities and equipment such as blinds to prevent disturbance of seabird nesting habitat during research activities or to install remote sensing equipment. Used and temporary facilities will minimize impacts to the refuge and to the wildlife, protect wilderness character, and leave no trace once removed. Temporary facilities and equipment will be installed prior to the breeding season or research project and removed immediately after the breeding season or completion of the research project.

"Natural" – Minimized. Wildlife disturbance from USFWS activities would be slightly greater than in Alternative #2. The ability of the USFWS to conduct research, monitoring, and management activities would be enhanced. Seabird, pinniped, and invasive species population trends would be more accurately tracked. Development of management options to reverse declining wildlife populations or increasing invasive species populations would be developed thus maintaining the natural quality.

"Outstanding opportunities for solitude or a primitive and unconfined type of recreation" – The rocks, reefs, and islands of the San Juan Islands wilderness area are not open to the public except for a 1.2 mile wilderness trail on Matia Island; however, they are extremely important to the recreational experience of Archipelago residents and visitors who view these areas from boats or Washington State Ferries. Because the duration and frequency of research, monitoring, and management efforts are limited; and because most of the refuge and associated wilderness area are closed to public use, the impacts to solitude are negligible.

Heritage and Cultural Resources – N/A

Maintaining Traditional Skills – N/A

Special Provisions – N/A

Economic and Time Constraints – N/A

Additional Wilderness-specific Comparison Criteria – N/A

Safety of Visitors, Personnel, and Contractors – N/A

Step 2 Decision: What is the Minimum Activity?

Selected alternative:

The option selected is Alternative # 3.

Rationale for selecting this alternative (including documentation of safety criterion, if appropriate):

Research, monitoring and management of the refuge wilderness rocks, reefs, and islands require occasionally accessing these areas approximately ten times per year. Access is from small boats at sea. Observations conducted from the water in motorized boats outside of the wilderness areas, infrequent aerial surveys above the wilderness, and erection of unobtrusive temporary structures and equipment are essential tools needed to conduct research, monitoring, and management activities in support of the refuges. The minor amount of wildlife disturbance caused by research, monitoring, and management is minimal compared to the importance of collecting data that directly contributes to species conservation. If conducted only when absolutely necessary, these activities are all considered the minimum tools needed to accomplish refuge purposes including wilderness values. They preserve wilderness character and only minimally impact human solitude while benefiting the wildlife values of the wilderness.

NEPA Compliance and Public Review: This MRA was prepared in association with the Protection Island and San Juan Islands National Wildlife Refuges Draft Comprehensive Conservation Plan; San Juan Islands Wilderness Plan; and associated Environmental Assessment (CCP/WSP/EA). It was made available for public review and comment at the same time as the Draft CCP/WSP/EA.

List any Wilderness Act Section 4(c) uses approved in this alternative:

3. temporary structure or installation (Blinds, weather station, ladders, remote sensing equipment and solar array)
4. motorized equipment (Chain saw and power auger)

Record and report any authorizations of Wilderness Act Section 4(c) uses according to agency procedures.

References:

National Marine Fisheries Service. 2008. Recovery plan for the Steller sea lion (*Eumetopias jubatus*). Revision. National Marine Fisheries Service. Silver Spring, MD. 325 pp.

Speich, S.M., and T.R. Wahl. 1989. Catalog of Washington seabird colonies. U.S. Fish and Wildlife Service, Service Biological Report 88(6). 510 pp.

USFWS (U.S. Fish and Wildlife Service). 2005a. Regional seabird conservation plan, Pacific Region. U.S. Fish and Wildlife Service, Migratory Bird and Habitat Programs. Pacific Region, Portland, OR. 261 pp.

Appendix I. Appropriateness Findings

I. Introduction

Under the Appropriate Refuge Uses Policy, 603 FW 1, (2006) refuge managers are directed to determine if a new or existing public use is an appropriate refuge use. If an existing use is not appropriate, the refuge manager is directed to modify the use to make it appropriate or terminate it, as expeditiously as practicable. If a new use is not appropriate, the refuge manager will deny the use without determining compatibility. If a use is determined to be appropriate, then a compatibility determination should be developed to determine whether the use can be allowed.

An "appropriate use" must meet at least one of the following three conditions.

- The use is a wildlife-dependent recreational use as identified in the Refuge Improvement Act.
- The use involves the take of fish and wildlife under State regulations.
- The use has been found to be appropriate as specified in section 1.11 of the policy and documented on FWS Form 3-2319.

During the CCP process the refuge manager reviewed all existing and proposed refuge uses on Protection Island and the San Juan Islands Refuges that are associated with the Preferred Alternative (Alternative B). Documentation of appropriateness findings for wildlife-dependent uses is not included in this Appendix because wildlife-dependent uses are appropriate by definition. They are however evaluated for compatibility in the following Appendix J. All other refuge uses were evaluated using the criteria described in policy and listed on FWS Form 3-2319. The table below shows the uses evaluated and appropriateness findings made by the refuge manager. Additional documentation is included in this appendix for each use identified in the table.

Refuge	Refuge Use	Appropriate	Page
Protection Island	Research	Yes	I-2
San Juan Islands	Research	Yes	I-4
San Juan Islands	Camping	Yes	I-6
San Juan Islands	Pets	No	I-8

Finding of Appropriateness of a Refuge Use

Refuge Name: _______**Protection Island**___________________________________

Use: ________**Research**____

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

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

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

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

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

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

Not Appropriate_____ Appropriate__✓

Refuge Manager:____ Date:______________________

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.
If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.
If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor:_______________________________________ Date:_______________________

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

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Finding of Appropriateness of a Refuge Use: Attachment

Refuge Name: _______**Protection Island**____________________________________

Use: ________**Research**____

Supplemental Information

Description of Use:

The Washington Maritime NWR Complex receives periodic requests from non-USFWS entities (e.g., universities, state agencies, other federal agencies, NGOs) to conduct research, scientific collecting, and surveys on Protection Island NWR. The Refuge Manager currently has the authority to issue research permits. (603 FW1)

Projects can involve a broad range of natural resource issues including habitat use and life-history requirements for specific species/species groups, practical methods for habitat restoration, extent and severity of environmental contaminants, techniques to control or eradicate pest species, effects of climate change on environmental conditions and associated habitat/wildlife response, modeling of wildlife populations, and assessing response of habitat/wildlife to disturbance. Projects may be species specific, Refuge-specific, or evaluate the relative contribution of the Refuge to larger landscape (e.g., ecoregion, region, flyway, national, international) issues and trends. The USFWS's Research and Management Studies (4 RM 6) and Appropriate Refuge Uses policies (603 FW1.10D(4)) indicate priority for scientific investigatory studies that contribute to the enhancement, protection, use, preservation, and management of native wildlife populations and their habitat as well as their natural diversity.

Facilities supporting research on Protection Island NWR include a 468 square foot Refuge office, 768 square foot research station/ bunkhouse, 120 square foot Research storage/ shop building, marina and 2 floating piers. In addition there is a 140 foot well, 33,000 gallon water tower, and 10,200 cubic foot water distribution system.

Justification:

(c) Is the use consistent with applicable Executive orders and Department and Service policies?

Research is consistent with Service policy. Protections Island's Refuge founding purpose includes the following provision; "… to provide for scientific research…". In addition, two provisions of the National Wildlife Refuge Improvement Act of 1997 directly support research within the Refuge; to "maintain biological integrity, diversity and environmental health" and to conduct "inventory and monitoring.".

(i) Does the use contribute to the public's understanding and appreciation of the Refuge's natural or cultural resources, or is the use beneficial to the Refuge's natural or cultural resources?

Research not only serves to further the user's knowledge and understanding of Protection Island NWR, it also aids in managing Refuge resources. Seabird and pinniped conservation and management within the Refuge are based upon best available scientific information from research combined with long-term monitoring. Some research is used to address specific wildlife conservation questions, such as understanding the causes of reduced or declining seabird and/or pinniped populations. Other research has broader applicability, such as using a suite of seabird species as indicators of ocean health conditions, and to document change in the larger marine environment and associated impacts associated with climate change and global warming.

Finding of Appropriateness of a Refuge Use

Refuge Name: _______**San Juan Islands NWR**_________________________

Use: ________**Research**____

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

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

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

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

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

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

Not Appropriate_____ Appropriate__✓___

Refuge Manager:____ Date:_____________________

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.
If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.
If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor:_______________________________________Date:_______________________

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

FWS Form 3-2319 02/06

Refuge Name: _______**San Juan Islands**__________________________________

Use: ________**Research**____

Supplemental Information

Description of Use:

The Washington Maritime NWR Complex receives periodic requests from non-USFWS entities (e.g., universities, state agencies, other federal agencies, NGOs) to conduct research, scientific collecting, and surveys on Refuge lands within the San Juan Islands NWR. The Refuge Manager currently has the authority to issue research permits. (603 FW1)

Projects can involve a wide range of natural and cultural resource as well as public-use management issues including habitat use and life-history requirements for specific species/species groups, practical methods for habitat restoration, extent and severity of environmental contaminants, techniques to control or eradicate pest species, effects of climate change on environmental conditions and associated habitat/wildlife response, identification and analyses of paleontological specimens, wilderness character, modeling of wildlife populations, and assessing response of habitat/wildlife to disturbance from public uses. Projects may be species specific, Refuge-specific, or evaluate the relative contribution of the Refuge to larger landscape (e.g., ecoregion, region, flyway, national, international) issues and trends. The USFWS's Research and Management Studies (4 RM 6) and Appropriate Refuge Uses policies (603 FW1.10D(4)) indicate priority for scientific investigatory studies that contribute to the enhancement, protection, use, preservation, and management of native wildlife populations and their habitat as well as their natural diversity.

Justification:

(c) Is the use consistent with applicable Executive orders and Department and Service policies?

Research is consistent with Service policy. Two provisions of the National Wildlife Refuge Improvement Act of 1997 are to "maintain biological integrity, diversity and environmental health" and to conduct "inventory and monitoring." These provisions support Refuge research.

(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?

Research not only serves to further the user's knowledge and understanding of the Refuge, it also aids in managing Refuge resources. Wildlife and habitat conservation and management within the Refuge are based upon best available scientific information from research combined with long-term monitoring. Some research is used to address specific wildlife conservation questions, such as understanding the causes of reduced or declining seabird and/or pinniped populations and development of tools and techniques to aid recovery of threatened or endangered species. Other research has broader applicability, such as using a suite of seabird species as indicators of ocean health conditions, and to document change in the larger marine environment and associated impacts associated with climate change and global warming.

Finding of Appropriateness of a Refuge Use

Refuge Name: _______ **San Juan Islands NWR** **_____________**___________

Use: ________**Camping_**____

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

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

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

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

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

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

Not Appropriate_____ Appropriate__✓___

Refuge Manager:____Date:_____________________

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.
If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.
If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor:_______________________________________Date:______________________

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

FWS Form 3-2319 02/06

Finding of Appropriateness of a Refuge Use: Attachment

Refuge Name: _______ **San Juan Islands NWR _____________**___________

Use: ________**Camping_**____

Supplemental Information

Description of Use:

Currently Matia Island has 6 primitive campsites and Turn Island has 13. All camping related facilities are managed by the Washington State Parks and Recreation Commission. Under the preferred alternative Matia would maintain all 6 sites and Turn would have 8 sites.

Camping would be allowed only by persons arriving by non-motorized (human powered) vessels and a camping reservation system would be initiated. Pets and open fires would be prohibited on both islands however visitors could continue to use liquid fuel camp stoves. Through an agreement with the Service, the State Parks and Recreation Commission would continue to manage the camping program including collecting fees.

Justification:

(d) Is the use consistent with public safety?

Due to their remote locations, visitors who travel to these refuge islands by human powered craft may be afforded safe refuge to rest, and to allow wind, currents, and inclement weather to abate. Because such vessels travel slower than motor powered vessels and have other mobility constraints, these visitors require more time to reach these Refuge units, particularly Matia Island. Without the ability to camp overnight such visitors may simply not have enough time to reach the islands and then safely reach another location before sunset. Thus, these camping sites must be maintained in order to provide this recreational opportunity while protecting public safety.

(i) Does the use contribute to the public's understanding and appreciation of the Refuge's natural or cultural resources, or is the use beneficial to the Refuge's natural or cultural resources?

Camping affords visitors a unique opportunity to experience wildlife at times when animals are particularly active such as dawn and dusk, and to listen to the sounds of wildlife at night. Such experiences support the priority public uses of wildlife observation, photography and environmental education and foster a greater appreciation and understanding of Refuge's wildlife resources. For example, due to its centralized location, Turn Island is an ideally suited staging area for multi-day human powered vessel excursions throughout the San Juan Archipelago. Such events promote wildlife dependant recreation throughout the geographically separated Refuge units fostering a greater understanding and appreciation of Refuge resources. Motorized vessels on the other hand do not have the same travel limitations and have other nearby camping opportunities. The opportunity to engage in several priority public uses provided through this type of camping experience would outweigh any anticipated negative impacts associated with offering this experience.

Finding of Appropriateness of a Refuge Use

Refuge Name: _______ **San Juan Islands NWR** _________________

Use: ________**Pets**____

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

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

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

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

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

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

Not Appropriate__✓___ Appropriate_____

Refuge Manager:____Date:_____________________

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.
If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.
If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor:_______________________________________Date:______________________

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

FWS Form 3-2319 02/06

Finding of Appropriateness of a Refuge Use: Attachment

Refuge Name: _______ **San Juan Islands NWR** _____________________________

Use: ________**Pets**____

Supplemental Information

Description of Use:
Currently pets are allowed on leashes in the campground areas on both Matia and Turn Islands. However, visitors sometimes allow pets to run free in the campgrounds and in areas that are off limits to domestic animals.

Allowing pets to enter Refuge units in the San Juan Islands has been determined not to be appropriate.

Justification:

(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?
(c) Is the use consistent with applicable Executive orders and Department and Service policies?

The use does not comply with Federal regulations and is inconsistent with Service policy. The presence of pets directly results in an absence of wildlife and is at odds with the establishing purpose of the Refuge. In addition, allowing pets to enter and roam within a National Wildlife Refuge is a violation of 50 CFR 26.21 (b).

(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?

The use cannot be accommodated without negatively impacting wildlife and impairing or eliminating wildlife viewing opportunities. Studies indicate that wildlife exhibit a greater response from disturbance by dogs than from disturbance by pedestrians (MacArthur et al. 1982; Hoopes 1993). In the case of birds, the presence of dogs may flush incubating birds from nests (Yalden and Yalden 1990), disrupt breeding displays (Baydack 1986), disrupt foraging activity in shorebirds (Hoopes 1993), and disturb roosting activity in ducks (Keller 1991). Many of these authors indicated that dogs with people, dogs on- leash, or loose dogs provoked the most pronounced disturbance reactions from their study animals.

Baydack, R. K. 1986. Sharp-tailed grouse response to lek disturbance in the Carberry Sand Hills of Manitoba. Colorado State University, Fort Collins, Colorado

Hoopes, E. M.1993. Relationships between human recreation and piping plover foraging ecology and chick survival. Thesis, University of Massachusetts, Amherst, Massachusetts

Keller, V. 1991 Effects of human disturbance on eider ducklings *Somateria mollissima* in estuarine habitat in Scotland. Biological Conservation 58: 213-228

MacArthur, R. A., V. Geist, R. H. Johnston. 1982. Cardiac and behavioral responses of mountain sheep to human disturbance. Journal of Wildlife Management 46: 351-358

Yalden, P. E., and D. W. Yalden. 1990. Recreational disturbance of breeding golden plovers *Pluvialus apricarius.* Biol. Conserve. 51: 243-262

Appendix J. Compatibility Determinations

J. Introduction

Compatibility is a tool refuge managers use to ensure that recreational and other uses do not interfere with wildlife conservation - the primary focus of refuges. Under the Compatibility policy 603 FW 2 (2000), refuge managers are directed to determine if a proposed or existing refuge use is compatible with refuge purposes and the National Wildlife Refuge System mission. Refuge uses are defined as recreational or economic/commercial or management use of the refuge by the public or a non-Refuge System entity. The Service does not, however, prepare compatibility determinations for uses when the Service does not have jurisdiction. Compatibility determinations are required to be in writing and the public should have an opportunity to comment on them.

The Service recognizes that compatibility determinations are complex. For this reason, refuge managers are required to consider principles of sound fish and wildlife management and best available science in making these determinations. If an existing use is not compatible, the refuge manager is directed to modify the use to make it compatible or terminate it, as expeditiously as practicable.

In July 2006, the Service published its Appropriate Refuge Uses Policy (603 FW1). Under this policy, most proposed uses must also undergo an appropriateness review prior to compatibility. If a proposed use is not appropriate, the refuge manager will deny the use without determining compatibility. Priority wildlife-dependent activities are automatically considered appropriate. If a use is determined to be appropriate, then a compatibility determination is developed to determine whether the use can be allowed. Appropriateness findings for Protection Island and San Juan Islands Refuges can be found in Appendix I.

Compatibility Determinations evaluated at this time

This set of compatibility determinations (CDs) evaluates uses projected to occur under the Preferred Alternative B in the Draft EA for the Comprehensive Conservation Plan and Wilderness Stewardship Plan for Protection Island and San Juan Islands Refuges (Draft CCP/WSP/EA). The evaluation of funds needed for management and implementation of each use also assumes implementation as described under Alternative B. Compatibility determinations are based on the professional judgment of refuge personnel, including observations of existing refuge uses.

Refuge	Refuge Use	Compatible	Page
Protection Island	Research, Scientific Collecting, and Survey Activities	Yes	J-2
Protection Island	Environmental Education	Yes	J-9
San Juan Islands	Research Scientific Collecting, and Survey Activities	Yes	J-15

Refuge	Refuge Use	Compatible	Page
San Juan Islands	Environmental Education	Yes	J-22
San Juan Islands	Wildlife Observation, Photography, and Interpretation	Yes	J-29
San Juan Islands	Camping	Yes	J-39

Draft Compatibility Determination

Use: Research, Scientific Collecting, and Survey Activities

Refuge Name: Protection Island National Wildlife Refuge

Refuge Purposes and Establishing/Acquisition Authorities

> *"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"* (All lands, Protection Island National Wildlife Refuge Act, Public Law 977-333, Oct 15, 1982, 96 Stat. 1623).
>
> *". . . for the development, advancement, management, conservation, and protection of fish and wildlife resources . . ."* (340 acres under tideland lease, 16 U.S.C.742 f(a)(4), Fish and Wildlife Act of 1956)

National Wildlife Refuge System Mission

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

Description of Use

The Washington Maritime National Wildlife Refuge Complex (Complex) receives periodic requests from non-Service entities (e.g., universities, state agencies, other federal agencies, NGOs) to conduct research, scientific collecting, and surveys on Protection Island. These projects can involve a wide range of natural and cultural resources, as well as public-use management issues, including habitat use and life-history requirements for specific species/species groups, practical methods for habitat restoration, extent and severity of environmental contaminants, techniques to control or eradicate pest species, effects of climate change on environmental conditions and associated habitat/wildlife response, identification and analyses of paleontological specimens, wilderness character, modeling of wildlife populations, and assessing response of habitat/wildlife to disturbance from public uses. Projects may be species-specific, refuge-specific, or evaluate the relative contribution of the refuge to larger landscape (e.g., ecoregion, region, flyway, national, international) issues and trends.

Facilities supporting research on Protection Island NWR include a 468-square-foot refuge field office, 768-square-foot research station/bunkhouse, 120-square-foot research storage/shop building, marina and 2 floating piers. In addition, there is a 140-foot well, 33,000 gallon water tower, and 10,200 cubic foot water distribution system. All of the above mentioned facilities except for the research station/bunkhouse and shop/storage support additional uses other than research. Replacement and relocation of the refuge office, research station/bunkhouse, and research shop/storage building are proposed to reduce or eliminate impacts to important habitat areas.

The Service's Research and Management Studies (4 RM 6) and Appropriate Refuge Uses policies (603 FW1.10D(4)) indicate priority for scientific investigatory studies that contribute to the enhancement, protection, use, preservation, and management of native wildlife populations and their habitat as well as their natural diversity. Projects that contribute to refuge-specific management, where applicable, would be given a higher priority over other requests. Priority would also be given to research that documents the understanding and impacts associated with climate change and global warming. Research applicants must submit a detailed proposal that outlines:

1) objectives of the study;
2) justification for the study;
3) detailed methodology and schedule; include measures to minimize wildlife and habitat disturbance or impacts through study design, including location, timing, scope, number of permittees, study methods, number of study sites, etc.;
4) potential impacts on refuge wildlife or habitat, including disturbance (short- and long-term), injury and/or mortality.
5) costs to the Refuge Complex, if any, including staff time and equipment;
6) expected outcomes or results; and
7) a timeline for submitting progress reports and final products (i.e., reports, theses, dissertations, publications).

Research proposals would be reviewed by Complex staff and others as appropriate, to weigh the anticipated impacts versus the benefits of the research activity to refuge management and understanding of natural systems. This would form the basis for allowing the project to proceed or be denied. If the proposal is approved, the Project Leader would issue a Special Use Permit (SUP) which would set the terms and conditions of the study to avoid and/or minimize the impacts on refuge resources, public use activities, and refuge field operations. All research projects would be assessed during implementation to ensure that impacts remain within acceptable levels. Projects which would result in unacceptable refuge impacts will not be found compatible and will not be approved

Research would not be allowed on refuge lands if one or more of the following criteria apply to a project proposal:

- Research that conflicts with other ongoing research, monitoring, or management programs will not be granted.
- Research projects that can be accomplished off the refuge are less likely to be approved.
- Highly intrusive and manipulative research or research which causes undue disturbance is generally not permitted in order to protect native bird and marine mammal populations.
- If staffing or logistics make it impossible for Complex staff to monitor the researcher, the permit is likely to be denied.
- If the activity is in a sensitive area, the research request may be denied, depending on the specific circumstances.

Availability of Resources

Complex staff responsibilities for projects by non-USFWS entities include the following: review of proposals, prepare SUPs and compliance documents (e.g., Section 7, Section 106 of the National Historic Preservation Act), and monitor project implementation to ensure that impacts and conflicts remain within acceptable levels to ensure compatibility over time. Additional administrative support, logistical and operational support may also be provided depending on each specific request. Estimated costs for one-time (e.g., prepare SUP) and annually re-occurring tasks by refuge staff and other Complex employees will be determined for each project. Limited funds for the Complex's administration of these projects (estimated $3,000 per requested project) may be available within the general operating budget of the Washington Maritime NWR Complex, which administers Protection Island NWR. In some cases, the Complex staff may act as a cooperator on research projects. The funding for these projects may be cost-shared and in some cases, specially designated funds may be utilized for the operation and administration of the projects.

The Complex has the following annual staffing and funding to administratively support and monitor the three research projects currently taking place on refuge lands (see table below). Any substantial increase in the number of projects would create a need for additional resources to oversee the administration and monitoring of the investigators and their projects. Any substantial additional costs above those itemized below (not including one-time costs associated with facility replacement and relocation) will result in finding a project not compatible unless expenses are offset by the investigator(s), sponsoring agency, or organization.

Category	**One Time Expense**	**Recurring Expense**
Administration (Evaluation of Applications, Management of Permits, Oversight)	$3,000	
Monitoring and participation	$6,000	$1,500
Maintenance		$2,250
Totals	$9,000	$3,750

Anticipated Impacts of the Use

Use of Protection Island NWR to conduct research, scientific collection, and surveys will generally benefit plant populations, wildlife, and habitats. The impacts of research activities would be project and site-specific, and would vary depending on the scope and type of research conducted. Scientific findings gained through these projects provide important information regarding life-history needs of species and species groups as well as identify or refine management actions to achieve resource management objectives in refuge management plans (especially CCPs). Reducing uncertainty regarding wildlife and habitat responses to refuge management actions in order to achieve desired outcomes reflected in resource management objectives is essential for adaptive management in accordance with 522 DM 1.

Data collection techniques will generally have negligible animal mortality or disturbance, habitat destruction, no introduction of contaminants, or no introduction of non-indigenous species. In contrast, projects involving the collection of biotic samples (plants or animals) or requiring intensive ground-based data or sample collection will have short-term impacts. To reduce impacts, the minimum number of samples (e.g., water, soils, vegetative litter, plants, macroinvertebrates, vertebrates) will be collected for identification and/or experimentation and statistical analysis. Where possible, researchers would coordinate and share collections to reduce sampling needed for multiple projects. For example, if one investigator collects fish for a diet study and another researcher examines otoliths, then it may be possible to accomplish sampling for both projects with one collection effort.

Some level of disturbance is expected with all research activities since most researchers will be entering areas that are normally closed to the public and, depending on specific research activities, may also be collecting samples or handling wildlife. However, minimal impact to Refuge wildlife and habitats will be expected with research studies because SUPs will include conditions to ensure that impacts to wildlife and habitats are kept to a minimum

Direct damage or alteration to the habitat from researchers would be minor due to the research proposal evaluation process and stipulations imposed through the SUP. However, some increase in invasive plants is possible from ground disturbance and/or transportation of source seed on research equipment and personnel, and rodents and disease organisms could potentially be transferred from boats and trapping equipment. Likewise, there could be localized and temporary effects resulting in direct impacts such as vegetation trampling, collecting of soil and plant samples, or trapping and handling of wildlife. Other potential, but localized and temporary, effects would include wildlife disturbance, which is expected with some research activities. Researcher disturbance could result in altering wildlife behavior. However, wildlife disturbance (including altered behavior) will be localized and temporary in nature. Only research with reasonably certain short-term effects from disturbance would be permitted. . Impacts may also occur from infrastructure necessary to support projects (e.g., permanent transects or plot markers, exclosure devices, monitoring equipment, solar panels to power unattended monitoring equipment).

Spread of invasive plants and/or pathogens is possible from ground disturbance and/or transportation of project equipment and personnel, but it will be minimized or eliminated by requiring proper cleaning of investigator equipment and clothing as well as quarantine methods, where necessary**.** If an unacceptable spread of invasive species is anticipated to occur, then the project will be found not compatible without a restoration or mitigation plan.

The combination of stipulations identified below and conditions included in any SUP(s) will ensure that proposed projects contribute to the enhancement, protection, conservation, and management of native wildlife populations and their habitats on the refuge(s). As a result, these projects will help fulfill refuge purposes; contribute to the Mission of the NWRS; and maintain the biological integrity, diversity, and environmental health of the refuge.

Public Review and Comment

Public review and opportunity to comment on this compatibility determination will occur in conjunction with the release of the Draft CCP/WSP/EA.

Determination

______ The use is not compatible.

__X__ The use is compatible with the following stipulations.

Stipulations Necessary to Ensure Compatibility

If the proposed research methods would impact or potentially impact refuge resources (habitat or wildlife), it must be demonstrated that the research is essential (i.e., critical to survival of a species; refuge islands provide only or critical habitat for a species; contributes significantly to understanding of impacts from climate change; or assessment and/or restoration after cataclysmic events), and the researcher must identify the issues in advance of the impact. Highly intrusive or manipulative research is generally not permitted in order to protect native bird and marine mammal populations. Stipulation and provisions would include the following:

User Stipulations:

- Potential researchers must submit a written, detailed research proposal to the Project Leader at least 6 months prior to start of field work. The required proposal format would be provided to researchers.
- Researchers are responsible for acquiring and/or renewing any necessary State and Federal permits prior to beginning or continuing their project.
- Research will adhere to scientifically defensible protocols for data collection, where available and feasible.
- The refuge staff will be provided with copies of raw data (preferably electronic database format) at the conclusion of the project.
- Upon completion of the project or annually, research sites must be cleaned up to the Project Leader's satisfaction and all physical markers removed. For long-term projects, conditions for clean-up and removal of equipment and physical markers would be stipulated in the SUP.
- Investigator(s) and support staff will follow all refuge-specific regulations that specify access and travel on the refuge(s).

Administrative Stipulations:

- A Section 7 consultation under the Endangered Species Act would be required for research activities that may affect a federally threatened, endangered, or proposed species. Only projects which have no effect or will result in not likely to adversely affect determinations will be considered compatible.
- Research that does not involve birds generally will only be allowed outside of the breeding season of avian species using the specific island(s), unless it can be demonstrated that there likely will be no impact to those breeding species. If a research project can only be conducted during the breeding season, such studies will only be permitted where there are specific protocols to minimize disturbance.
- Approved research projects will be conducted under a Complex-issued Special Use Permit which will have additional project-specific stipulations.
- Annual or other short term SUPs are preferred; however, some permits will be for a longer period, if needed, to facilitate the research. All SUPs will have a definite termination date in accordance with 5 RM 17.11. Renewals will be subject to Project Leader review of research data, status reports, compliance with compatibility determination and permit stipulations, and permits.

- If unacceptable impacts or issues arise or are noted by the Complex staff, then the Project Leader can suspend/modify conditions/terminate on-refuge research that is already permitted and in progress.
- All samples collected on refuge lands are the property of the Service even while in the possession of the investigator(s). Any future work with previously collected samples not clearly identified in the project proposal will require submission of a subsequent proposal for review and approval. In addition, a new SUP will be required for additional project work. For samples or specimens to be stored at other facilities (e.g., museums), a Memorandum of Understanding will be necessary.
- After approval, all projects also will be assessed during implementation to ensure impacts and conflicts remain within acceptable levels.
- Projects which are not covered by the CCP may require additional NEPA documentation.

Justification

Research is not considered a priority public use by NWRS policy (603 FW1); however, Protection Island's refuge purpose includes "…and to provide for scientific research…" Two provisions of the National Wildlife Refuge Improvement Act of 1997 are to "maintain biological integrity, diversity and environmental health" and to conduct "inventory and monitoring." Refuge plans and actions based on research and monitoring provide an informed approach to habitat, wildlife, and public use management programs. Seabird and pinniped conservation and management at the Complex are based upon best available scientific information from research combined with long-term monitoring. Some research is used to address specific wildlife conservation questions, such as understanding the causes of reduced or declining seabird and/or pinniped populations and development of tools and techniques to aid recovery of threatened or endangered species. Other research has broader applicability, such as using a suite of seabird species as indicators of ocean health conditions and to document change in the larger marine environment and associated impacts associated with climate change and global warming. Research, scientific collecting, and surveys on refuge lands are inherently valuable to the USFWS because they will expand scientific information available for resource management decisions. In addition, only projects which directly or indirectly contribute to the enhancement, protection, use, preservation, and management of refuge wildlife populations and their habitats generally will be authorized on refuge lands. In many cases, if it were not for the Complex staff providing access to refuge lands and waters along with some support, the project would never occur and less scientific information would be available to the USFWS and others to aid in managing and conserving these species. By allowing the use to occur under the stipulations described above, it is anticipated that wildlife species which may be disturbed during the use of refuge habitats, would find sufficient food resources and resting places elsewhere on the refuge so their abundance and use will not be measurably lessened. Additionally, it is anticipated that monitoring, as needed, will prevent unacceptable or irreversible impacts to fish, wildlife, plants, and their habitats. As a result, these projects will not materially interfere with or detract from fulfilling refuge purposes and they would contribute to the Mission of the NWRS, as well as maintaining the biological integrity, diversity, and environmental health of the refuges.

Mandatory 10- or 15-year Re-evaluation Date

Provide month and year for "allowed" uses only.
_______ Mandatory 15-year re-evaluation date (for wildlife-dependent public uses).
____X__ Mandatory 10-year re-evaluation date (for all uses other than wildlife-dependent public uses).

NEPA Compliance for Refuge Use Decision

_______ Categorical Exclusion without Environmental Action Statement
_______ Categorical Exclusion and Environmental Action Statement
_______ Environmental Assessment and Finding of No Significant Impact
_______ Environmental Impact Statement and Record of Decision.

Refuge Determination

Prepared by
Refuge Manager: ______________________________ ___________
(Signature) (Date)

Concurrence

Refuge Supervisor:
______________________________ ___________
(Signature) (Date)

Regional Chief, National
Wildlife Refuge System:
______________________________ ___________
(Signature) (Date)

Draft Compatibility Determination

Use: Environmental Education

Refuge Name: Protection Island National Wildlife Refuge

Refuge Purposes and Establishing/Acquisition Authorities

> *"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"* (All lands, Protection Island National Wildlife Refuge Act, Public Law 977-333, Oct 15, 1982, 96 Stat. 1623).
>
> *". . . for the development, advancement, management, conservation, and protection of fish and wildlife resources . . ."* (340 acres under tideland lease, 16 U.S.C.742 f(a)(4), Fish and Wildlife Act of 1956)

National Wildlife Refuge System Mission

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

Description of Use

Environmental Education is a key component of the enabling legislation of Protection Island National Wildlife Refuge. Protection Island is closed to public use so most environmental education would take place off-refuge. A limited amount of off-refuge environmental education currently takes place in partnership with the Port Townsend Marine Science Center. On-refuge environmental education will be limited and will consist of providing opportunities for volunteers to learn about the refuge and its resources while participating in stewardship projects and for college level students to pursue environmental studies in accordance with Service policies and criteria.

Refuge staff and others would provide an educational context to stewardship projects which may include, but are not limited to, debris clean up from island beaches, invasive vegetative species control, observation and monitoring of wildlife, and maintenance of facilities and equipment. The Complex will issue permits to allow students from regional colleges and universities to conduct environmental studies on Protection Island. Environmental studies will be of limited duration, complexity and scale and will be geared toward students gaining field experience and knowledge of the National Wildlife Refuge System, Protection Island NWR, and its management.

Availability of Resources

Complex staff will identify, and in many cases participate in, educational stewardship opportunities for volunteers. Staff responsibilities for projects/studies proposed by students will include the following: review of proposals, prepare SUPs and compliance documents, and monitor project/study implementation to ensure that impacts and conflicts remain within acceptable levels to ensure compatibility over time. Additional administrative support, logistical and operational support may also be provided depending on each specific request. Estimated costs for one-time (e.g., prepare SUP) and annually re-occurring tasks by Complex staff will be determined for each project. Limited funds for the Complex's administration of these projects/studies (estimated $2,500 per requested project) may be available within the general operating budget of the Washington Maritime Refuge Complex, which administers Protection Island NWR.

The Complex has the following staffing and funding over a 5-year period to administratively support and monitor the minimum number of stewardship projects (5) and environmental studies (2) identified in the CCP to take place over that timeframe. Any substantial increase in the number of projects/studies would create a need for additional resources to oversee the administration and monitoring of the studies. Any substantial additional costs above those itemized below will result in finding a project not compatible unless expenses are offset by the student(s) and/or the college and university.

Category	**One Time Expense**	**Recurring Expense**
Administration (Evaluation of Applications, Management of Permits, Oversight)	$7,000	$3,500
Monitoring and participation	$10,500	$3,500
Totals for five year period	$17,500	$7,000

Anticipated Impacts of the Use

Protection Island educational stewardship projects will be designed to minimize disturbance to wildlife and habitat. Impacts will be site-specific and may include short-term disturbance to species using refuge shorelines during beach cleanup projects. Island vegetation may be minimally impacted as invasive vegetative species are removed. Wildlife observation and monitoring may disturb some species as volunteers move from one monitoring location to another. Maintenance of facilities and equipment may also result in very local disturbance depending on time and place of need.

Use of Protection Island NWR to conduct college level environmental education will generally benefit plant populations, wildlife, and habitats. The impacts of individual studies would be site-specific, and would vary depending on the scope and type of study. Scientific findings gained through these studies will provide additional information for the Service to use in managing the refuge. In addition, it is the goal of this use to increase the student's knowledge and understanding of the refuge's unique wildlife and habitats, its linkage to the marine environment, and contribute to its and similar area's conservation. Data collection techniques will generally have minimal impacts on animal mortality or disturbance or habitat destruction; no introduction of contaminants; or no introduction of non-indigenous species. Studies involving the collection of biotic samples (plants or animals) or requiring intensive ground-based data or sample collection will have short-term impacts. To reduce impacts, the minimum number of samples (e.g., water, soils, vegetative litter, plants, macroinvertebrates, and vertebrates) will be collected for identification and/or experimentation and statistical analysis.

Some level of disturbance is expected with all study activities since most students will be entering areas that are normally closed to the public and, depending on specific study activities, may also be collecting samples or handling wildlife. However, minimal impact to refuge wildlife and habitats will be expected with studies because SUPs will include conditions to ensure that impacts to wildlife and habitats are kept to a minimum.

Direct damage or alteration to the habitat from students would be minor due to the study proposal evaluation process and stipulations imposed through the SUP. However, some increase in invasive plants is possible from ground disturbance and/or transportation of source seed on equipment and personnel, and rodents and disease organisms could potentially be transferred from boats and trapping equipment. Likewise there could be localized and temporary effects from vegetation trampling, colleting of soil and plant samples, or trapping and handling of wildlife. Impacts may also occur from infrastructure necessary to support projects (permanent transects or plot markers, exclosure devices, monitoring equipment, etc).

Spread of invasive plants and/or pathogens is possible from ground disturbance and/or transportation of project equipment and personnel, but it will be minimized or eliminated by requiring proper cleaning of investigator equipment and clothing as well as quarantine methods, where necessary**.** If an unacceptable spread of invasive species is anticipated to occur, then the study will be found not compatible.

There also could be localized and temporary effects from vegetation trampling, collecting of soil and plant samples, or trapping and handling of wildlife. Some level of disturbance is expected with these studies, especially if students enter areas closed to the public and collect samples or handle wildlife. However, wildlife disturbance (including altered behavior) will be localized and temporary in nature. Where long-term or cumulative unacceptable effects cannot be avoidrf, the project will not be found compatible.

The combination of stipulations identified below and conditions included in any SUP(s) will ensure that proposed studies minimize negative impacts to wildlife and habitats and positively contribute to the enhancement, protection, conservation, and management of native wildlife populations and their habitats on the refuge. As a result, these studies will help fulfill refuge purposes, contribute to the Mission of the NWRS, and maintain the biological integrity, diversity, and environmental health of the refuge.

Public Review and Comment

Public review and the opportunity to comment on this compatibility determination will occur in conjunction with the release of the Draft CCP/WSP/EA.

Determination

______ The use is not compatible.
__X__ The use is compatible with the following stipulations.

Stipulations Necessary to Ensure Compatibility

Design and conduct educational stewardship projects to minimize impacts to wildlife. Beach cleanup projects will be conducted outside seabird and marine mammal breeding/pupping seasons. Invasive species control will be conducted at the best time of year to ensure successful control efforts balanced against potential wildlife disturbance. Any control around major seabird colonies will take place outside the breeding season. Sign, trail, and facility maintenance will take place outside breeding and pupping areas except in emergency situations.

Highly intrusive or manipulative studies generally will not permitted in order to protect native bird and marine mammal populations. Stipulation and provisions would include the following:

User Stipulations:
- Potential students must submit a written, detailed study proposal to the Project Leader at least 1 month prior to start of field work. The required proposal format would be provided to students.
- Students are responsible for acquiring and/or renewing any necessary State and Federal permits prior to beginning or continuing their project.
- The Complex staff will be provided with copies of raw data (preferably electronic database format) at the conclusion of the study.
- Upon completion of the study or annually, study sites must be cleaned up to the Project Leader's satisfaction and all physical markers removed. For long-term studies, conditions for clean-up, and removal of equipment and physical markers would be stipulated in the SUP.
- Students and support staff will follow all refuge-specific regulations that specify access and travel on the refuge(s).

Administrative Stipulations:
- Design and conduct educational stewardship projects to minimize impacts to wildlife. Beach clean up projects will be conducted outside seabird and marine mammal breeding/pupping seasons. Invasive species control will be conducted at the best time of year to ensure successful control efforts balanced against potential wildlife disturbance. Any control around major seabird colonies will take place outside the breeding season. Sign, trail, and facility maintenance will take place outside breeding and pupping except in emergency situations.
- Highly intrusive or manipulative studies generally will not permitted in order to protect native bird and marine mammal populations.
- A Section 7 consultation under the Endangered Species Act would be required for studies that may affect a federally threatened, endangered, or proposed species. Only projects which have no effect or will result in not likely to adversely affect determinations will be considered compatible.
- Studies that do not involve birds generally will only be allowed outside of the breeding season of avian species using the specific island(s), unless it can be demonstrated that there likely will be no impact to those breeding species. If a study can only be conducted during

the breeding season, such studies will only be permitted where there are specific protocols to minimize disturbance.
- Studies will adhere to scientifically defensible protocols for data collection, where available and feasible.
- Approved studies will be conducted under a Complex-issued SUP which will have additional project-specific stipulations.
- Annual or other short-term SUPs are preferred; however some permits will be for a longer period, if needed, to facilitate the study. All SUPs will have a definite termination date in accordance with 5 RM 17.11. Renewals will be subject to Project Leader review of research data, status reports, compliance with compatibility determination and permit stipulations, and permits.
- After approval, all projects also will be assessed during implementation to ensure impacts and conflicts remain within acceptable levels.
- If unacceptable impacts or issues arise or are noted by the Complex staff, then the Project Leader can suspend/modify conditions/terminate on-refuge studies that are already permitted and in progress.
- All samples collected on refuge lands are the property of the Service even while in the possession of the students. Any future work with previously collected samples not clearly identified in the study proposal will require submission of a subsequent proposal for review and approval. In addition, a new SUP will be required for additional project work. For samples or specimens to be stored at other facilities (e.g., museums), a Memorandum of Understanding will be necessary.

Justification

Wildlife-oriented education is part of the purposes of Protection Island and therefore the environmental education program as described here is consistent with refuge purposes. Environmental education stewardship projects and studies on refuge lands are inherently valuable to the USFWS because they will enhance the public's knowledge of the refuge and its resources and expand scientific information available for resource management decisions. In addition, only studies which directly or indirectly contribute to the enhancement, protection, use, preservation, and management of refuge wildlife populations and their habitats generally will be authorized on refuge lands. In many cases, if it were not for the Complex staff providing access to refuge lands and waters along with some support, the study would never occur and less scientific information would be available to the USFWS and others to aid in managing and conserving these species. By allowing the use to occur under the stipulations described above, it is anticipated that wildlife species which may be disturbed during the use would find sufficient food resources and resting places elsewhere on the refuge so their abundance and use of refuge habitats will not be measurably lessened. Additionally, it is anticipated that monitoring, as needed, will prevent unacceptable or irreversible impacts to fish, wildlife, plants, and their habitats. As a result, these studies will not materially interfere with or detract from fulfilling refuge purposes (including wilderness) and they would contribute to the Mission of the NWRS, as well as maintaining the biological integrity, diversity, and environmental health of the refuges.

Mandatory 10- or 15-year Re-evaluation Date

Provide month and year for "allowed" uses only.
_______ Mandatory 15-year re-evaluation date (for wildlife-dependent public uses).
____X__ Mandatory 10-year re-evaluation date (for all uses other than wildlife-dependent public uses).

NEPA Compliance for Refuge Use Decision

______ Categorical Exclusion without Environmental Action Statement
_______ Categorical Exclusion and Environmental Action Statement
_______ Environmental Assessment and Finding of No Significant Impact
_______ Environmental Impact Statement and Record of Decision.

<u>Refuge Determination</u>

Prepared by
Refuge Manager: ________________________________ ___________
(Signature) (Date)

<u>Concurrence</u>

Refuge Supervisor:
________________________________ ___________
(Signature) (Date)

Regional Chief, National
Wildlife Refuge System:
________________________________ ___________
(Signature) (Date)

Draft Compatibility Determination

Use: Research, Scientific Collecting, and Survey Activities

Refuge Name: San Juan Islands National Wildlife Refuge

Refuge Purposes and Establishing/Acquisition Authorities

". . . reserved under jurisdiction of the Bureau of Sport Fisheries and Wildlife, United States Fish and Wildlife Service. . ." (all lands, PLO 2249).

". . .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." (all lands, Proposal published in 38 FR 29831 on Oct 29, 1973 prior to PLO 5515, 1975)

"as a preserve, breeding ground and winter sanctuary for native birds." (Smith and Minor Islands, E.O. 1959 of 1914)

". . .to secure for the American people of present and future generations the benefits of an enduring resource of wilderness" (353 acres, all units of the refuge except for Smith, Minor, Turn, and a 5 acre portion of Matia Island, P.L. 94-557 of October 1976 and P.L. 88-577, the Wilderness Act of 1964.)

"lighthouse purposes." Navigation aids maintained under the jurisdiction of the U.S. Coast Guard (~19 units, Executive Orders from 1854 and 1875).

National Wildlife Refuge System Mission

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

Description of Use

The Washington Maritime NWR Complex receives periodic requests from non-USFWS entities (e.g., universities, state agencies, other federal agencies, NGOs) to conduct research, scientific collecting, and surveys on San Juan Islands NWR. These projects can involve a wide range of natural and cultural resources as well as public-use management issues, including habitat use and life-history requirements for specific species/species groups, practical methods for habitat restoration, extent and severity of environmental contaminants, techniques to control or eradicate pest species, effects of climate change on environmental conditions and associated habitat/wildlife response, identification and analyses of paleontological specimens, wilderness character, modeling of wildlife populations, and assessing response of habitat/wildlife to disturbance from public uses. Projects may be species-specific, refuge-specific, or evaluate the relative contribution of the refuge to larger landscape (e.g. ecoregion, region, flyway, national, international) issues and trends.

The USFWS's Research and Management Studies (4 RM 6) and Appropriate Refuge Uses policies (603 FW1.10D(4)) indicate priority for scientific investigatory studies that contribute to the enhancement, protection, use, preservation, and management of native wildlife populations and their habitat as well as their natural diversity. Projects that contribute to refuge-specific and/or wilderness management, where applicable, would be given a higher priority over other requests. Priority would also be given to research that documents the understanding and impacts associated with climate change and global warming. Research applicants must submit a detailed proposal that outlines:

1) objectives of the study;
2) justification for the study;
3) detailed methodology and schedule; include measures to minimize wildlife and habitat disturbance or impacts through study design, including location, timing, scope, number of permittees, study methods, number of study sites, etc;
4) potential impacts on refuge wildlife or habitat, including disturbance (short-and long-term), injury and/or mortality.;
5) costs to the Refuge Complex, if any, including staff time and equipment;
6) expected outcomes or results; and
7) a timeline for submitting progress reports and final products (i.e., reports, theses, dissertations, publications).

Research proposals would be reviewed by Complex staff and others as appropriate, to weigh the anticipated impacts versus the benefits of the research activity to refuge management and understanding of natural systems. This would form the basis for allowing the project to proceed or be denied. If the proposal is approved, the Project Leader would issue an SUP which would set the terms and conditions of the study to avoid and/or minimize the impacts on refuge resources, public use activities, and refuge field operations. All research projects would be assessed during implementation to ensure that impacts remain within acceptable levels. Projects which would result in unacceptable refuge impacts will not be found compatible and will not be approved.

Research would not be allowed on refuge lands if one or more of the following criteria apply to a project proposal:

- Research that conflicts with other ongoing research, monitoring, or management programs will not be granted.
- Research projects that can be accomplished off the refuge are less likely to be approved.
- Highly intrusive and manipulative research or research which causes undue disturbance is generally not permitted in order to protect native bird and marine mammal populations and wilderness values.
- If staffing or logistics make it impossible for Complex staff to monitor the researcher, the permit is likely to be denied.
- If the activity is in a sensitive area, the research request may be denied, depending on the specific circumstances.

Availability of Resources

Complex staff responsibilities for projects by non-USFWS entities include the following: review of proposals, prepare SUPs and compliance documents (e.g., Section 7, Section 106 of the National Historic Preservation Act), and monitor project implementation to ensure that impacts and conflicts remain within acceptable levels to ensure compatibility over time. Additional administrative support, logistical, and operational support may also be provided depending on each specific request. Estimated costs for one-time (e.g., prepare SUP) and annually re-occurring tasks by refuge staffs and other Complex employees will be determined for each project. Limited funds for the Complex's administration of these projects (estimated $3,500 per requested project) may be available within the general operating budget of the Washington Maritime NWR Complex, which administers San Juan Islands NWR. In some cases, the Complex staff may act as a cooperator on research projects. The funding for these projects may be cost-shared and in some cases, specially designated funds may be utilized for the operation and administration of the projects.

The Complex has the following funding to annually administratively support and monitor one research project on San Juan Islands NWR (see table below). Any substantial increase in the number of projects would create a need for additional resources to oversee the administration and monitoring of the investigators and their projects. Any substantial additional costs above those itemized below (not including one-time costs associated with facility replacement and relocation) could result in finding a project not compatible unless expenses are offset by the investigator(s), sponsoring agency, or organization.

Category	One-Time Expense	Recurring Expense
Administration (Evaluation of Applications, Management of Permits, Oversight)	$1,000	$1,000
Monitoring and participation	$2,500	$1,500
Totals	$3,500	$2,500

Anticipated Impacts of the Use

Use of San Juan Islands NWR to conduct research, scientific collection, and surveys will generally benefit plant populations, wildlife, and habitats. The impacts of research activities would be project and site-specific, and would vary depending on the scope and type of research conducted. Scientific findings gained through these projects provide important information regarding life-history needs of species and species groups, as well as identify or refine management actions to achieve resource management objectives in refuge management plans (especially CCPs). Reducing uncertainty regarding wildlife and habitat responses to refuge management actions in order to achieve desired outcomes reflected in resource management objectives is essential for adaptive management in accordance with 522 DM 1.

Data collection techniques will generally have negligible animal mortality or disturbance, habitat destruction, no introduction of contaminants, or no introduction of non-indigenous species. In contrast, projects involving the collection of biotic samples (plants or animals) or requiring intensive ground-based data or sample collection will have short-term impacts. To reduce impacts, the minimum number of samples (e.g., water, soils, vegetative litter, plants, macroinvertebrates, vertebrates) will be collected for identification and/or experimentation and statistical analysis. Where possible, researchers would coordinate and share collections to reduce sampling needed for multiple projects. For example, if one investigator collects fish for a diet study and another research examines otoliths, then it may be possible to accomplish sampling for both projects with one collection effort.

Some level of disturbance is expected with all research activities since most researchers will be entering areas that are normally closed to the public and, depending on specific research activities, may also be collecting samples or handling wildlife. However, minimal impact to refuge wildlife and habitats will be expected with research studies because SUPs will include conditions to ensure that impacts to wildlife and habitats are kept to a minimum. Only research with reasonably certain short-term effects from disturbance would be permitted.

Direct damage or alteration to the habitat from researchers would be minor due to the study proposal evaluation process and stipulations imposed through the SUP. However, some increase in invasive plants is possible from ground disturbance and/or transportation of source seed on equipment and personnel, and rodents and disease organisms could potentially be transferred from boats and trapping equipment. Likewise there could be localized and temporary effects from vegetation trampling, colleting of soil and plant samples, or trapping and handling of wildlife. Impacts may also occur from infrastructure necessary to support projects (permanent transects or plot markers, exclosure devices, monitoring equipment, etc). .

Spread of invasive plants and/or pathogens is possible from ground disturbance and/or transportation of project equipment and personnel, but it will be minimized or eliminated by requiring proper cleaning of investigator equipment and clothing as well as quarantine methods, where necessary**.** If an unacceptable spread of invasive species is anticipated to occur, then the project will be found not compatible without a restoration or mitigation plan.

The combination of stipulations identified below and conditions included in any SUP(s) will ensure that proposed projects minimize negative impacts to wildlife and habitats and positively contribute to the enhancement, protection, conservation, and management of native wildlife populations and their habitats on the refuge. As a result, these projects will help fulfill refuge purposes, contribute to the Mission of the NWRS, and maintain the biological integrity, diversity, and environmental health of the refuge.

Public Review and Comment

Public review and the opportunity to comment on this compatibility determination will occur in conjunction with the release of the Draft CCP/WSP/EA.

Determination

______ The use is not compatible.
__X__ The use is compatible with the following stipulations.

Stipulations Necessary to Ensure Compatibility

If the proposed research methods would impact or potentially impact refuge resources (habitat or wildlife), it must be demonstrated that the research is essential (i.e., critical to survival of a species; refuge islands provide only or critical habitat for a species; contributes significantly to understanding of impacts from climate change; or assessment and/or restoration after cataclysmic events), and the researcher must identify the issues in advance of the impact. Highly intrusive or manipulative research is generally not permitted in order to protect native bird and marine mammal populations and wilderness values. Projects that represent public or private economic use of the natural resources of any national wildlife refuge (e.g., bioprospecting), in accordance with 16 U.S.C. 715s, must contribute to the achievement of the national wildlife refuge purposes or the National Wildlife Refuge System mission to be compatible (50 C.F.R. 29.1). Stipulations and provisions would include the following:

User Stipulations:
- Potential researchers must submit a written, detailed research proposal to the Project Leader at least 6 months prior to start of field work. The required proposal format would be provided to researchers.
- Researchers are responsible for acquiring and/or renewing any necessary State and Federal permits prior to beginning or continuing their project.
- Research will adhere to scientifically defensible protocols for data collection, where available and feasible.
- Research progress reports are required at least annually, and final reports are due within one year of the completion of the project, unless negotiated otherwise. The minimum required elements for a progress report will be provided to investigator(s).
- The refuge staff will be provided with copies of raw data (preferably electronic database format) at the conclusion of the project.
- Upon completion of the project or annually, research sites must be cleaned up to the Project Leader's satisfaction and all physical markers removed. For long-term projects, conditions for clean-up and removal of equipment and physical markers would be stipulated in the Special Use Permit.
- Investigator(s) and support staff will follow all refuge-specific regulations that specify access and travel on the refuge(s).

Administrative Stipulations:
- Any proposed research by USFWS or their agents within wilderness would have to comply with the provisions of the existing Minimum Requirements Analysis (Appendix H). Anyone not acting as an agent of USFWS and requesting to conduct research in wilderness must prepare an MRA consistent with FWS Policy and adhere to the requirements of the Wilderness Act of 1964 (16 U.S.C. 1131-1136).
- A Section 7 consultation under the Endangered Species Act would be required for research activities that may affect a federally threatened, endangered, or proposed species. Only projects which have no effect or will result in not likely to adversely affect determinations will be considered compatible.
- Research that does not involve birds generally will only be allowed outside of the breeding season of avian species using the specific island(s), unless it can be demonstrated that there likely will be no impact to those breeding species. If a research project can only be

conducted during the breeding season, such studies will only be permitted where there are specific protocols to minimize disturbance.

- Approved research projects will be conducted under a Complex-issued SUP which will have additional project-specific stipulations.
- Annual or other short-term SUPs are preferred; however, some permits will be for a longer period, if needed, to facilitate the research. All SUPs will have a definite termination date in accordance with 5 RM 17.11. Renewals will be subject to Project Leader review of research data, status reports, compliance with compatibility determination and permit stipulations, and permits.
- If unacceptable impacts or issues arise or are noted by the Complex staff, then the Project Leader can suspend/modify conditions/terminate on-refuge research that is already permitted and in progress.
- All samples collected on refuge lands are the property of the Service even while in the possession of the investigator(s). Any future work with previously collected samples not clearly identified in the project proposal will require submission of a subsequent proposal for review and approval. In addition, a new SUP will be required for additional project work. For samples or specimens to be stored at other facilities (e.g., museums), a Memorandum of Understanding will be necessary
- After approval, all projects also will be assessed during implementation to ensure impacts and conflicts remain within acceptable levels.
- Projects which are not covered by the CCP may require additional NEPA documentation.

Justification

Research is not considered a priority public use by NWRS policy (603 FW1); however, it contributes to two provisions of the National Wildlife Refuge Improvement Act of 1997, which are to “maintain biological integrity, diversity and environmental health” and to conduct “inventory and monitoring.” Refuge plans and actions based on research and monitoring provide an informed approach to habitat, wildlife, and public use management programs. Migratory bird and pinniped conservation and management at the Complex are based upon best available scientific information from research combined with long-term monitoring. Some research is used to address specific wildlife conservation questions, such as understanding the causes of reduced or declining seabird and/or pinniped populations and development of tools and techniques to aid recovery of threatened or endangered species. Other research has broader applicability, such as using a suite of seabird species as indicators of ocean health conditions and to document change in the larger marine environment and associated impacts associated with climate change and global warming.

Research, scientific collecting, and surveys on refuge lands are inherently valuable to the USFWS because they will expand scientific information available for resource management decisions. In addition, only projects which directly or indirectly contribute to the enhancement, protection, use, preservation, and management of refuge wildlife populations and their habitats generally will be authorized on refuge lands. In many cases, if it were not for the Complex staff providing access to refuge lands and waters along with some support, the project would not occur and less scientific information would be available to the USFWS and others to aid in managing and conserving these species. By allowing the use to occur under the stipulations described above, it is anticipated that wildlife species which may be disturbed during the use would find sufficient food resources and resting places elsewhere on the refuge so their abundance and use will not be measurably lessened on the refuge. Additionally, it is anticipated that monitoring, as needed, will prevent unacceptable or irreversible impacts to fish, wildlife, plants, and their habitats. As a result, these projects will not materially interfere with or detract from fulfilling refuge purposes (including wilderness) and they would contribute to the Mission of the NWRS as well as maintaining the biological integrity, diversity, and environmental health of the refuges.

Mandatory 10- or 15-year Re-evaluation Date

Provide month and year for "allowed" uses only.
_______ Mandatory 15-year re-evaluation date (for wildlife-dependent public uses).
____X__ Mandatory 10-year re-evaluation date (for all uses other than wildlife-dependent public uses).

NEPA Compliance for Refuge Use Decision

______ Categorical Exclusion without Environmental Action Statement
_______ Categorical Exclusion and Environmental Action Statement
_______ Environmental Assessment and Finding of No Significant Impact
_______ Environmental Impact Statement and Record of Decision

Refuge Determination

Prepared by
Refuge Manager: ________________________________ ____________
(Signature) (Date)

Concurrence

Refuge Supervisor:
________________________________ ____________
(Signature) (Date)

Regional Chief, National
Wildlife Refuge System:
________________________________ ____________
(Signature) (Date)

Draft Compatibility Determination

Use: Environmental Education

Refuge Name: San Juan Islands National Wildlife Refuge

Refuge Purposes and Establishing/Acquisition Authorities

> *". . . reserved under jurisdiction of the Bureau of Sport Fisheries and Wildlife, United States Fish and Wildlife Service. . ."* (all lands, PLO 2249).
>
> *". . .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."* (all lands, Proposal published in 38 FR 29831 on Oct 29, 1973 prior to PLO 5515, 1975)
>
> *"as a preserve, breeding ground and winter sanctuary for native birds."* (Smith and Minor Islands, E.O. 1959 of 1914)
>
> *". . .to secure for the American people of present and future generations the benefits of an enduring resource of wilderness"* (353 acres, all units of the refuge except for Smith, Minor, Turn, and a 5 acre portion of Matia Island, P.L. 94-557 of October 1976 and P.L. 88-577, the Wilderness Act of 1964.)
>
> *"lighthouse purposes."* Navigation aids maintained under the jurisdiction of the U.S. Coast Guard (~19 units, Executive Orders from 1854 and 1875).

National Wildlife Refuge System Mission

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

Description of Use

In the NWRS Improvement Act, the United States Congress declared environmental education as one of six priority wildlife-dependent public uses of the NWRS. Environmental education activities seek to increase public knowledge and understanding of wildlife and habitats and contribute to its conservation. On-refuge environmental education on San Juan Islands NWR will consist of interpretive panels, volunteer stewardship projects and opportunities to pursue environmental studies in accordance with Service policies and criteria to a limited number of college level students. Offering students the opportunity to conduct environmental studies will increase their knowledge and understanding of refuge resources and contribute to our knowledge base.

Interpretive panels will be located on Matia and Turn Islands, which are the only islands open to the public.

Stewardship projects will be geared to accomplishing a management need while at the same time educating the participating volunteer(s). Projects may take place on any island and include, but are not limited to: debris clean up from island beaches, invasive vegetative species control, observation and monitoring of wildlife, and maintenance of refuge trails, signs, and facilities.

The Complex will issue permits to allow students from regional colleges and universities to conduct environmental studies on San Juan Islands NWR Island. Environmental studies will be of limited duration, complexity, and scale, and will be geared toward students gaining field experience and knowledge of the NWRS, San Juan Islands NWR, and its management. These study activities may take place on any island in the refuge.

Availability of Resources

Complex staff responsibilities for environmental education that takes place at interpretive panels will consist of maintaining the panels and monitoring vegetative impacts associated with placement and use.

Stewardship projects will require more intense Complex staff participation. Beach clean up projects will need to be coordinated to take advantage of wildlife seasonal use and tides. Some islands will require the refuge to transport volunteers to the site and back and facilitate removal of debris. Other islands may be cleaned through local “adopt an island” groups which will handle transportation and debris removal and disposal. In these cases, Complex staff will have limited participation, such as determining the best time of the year to conduct clean up operations. Invasive species control and maintenance of trails, signs, and facilities will require Complex staff participation. Wildlife observation and monitoring may run the gamut of intense to minimal staff participation depending on the area, specie, and complexity of monitoring effort.

Staff responsibilities for projects/studies proposed by students will include the following: review of proposals, prepare special use permits (SUPs) and compliance documents, monitor project/study implementation to ensure that impacts and conflicts remain within acceptable levels to ensure compatibility over time. Additional administrative support, logistical and operational support may also be provided depending on each specific request. Estimated costs for one-time (e.g., prepare SUP) and annually re-occurring tasks by Complex staff will be determined for each project. Limited funds for the Complex’s administration of these projects/studies (estimated $3,000 per requested project) may be available within the general operating budget of the Washington Maritime NWR Complex, which administers San Juan Islands NWR.

The Complex has the following staffing and funding to administratively support and monitor the minimum number of stewardship projects (5) and environmental studies (1) identified in the CCP to take place over a five-year period. Any substantial increase in the number of projects/studies would create a need for additional resources to oversee the administration and monitoring of the studies. Any substantial additional costs above those itemized below will result in finding a project not compatible unless expenses are offset by the student(s) and/or the college and university.

Category	**One Time Expense**	**Recurring Expense**
Administration (Evaluation of Applications, Management of Permits, Oversight)	$6,000	$3,000
Monitoring and participation	$12,000	$3,000
Totals for five year period	$18,000	$6,000

Anticipated Impacts of the Use

Environmental education through use of interpretive panels will take place on Matia and Turn Islands and will consist of panels placed at strategic locations in areas open to the public. Matia Island will have one panel at the Rolfe Cove access point, one at the wilderness trailhead, and one at the west end of the campground. Turn will have three large interpretive panels: one located at the main access point, one east of the camping area at trail head, and one in the camping area. In addition there will be up to five small panels placed at various locations along the trail sufficiently spaced as to not concentrate use. Localized effects could include limited vegetation trampling and compaction of soils at these locations as the visiting public gathers to study the panels

Educational stewardship projects will be designed to minimize disturbance to wildlife and habitat. Impacts will be site specific and may include short term disturbance to species using refuge shorelines during beach clean up projects. Island vegetation may be minimally impacted as invasive vegetative species are removed. Wildlife observation and monitoring may disturb some specie as volunteers move from one monitoring location to another. Maintenance of facilities and equipment may also result in very local disturbance depending on time and place of need.

Use of San Juan Islands NWR to conduct college level environmental education will generally benefit plant populations, wildlife, and habitats. The impacts of individual studies would be site-specific, and would vary depending on the scope and type of study. Scientific findings gained through these studies will provide additional information for the Service to use in managing the refuge. In addition, it is the goal of this use to increase the student’s knowledge and understanding of the refuge’s unique wildlife and habitats, its linkage to the marine environment, and contribute to its and similar area’s conservation. Data collection techniques will generally have minimal impacts on animal mortality or disturbance, or habitat destruction; no introduction of contaminants; or no introduction of non-indigenous species. Studies involving the collection of biotic samples (plants or animals) or requiring intensive ground-based data or sample collection will have short-term impacts. To reduce impacts, the minimum number of samples (e.g., water, soils, vegetative litter, plants, macroinvertebrates, and vertebrates) will be collected for identification and/or experimentation and statistical analysis.

Some level of disturbance is expected with all study activities since most students will be entering areas that are normally closed to the public and, depending on specific study activities, may also be collecting samples or handling wildlife. However, minimal impact to refuge wildlife and habitats will be expected with studies because SUPs will include conditions to ensure that impacts to wildlife and habitats are kept to a minimum.

Direct damage or alteration to the habitat from students would be minor due to the study proposal evaluation process and stipulations imposed through the SUP. However, some increase in invasive plants is possible from ground disturbance and/or transportation of source seed on equipment and personnel, and rodents and disease organisms could potentially be transferred from boats and trapping equipment. Likewise there could be localized and temporary effects from vegetation trampling, colleting of soil and plant samples, or trapping and handling of wildlife. Impacts may also occur from infrastructure necessary to support projects (permanent transects or plot markers, exclosure devices, monitoring equipment, etc).

Spread of invasive plants and/or pathogens is possible from ground disturbance and/or transportation of project equipment and personnel, but it will be minimized or eliminated by requiring proper cleaning of investigator equipment and clothing as well as quarantine methods, where necessary**.** If after all practical measures are taken and unacceptable spread of invasive species is anticipated to occur, then the study will be found not compatible.

The combination of stipulations identified below and conditions included in any SUP(s) will ensure that proposed studies contribute to the enhancement, protection, conservation, and management of native wildlife populations and their habitats on the refuge(s). As a result, these studies will help fulfill refuge purposes; contribute to the mission of the NWRS; and maintain the biological integrity, diversity, and environmental health of the refuge.

Public Review and Comment

Public review and the opportunity to comment on this compatibility determination will occur in conjunction with the release of the Draft CCP/WSP/EA.

Determination

______ The use is not compatible.
__X__ The use is compatible with the following stipulations.

Stipulations Necessary to Ensure Compatibility

User Stipulations:
- Potential students must submit a written, detailed study proposal to the Project Leader at least 1 month prior to start of field work. The required proposal format would be provided to researchers.
- Students are responsible for acquiring and/or renewing any necessary State and Federal permits prior to beginning or continuing their project.
- The Complex staff will be provided with copies of raw data (preferably electronic database format) at the conclusion of the study.
- Upon completion of the study or annually, study sites must be cleaned up to the Project Leader’s satisfaction and all physical markers removed. For long-term studies, conditions for clean-up, and removal of equipment and physical markers would be stipulated in the SUP.

- Students and support staff will follow all refuge-specific regulations that specify access and travel on the refuge(s).

Administrative Stipulations:

- Design and conduct educational stewardship projects to minimize impacts to wildlife. Beach clean up projects will be conducted outside seabird and marine mammal breeding/pupping seasons. Invasive species control will be conducted at the best time of year to ensure successful control efforts balanced against potential wildlife disturbance. Any control around major seabird colonies will take place outside the breeding season. Sign, trail, and facility maintenance will take place outside breeding and pupping areas except in emergency situations.
- Highly intrusive or manipulative studies generally will not be permitted in order to protect native bird and marine mammal populations.
- A Section 7 consultation under the Endangered Species Act would be required for studies that may affect a federally threatened, endangered, or proposed species. Only projects which have no effect or will result in not likely to adversely affect determinations will be considered compatible.
- Studies that do not involve birds generally will only be allowed outside of the breeding season of avian species using the specific island(s), unless it can be demonstrated that there likely will be no impact to those breeding species. If a study can only be conducted during the breeding season, such studies will only be permitted where there are specific protocols to minimize disturbance.
- Studies will adhere to scientifically defensible protocols for data collection, where available and feasible.
- Approved studies will be conducted under a Complex-issued SUP which will have additional project-specific stipulations.
- Annual or other short-term SUPs are preferred; however some permits will be for a longer period, if needed, to facilitate the study. All SUPs will have a definite termination date in accordance with 5 RM 17.11. Renewals will be subject to Project Leader review of research data, status reports, compliance with compatibility determination and permit stipulations, and permits.
- If unacceptable impacts or issues arise or are noted by the Complex staff, then the Project Leader can suspend/modify conditions/terminate on-refuge studies that are already permitted and in progress.
- All samples collected on refuge lands are the property of the Service even while in the possession of the students. Any future work with previously collected samples not clearly identified in the study proposal will require submission of a subsequent proposal for review and approval. In addition, a new SUP will be required for additional project work. For samples or specimens to be stored at other facilities (e.g., museums), a Memorandum of Understanding will be necessary.

Justification

Environmental education stewardship projects and studies on refuge lands are inherently valuable to the USFWS because they will enhance the public's knowledge of the refuge and its resources and expand scientific information available for resource management decisions. In addition, only studies which directly or indirectly contribute to the enhancement, protection, use, preservation, and management of refuge wildlife populations and their habitats generally will be authorized on refuge lands. In many cases, if it were not for the Complex staff providing access to refuge lands and waters along with some support, the study would never occur and less scientific information would be available to the USFWS and others to aid in managing and conserving these species. By allowing the use to occur under the stipulations described above, it is anticipated that wildlife species which may be disturbed during the use would find sufficient food resources and resting places elsewhere on the refuge so their abundance and use will not be measurably lessened. Additionally, it is anticipated that monitoring, as needed, will prevent unacceptable or irreversible impacts to fish, wildlife, plants, and their habitats. As a result, these studies/projects will not materially interfere with or detract from fulfilling refuge purposes (including wilderness) and they would contribute to the Mission of the NWRS as well as maintaining the biological integrity, diversity, and environmental health of the refuges.

Mandatory 10- or 15-year Re-evaluation Date

Provide month and year for “allowed” uses only.
___X__ Mandatory 15-year re-evaluation date (for wildlife-dependent public uses).
_______ Mandatory 10-year re-evaluation date (for all uses other than wildlife-dependent public uses).

NEPA Compliance for Refuge Use Decision

______ Categorical Exclusion without Environmental Action Statement
_______ Categorical Exclusion and Environmental Action Statement
_______ Environmental Assessment and Finding of No Significant Impact
_______ Environmental Impact Statement and Record of Decision.

Refuge Determination

Prepared by
Refuge Manager: ______________________________ ___________
(Signature) (Date)

Concurrence

Refuge Supervisor: ______________________________ __________
(Signature) (Date)

Regional Chief, National
Wildlife Refuge System:

______________________________ ___________
(Signature) (Date)

Draft Compatibility Determination

Uses: Wildlife observation, photography, and interpretation

Refuge Name: San Juan Islands National Wildlife Refuge

City/County and State: San Juan County, Island County, and Skagit County, Washington

Refuge Purposes and Establishing/Acquisition Authorities:

> *". . . reserved under jurisdiction of the Bureau of Sport Fisheries and Wildlife, United States Fish and Wildlife Service. . ."* (all lands, PLO 2249).
>
> *". . .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."* (all lands, Proposal published in 38 FR 29831 on Oct 29, 1973 prior to PLO 5515, 1975)
>
> *"as a preserve, breeding ground and winter sanctuary for native birds."* (Smith and Minor Islands, E.O. 1959 of 1914)
>
> *". . .to secure for the American people of present and future generations the benefits of an enduring resource of wilderness"* (353 acres, all units of the refuge except for Smith, Minor, Turn, and a 5 acre portion of Matia Island, P.L. 94-557 of October 1976 and P.L. 88-577, the Wilderness Act of 1964.)
>
> *"lighthouse purposes."* Navigation aids maintained under the jurisdiction of the U.S. Coast Guard (~19 units, Executive Orders from 1854 and 1875).

National Wildlife Refuge 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" (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd-668ee]).

Description of Uses:

Conduct and allow access for wildlife-dependent priority public uses (wildlife observation, photography, and interpretation) as provided for under the National Wildlife Refuge System Improvement Act of 1997. These uses will occur on-refuge on Matia and Turn Islands with specific conditions as noted in this determination.

On Matia these uses will occur along the refuge trail and at the access point and shoreline at Rolfe Cove. Three proposed interpretive panels will be installed at the access area and trailhead.

Additional regulation signs will be placed at non-permitted access points, which tend to be the pocket beaches on the west, south, and east sides of the island. Current facilities include a 1.3 mile trail, four large refuge information signs, regulatory signage, and trailhead signs maintained by the Service; and an information kiosk, picnic tables, composting toilet, seasonal dock (April-October), and two mooring buoys maintained by Washington State Parks under a Memorandum of Understanding with the Service. Washington State Parks also assists with trail maintenance.

On Turn Island these uses will occur along the refuge trail and the access areas and associated shoreline on the southwest end of the island. Three proposed interpretive panels will be placed in the access area and up to five along the trail. A large refuge sign, trailhead signs, and some regulatory signs are maintained by the Service along with the trail. A kiosk, two composting toilets, picnic tables with grills, and three mooring buoys are maintained by Washington State Parks at the access areas under a Memorandum of Understanding with the Service. Washington State Parks also assists with trail maintenance.

Public use access is year-round, day use only, except for camping areas managed by Washington State Parks at the access areas. Camping is addressed in a separate Appropriateness Finding and Compatibility Determination.

Wildlife observation, photography, and interpretive activities seek to increase awareness, enjoyment, and understanding of the refuge's wildlife and plant resources. Interpretive panels will be located at the access areas and trailheads at Matia and Turn Islands and at several locations along the trail on Turn Island. Wildlife observation and photography will take place from refuge trails or from boats circumnavigating the islands.

Availability of Resources:

The following funds will be required to run a program as designed under the CCP. The projected need represents an increase of approximately 150% in recurring expenses compared to current funding for this program. For the one-time expenses, all available sources will be investigated.

Category	**One-time Expense**	**Recurring Expense**
Administration and management:	$15,000	$1,000
Maintenance:		$2,500
Monitoring:	$2,500	$2,500
Special equipment, facilities, or improvements:	$120,000	
Totals:	$137,500	$6,000

Anticipated Impacts of the Use(s):

The refuge wildlife-dependent uses being evaluated (wildlife observation, photography, and interpretation) will impose some negative impacts on specific physical resources such as trails and on natural resources such as wildlife and vegetation. Impacts may include erosion, deterioration, trampling, and disturbance.

Wildlife Observation:
Physical and habitat alteration: The impact of these activities depends upon the size of the group(s), the season of use, the location within the Public Use Area on Matia and Turn Islands, and the duration of the activity. These two islands receive heavy use for four months of the year with very little use the rest of the year. The potential exists for a maximum of approximately 100 visitors on each island at any one time although this would be a rare occurrence. The construction and maintenance of visitor use facilities (i.e. trails, observation points, interpretive sites, composting toilets, and picnic tables) would have some effect on soils, vegetation and possibly hydrology in specific areas. This could potentially increase erosion and cause localized soil compaction (Liddle 1975); reduced seed emergence (Cole and Landres1995); alteration of vegetative structure and composition; and sediment loading (Cole and Marion 1988). The fact that the islands receive very little use for 8 months of the year ameliorates these impacts.

Human disturbance - general: The presence of people observing or photographing wildlife will also cause some impact to wildlife. Numerous studies have confirmed that people on foot can cause a variety of disturbance reactions in wildlife, including flushing or displacement (Erwin 1989; Fraser et al. 1985; Freddy 1986), heart rate increases (MacArthur et al. 1982), altered foraging patterns (Burger and Gochfeld, 1991), and even, in some cases, diminished reproductive success (Boyle and Samson 1985). These studies and others have shown that the severity of the effects depends upon the distance to the disturbance and its duration, frequency, predictability, and visibility to wildlife (Knight and Cole 1991). The variables found to have the greatest influence on wildlife behavior are a) the distance from the animal to the disturbance, and b) the duration of the disturbance. Animals show greater flight response to humans moving unpredictably than to humans following a distinct path (Gabrielsen and Smith 1995). Short-term and immediate responses to disturbance are fairly simple to document. A question that has received less research attention is whether these short term responses, which generally require increased energetic expenditures on the part of the individual, ultimately diminish an individual or population's capacity to survive and breed successfully (fitness). Energetic demands of responding to disturbance events were measured by Belanger and Bedard (1989). In Quebec, they found that if disturbance was severe enough to cause geese to fly and not resume feeding upon alighting, hourly energy expenditure increased by 3.4%; hourly metabolized energy intake decreased by 2.9 to 19.4%. A 32% increase in nighttime feeding was required to restore the energy losses incurred.

Effect of disturbance intensity: Some researchers have attempted to correlate disturbance events in wildlife to the intensity, proximity, or loudness of human disturbance. Burger (1986), studying shorebirds on an eastern coastal refuge, found that the level of disturbance in the shorebirds increased (fewer remained, more flew) as the total number of disturbances and the number of children, joggers, people walking, dogs, aircraft, and boats increased, and the duration of the disturbance and distance from the disturbance decreased.

Effect of human proximity: Other researchers have looked at the question of proximity. At what distance do humans on foot elicit a disturbance response? From an examination of the available studies, it appears that the distance varies dramatically from species to species. Burger and Gochfeld (1991) found that sanderlings foraged less during the day and more during the night as the number of people within 100 m increased. Elk in Yellowstone National Park were disturbed when people were at average distances of 573 m (Cassirer 1990). These elk temporarily left the drainage and their home range core areas and moved to higher elevations, steeper slopes, and closer to forested areas. Average return time to the drainage was 2 days. Erwin [1989] studied colonial wading and seabirds in Virginia and North Carolina. Mixed colonies of common terns-black skimmers responded at the greatest distances, with respective means of 142 and 130m; mixed wading bird species were more reluctant to flush (30-50 m average). There were few statistically significant relationships between flushing distance and colony size. Similarly, there were few differences between responses during incubation compared to post-hatching periods.

An analysis of over 4,000 human activity events near bald eagle nests in Central Arizona (Grubb and King 1991) found distance to disturbance to be the most important classifier of bald eagle response, followed in decreasing order of discriminatory value by duration of disturbance, visibility, number of units per event, position relative to affected eagle, and sound.

Breeding bald eagles in north-central Minnesota (Fraser et al. 1985) flushed at an average distance of 476 m at the approach of a pedestrian. A multiple regression model including number of previous disturbances, date and time of day explained 82% of the variability in flush distance and predicted a maximum flush distance at the first disturbance of 503 m (SE=131). Skagen (1980), also studying bald eagles in northwest Washington, found a statistically significant decrease in the proportion of eagles feeding when human activity was present within 200 m of the feeding area in the previous 30 minutes. A statistically significant between-season variation occurred in the use of feeding areas relative to human presence, which correlated with food availability. Eagles appeared more tolerant of human activity in the season of low food availability.

In a review of several studies of the reaction of waterfowl and other wetland birds to people on foot, distances greater than 100 meters in general did not result in a behavioral response (DeLong 2002).

Effects on migrant birds versus resident birds: Klein (1989) studied the effect of visitation on migrant and resident waterbirds at Ding Darling National Wildlife Refuge, finding that resident birds were less sensitive to human disturbance than migrants. Migrant ducks were particularly sensitive when they first arrived on site in the fall. They usually remained more than 80 m from [a visitor footpath on a dike], even at very low visitor-levels. Herons, egrets, brown pelicans, and anhingas were most likely to habituate to humans, thus exposing them to direct disturbance as they fed on or near the dike. Shorebirds showed intermediate sensitivity. Strauss (1990) observed piping plover chicks spent less time feeding (50% versus 91%) and spent more time running (33% versus 2%), fighting with other chicks (4% versus 0.1%), and standing alert (9% versus 0.1%) when pedestrians or moving vehicles were closer than 100 m than when they were undisturbed. In addition plover chicks spent less time out on the feeding flats (8% versus 97%) and more time up in the grass (66% versus 0.1%) during periods of human disturbance.

Wildlife Photography:
Wildlife photography is likely more disturbing, per instance, than wildlife observation. Klein (1993) observed at Ding Darling NWR, that of all the non-consumptive uses, photographers were the most likely to attempt close contact with birds, and that even slow approach by photographers disrupted waterbirds.

Dwyer and Tanner (1992) noted that wildlife habituate best to disturbance that is somewhat predictable or "background." Investigating 111 nests of sandhill cranes in Florida, Dwyer and Tanner found that nesting cranes seemed to habituate to certain forms of human disturbance and nested within 400 m of highways, railroads, and mines; cranes also were tolerant of helicopter flyovers. Even so, investigator visits to nests and development-induced alterations of surface water drainage were implicated in 24% of the nest failures.

Interpretation:
Enhanced interpretation will take place on refuge on Matia and Turn Islands and consist of panels placed at strategic locations. Three interpretive panels will be installed on Matia Island. One panel will be placed at the Rolfe Cove access area; one approximately 100 feet west at the west end of the campground; and one at the Wilderness Trail trailhead. On Turn Island, three larger panels will be installed: one at the main access area, one approximately 150 feet southeast in the campground area, and one approximately 200 feet east at eastern trailhead. In addition, up to five additional smaller panels will be placed along the island trail at key interpretive locations. None of these panels will be located in close proximity to each other. Localized effects could include limited vegetation trampling and compaction of soils at these locations as the visiting public gathers to study the panels.

Summary:
All of the uses described occur in specific footprints on the refuge – Matia and Turn Island trails, access areas, and associated beaches. Estimated current use of less than 18,000 visits per year (Washington State Parks monthly attendance reports) does cause adverse effects though. The fact that all uses are confined to a limited number of areas, means that overall impacts are not extensive nor do they impact the greater part of the refuge. Interpretive panels are sufficiently spaced so as not to congregate use and impacts. Most use is during the summer months with very little use occurring in the spring and winter allowing for some revegetation.

Access from points other than Rolfe Cove on Matia Island have resulted in illegal spur trails. This has resulted in vegetation trampling, deterioration, and some erosion, particularly coming from pocket beaches on the west, south, and east sides of the island. Replacement of three informational/regulatory signs and installation of three additional signs at these access points is expected to curb this use.

The Turn Island trail has been developed from a social trail that follows the perimeter of the island. This has resulted in the trail being located in a sensitive meadow area where tramping of vegetation occurs. In addition there are two steep trails leading up from a beach area that have resulted in erosion. Although these impacts are short-term in the meadow area and long-term at the beach access, they can be remediated through rerouting of the trail around sensitive areas, interpreting the sensitivity of these areas with interpretive panels, and closure and rehabilitation of beach access trails.

The most heavily used areas around the composting toilets and picnic tables result in severely trampled or complete absence of vegetation with some erosion. This may also occur at interpretive sites when they are established. These areas make up approximately 1% of the total Turn and Matia Islands' acreage. The trampling at picnic table sites can be remediated by periodically moving the tables to new locations, however the toilet locations are fixed.

Public Review and Comment:

Public review and the opportunity to comment on this compatibility determination will occur in conjunction with the release of the Draft CCP/WSP/EA.

Determination: (check one below)

___ Use is Not Compatible

_X_ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility:

User stipulations:

- Visitors will be required to access islands only at designated access points/areas, thus reducing potential for wildlife disturbance and establishment of illegal trails.
- Visitors will be required to stay on legally established, trails thus limiting the amount of area on the islands where impacts may take place.
- Use is restricted to daylight hours outside of camping area.

Administrative stipulations:

- Directional, informational, and interpretive signs will be posted and maintained to help keep visitors on trails and help educate the public on minimizing wildlife and habitat disturbance.
- Monitor impacts to wildlife, vegetation, and soil and employ adaptive management when needed. Management responses may include such actions as moving picnic tables and interpretive panels to new locations, rerouting island trails, and rehabilitation of impacted sites.
- Promote the "Leave No Trace" philosophy. At least 75 % of the refuge will be managed as wildlife sanctuary, free from routine disturbance.

Justification:

Specific areas in the San Juan Islands National Wildlife Refuge (trails and access areas on Matia and Turn Islands) have been designated for these uses. These areas will be monitored periodically for impacts that would degrade the natural environment specific management actions would be implemented if impacts reached unacceptable levels. Wildlife observation, photography, and interpretation are three of the six wildlife-dependent recreational uses of the National Wildlife Refuge System as stated in the National Wildlife Refuge System Administration Act, as amended. Wildlife observation, photography, and interpretation through interpretive panels provide an excellent forum for increasing public understanding of the refuge's natural resources. By limiting these activities to a small percentage of the refuge and by providing wildlife sanctuary from human disturbance in other areas of the refuge, these programs will not interfere with the refuge achieving its purpose 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" and with regard to all by five acres of Matia Island "…to secure for the American people of present and future generations the benefits of an enduring resource of wilderness." These activities are used throughout the country to inform and educate visitors to public lands. (Grater1976).

Given the scale of the activity, the stipulations outlined above, as well as the best management practices identified, potential impacts relative to wildlife/human interactions will be minimal. The opportunity to engage in several priority public uses provided would outweigh any anticipated negative impacts associated with implementation of the program.

With the stipulations noted, access trails, interpretive panels, and information/regulatory signs activities will be compatible with Refuge purposes, while providing opportunities for visitors to use and learn about Refuge and marine resources. Thus allowing the priority public uses in this determination will not materially interfere with or detract from the fulfillment of the National Wildlife Refuge System mission or the purposes of this Refuge.

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Mandatory 10- or 15-Year Re-evaluation Date: (provide month and year for “allowed” uses only)

_____X_____ Mandatory 15-year reevaluation date (for wildlife-dependent public uses)

__________ Mandatory 10-year reevaluation date (for all uses other than wildlife-dependent public uses)

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

___ Categorical Exclusion without Environmental Action Statement

___ Categorical Exclusion and Environmental Action Statement

___ Environmental Assessment and Finding of No Significant Impact

___ Environmental Impact Statement and Record of Decision

Refuge Determination

Prepared by
Refuge Manager: ______________________________ ___________
(Signature) (Date)

Concurrence

Refuge Supervisor: ______________________________ ___________
(Signature) (Date)

Regional Chief, National
Wildlife Refuge System: ______________________________ ___________
(Signature) (Date)

Draft Compatibility Determination

Use: Camping

Refuge Name: San Juan Islands National Wildlife Refuge

City/County and State: San Juan County, Island County, and Skagit County, Washington

Refuge Purposes and Establishing/Acquisition Authorities:

> *". . . reserved under jurisdiction of the Bureau of Sport Fisheries and Wildlife, United States Fish and Wildlife Service. . ."* (all lands, PLO 2249).
>
> *". . .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."* (all lands, Proposal published in 38 FR 29831 on Oct 29, 1973 prior to PLO 5515, 1975)
>
> *"as a preserve, breeding ground and winter sanctuary for native birds."* (Smith and Minor Islands, E.O. 1959 of 1914)
>
> *". . .to secure for the American people of present and future generations the benefits of an enduring resource of wilderness"* (353 acres, all units of the refuge except for Smith, Minor, Turn, and a 5 acre portion of Matia Island, P.L. 94-557 of October 1976 and P.L. 88-577, the Wilderness Act of 1964.)
>
> *"lighthouse purposes."* Navigation aids maintained under the jurisdiction of the U.S. Coast Guard (~19 units, Executive Orders from 1854 and 1875).

National Wildlife Refuge System Mission:

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

Description of Use:

Matia and Turn Islands are uniquely managed as National Wildlife Refuges and Washington State Marine Parks through an agreement between the Service and the Washington State Parks and Recreation Commission (WSPRC). The Service first entered into a long-term agreement with WSPRC in 1959 in response to uncontrolled public uses which created littering and sanitation problems on refuge lands. Washington State Parks established and maintains facilities needed for day use and overnight camping to support wildlife-dependent recreation at designated areas on Matia and Turn Islands. They also provide information to refuge visitors and enforce regulations.

Under the preferred alternative (Alt B) there would be 8 campsites on Turn Island and 6 campsites on Matia Island; camping would be limited to visitors arriving by human-powered watercraft and there would be a new camping reservation system. Motor powered vessels have greater flexibility to safely travel to other adjacent State Marine Parks. Changes to the camping program would be phased in as soon as practical.

On Matia Island facilities include 6 primitive campsites, kiosk, pay station, seasonal dock, composting toilet, picnic tables, and some signage in an approximately 2-acre area adjacent to Rolfe Cove. This area is outside the designated wilderness which encompasses most of Matia Island. On Turn Island, none of which is wilderness, facilities located on the southwest side of the island would include 8 (instead of the current 13) primitive campsites, two composting toilets, picnic tables, kiosk, two pay stations, and some signage. Camping is allowed year-round, however, most occurs from April through September. The heaviest camping usage is expected to continue to be during June, July, and August with most campsites occupied on weekends and many weekdays during much of this time. Camping fees are charged and collected by WSPRC.

Because the majority of the San Juan Islands NWR is closed to the public, Matia and Turn Islands offer a nonpareil opportunity to the visiting public to observe island wildlife and learn about and experience various island habitats. With this in mind, the Service plans to expand its interpretation on these two islands to enhance visitors', including campers', knowledge, enjoyment, and stewardship of wildlife and habitats within the San Juan Islands Refuge and all of the Salish Sea. Interpretive panels will be installed at strategic locations on the islands including the campground area. Matia Island will have one panel at the Rolfe Cove access point, one at the wilderness trailhead, and one at the west end of the campground. Turn will have three large interpretive panels: one located at the main access point, one east of the camping area at trail head, and one in the camping area. In addition there will be up to five small panels placed at various locations along the trail sufficiently spaced as to not concentrate use.

Availability of Resources:

Current staffing and budget is sufficient to monitor use periodically during the summer camping season. Washington State Parks maintains all of the facilities associated with camping and performs law enforcement duties, enforcing all state park regulations and the laws of the State of Washington. If, for any reason, State Parks decides to terminate the MOU and the Service wished to retain camping and associated facilities, existing refuge resources will not be adequate to administer the program.

Category	**One-time ($)**	**Annual ($/yr)**
Administration and management:	$1,000	$1,000
Maintenance:	$0	$750
Monitoring:	$0	$2,500
Totals	$1,000	$4,250

Anticipated Impacts of the Use:

The presence of humans on Turn and Matia Islands displaces some wildlife species and is an attractant to others. Marine mammals, seabirds, and black oystercatchers will avoid areas where people are frequently present and engaging in activities such as landing boats and camping. They are displaced to other areas with less human disturbance, including closed islands within the San Juan Islands NWR. Ravens and raccoons, on the other hand, are attracted to places where people camp and eat because they often have easy access to food. Ravens and raccoons also prey on the eggs and young of native passerine birds. When raven and raccoon numbers increase due to human activities, predation on native birds likely increases as well. Wildlife found on Turn and Matia Islands are likely to experience more incidents of human disturbance in general which can distract them from resting, foraging, and caring for their young. These negative impacts are considered acceptable because of the presence of "sanctuary" areas on the San Juan Island NWR where seabirds, shorebirds, marine mammals, and other wildlife can go to avoid human disturbance. Allowing camping on Turn and Matia Islands also provides the opportunity to educate visitors and increase their appreciation and stewardship of marine wildlife. This would benefit wildlife throughout the refuge and Salish Sea.

Camping results in some vegetation trampling, soil compaction, and localized denuding of vegetation at campsites and where people concentrate. The new reservation system and enhanced enforcement is expected to decrease unauthorized camping outside of designated campsites. Limiting night use of the island to authorized campers only would also decrease the extremely heavy use of the island during popular weekends and holidays such as Independence Day. This along with 5 fewer campsites (8 instead of 13) on Turn Island would allow vegetation and soils to recover in those areas. Encouraging people to use liquid fuel campstoves and enforcing the "no open fires" regulation would minimize unauthorized wood collecting and cutting. This would retain more down wood and driftwood, which are important wildlife habitat components. Enforcement of "no open fires" would also reduce the risk of an open fire escaping and burning refuge habitats. Even after decades of being popular camping areas, the majority of habitats on Turn and Matia islands are in very good condition. The impacts of camping are found on just a few acres and should continue to be controllable within acceptable limits into the future with changes to the program

Public Review and Comment:

Public review and the opportunity to comment on this compatibility determination will occur in conjunction with the release of the Draft CCP/WSP/EA.

Determination:

___ Use is Not Compatible

_X_ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility:

User stipulations:
- Only visitors arriving by human-powered watercraft are authorized to camp.
- All commercial operators wishing to use Turn and Matia campgrounds (e.g., kayak tour guides) must obtain a special use permit and have a copy in their possession while occupying refuge lands.
- Camping is limited to designated campsites. For example camping is prohibited on closed shorelines.
- Overnight use of refuge limited to authorized campers with a maximum of 8 people per campsite.
- Fires (cooking or camp) are not permitted.   Liquid fuel stoves only permitted.
- Pets are not allowed on refuge lands at any time.

Administrative stipulations:
- There is sufficient staff and funding resources available within WSPRC and/or USFWS to maintain the facilities associated with camping (composting toilets, campsite markers, etc.) and administer the program.
- A reservation system for camping on Matia and Turn Islands is initiated as soon as practical.
- Campers feel safe on refuge lands and the number of reported unsafe incidents and undesirable behaviors is minimal

Justification:

This camping program facilitates and supports the priority public uses of wildlife observation, photography, interpretation, and environmental education both on-refuge as well as off-refuge. Allowing limited camping use offers a nonpareil opportunity to the visiting public to observe refuge wildlife and learn about and experience various island habitats at times when animals are particularly active, such as dawn and dusk, and to listen to the sounds of wildlife at night. Wildlife observation and photography in particular are very popular activities throughout the San Juan Archipelago. Many of the closed refuge islands within the San Juan Islands Refuge are popular for wildlife observation at a distance from a boat. Because human-powered watercraft are slower than motorboats, allowing these visitors to camp on Turn and Matia islands facilitated their opportunity to travel greater distances to observe and photograph wildlife throughout the San Juan Archipelago including other refuge islands.

Camping allows visitors arriving by human-powered watercraft to find safe haven to rest, and if necessary, to allow wind and inclement weather to abate. Matia Island is at the extreme northeast end of the San Juan Archipelago and takes many hours to reach by human-powered watercraft. Providing camping allows these users sufficient time to enjoy the refuge's wildlife-dependent recreation once they arrive. Camping on Turn Island allows visitors in the central portion of the San Juan Islands Archipelago a similar opportunity. Distances to adjacent safe harbor camping locations from Turn Island vary from approximately 6 nautical miles to the north to 3 ½ nautical miles to the south.

Given the scale of camping, the stipulations outlined above, as well as best management practices identified, potential impacts relative to wildlife/human interactions are expected to be minimal. By limiting camping to two small areas within the 83 island refuge, the opportunity to engage in several priority public uses provided through camping would outweigh any anticipated negative impacts associated with implementation of the program. Thus allowing camping to occur in the circumstances described above will not materially interfere with the purpose for which the refuge was established or the Mission of the National Wildlife Refuge System.

Mandatory 10- or 15-Year Re-evaluation Date: (provide month and year for "allowed" uses only)

__________ Mandatory 15-year reevaluation date (for wildlife-dependent public uses)

____X______Mandatory 10-year reevaluation date (for all uses other than wildlife-dependent public uses

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

___ Categorical Exclusion without Environmental Action Statement

___ Categorical Exclusion and Environmental Action Statement

___ Environmental Assessment and Finding of No Significant Impact

___ Environmental Impact Statement and Record of Decision

Refuge Determination

Prepared by
Refuge Manager: ______________________________ ___________
(Signature) (Date)

Concurrence

Refuge Supervisor: ______________________________ ___________
(Signature) (Date)

Regional Chief, National
Wildlife Refuge System:
______________________________ ___________
(Signature) (Date)

Appendix K. CCP Team Members, Public Involvement, and Compliance

CCP Team Members

The CCP was developed and prepared primarily by a core team made up of refuge and regional office staff. There was some turnover of refuge staff core team members during the planning process. The core team sought technical expertise from other professionals both within and outside the Fish and Wildlife Service throughout the CCP process. Portions of the document were researched and written with the assistance of a contracting firm, SWCA environmental consultations. The List of Preparers below includes the core team members as well as other persons responsible for writing specific portions of the plan. Many others provided assistance in developing and reviewing the CCP and associated products and in providing advice throughout the planning process. These people are captured in the List of Reviewers and Advisors.

List of Preparers

Name and title	CCP Contributions
Kevin Ryan, Project Leader	Decision-making and document quality reviewer; public involvement and communications plan lead; researcher/writer, compatibility determinations, implementation, compliance with NEPA, ESA, NHPA, etc.; Federal and State agency, and Tribal coordination.
Jane Bardolf , Conservation Planner	CCP Team Leader responsible for regional office coordination, and process and policy guidance for development of the CCP; CCP schedule and status reports; team meeting facilitator; document layout, management, and review; planning record; refuge purposes research; public involvement: public meetings, communications plan, and scoping report.
Lorenz Sollmann, Deputy Project Leader	Writer/reviewer: biological goals and objectives, affected environment and environmental consequences, contaminants, integrated pest management plan; research/analysis: invasive species, fire management, and habitat restoration; public involvement.
Sue Thomas, Refuge Biologist	Writer/reviewer: biological goals and objectives, affected environment and environmental consequences; climate change; research/analysis: habitats, wildlife, biological integrity, diversity, and environmental health; public involvement including outreach to local area and seabird biologists and managers.
Dave Falzetti, Refuge Officer and Visitor Services Manager	Writer/reviewer: visitor services goals and objectives, affected environment and environmental consequences; sign inventory and maintenance plans; research/analysis: appropriateness findings and compatibility determinations; public involvement including planning updates.
Khemarith So , Geographer	Development of working, public involvement, and document maps; GIS data gathering and analysis; researcher/writer: habitats and vegetation, rare plants and plant communities, climate change; San

Name and title	CCP Contributions
	Juan Island unit descriptions and photographs: public involvement meetings.
Staci McCorkle, Natural Res. Scientist, SWCA Env. Consultants	Researcher/writer/editor: physical environment, regional recreation, socioeconomics, and environmental consequences; public involvement: communication plan, scoping comments compilation, and public meetings.
James Feldman, Environmental Planner, SWCA Env. Consultants	Researcher/writer: socioeconomic environmental consequences
Pam Sanguinetti, former Refuge Biological Tech.	Researcher/writer: preliminary biological goals, objectives, and biological environment, refuge vision statements; research/analysis: habitats, wildlife; communications plan and public involvement including planning updates.
Virginia Parks, Archeologist	Researcher/writer: cultural resources objectives, affected environment, and environmental consequences.
Jory Clark, Archeologist	Researcher/writer: paleontological resources objectives, affected environment, and environmental consequences.
Nicole Garner, Writer/editor	Technical edit review of CCP document and Federal Register Notices; design and edit of planning updates.
Sue Mayo, Administrative Assistant	Researcher/writer: list of common and scientific species names, San Juan Island descriptions; abbreviations and glossary; CCP mailing list
Annette de Knijf, former Deputy Project Leader	Writer: refuge vision statements; research/analysis: contaminants, rare plants, county plans
Kay Kier-Haggenjos, Writer/editor	Technical edit review of Federal Register notices; design and edit of planning updates
Pat Stark, Visitor Service	CCP cover design and print management
Chris Columbus, Maintenance Technician	Public involvement: field trip transportation

List of Reviewers and Advisors

Name and title	CCP Contributions
Robyn Thorson, Regional Director	Final decision-maker, CCP/EA and Federal Register notice approvals
Carolyn Bohan, Regional Chief of Refuges	Major decisions on CCP direction, CCP/EA and Federal Register notice approvals
Forrest Cameron, Refuge Supervisor	Refuge workload assistance; reviewer; decision-maker
Linda Watters, Assistant Refuge	Refuge workload assistance; reviewer; decision-

Name and title	**CCP Contributions**
Supervisor	maker
Chuck Houghten, Division Chief of Refuge Planning	CCP Advisor for planning policy and guidance; reviewer; coordination with other divisions and WO.
Scott McCarthy, Branch Chief, Planning	CCP Advisor for planning policy and guidance; Planning workload priorities; coordination with other divisions.
Mike Marxen, Branch Chief, Visitor Services	Visitor Services review and guidance design, public use goals and objectives; public involvement assistance, CD review
Matt Hasti, Visitor Services	Visitor Services advice and field trip
Ben Harrison, Division Chief, Natural and Cultural Resources	CCP Advisor, wilderness review, policy, appropriateness findings, compatibility determinations, environmental consequences review
Fred Paveglio, Branch Chief, Refuge Biology	Development and review of biological goals and objectives and biological integrity, diversity, and environmental health analysis
Kevin Kilbride, Wildlife Biologist/ Regional IPM Coordinator	Development and review of biological goals and objectives and biological integrity, diversity, and environmental health analysis
Joe Engler, Wildlife Biologist/Wilderness Coordinator	Review of wilderness stewardship plan, wilderness reviews, and minimum requirements analyses
Cathy Sheppard, Division Chief, Realty and Refuge Information	Advice on realty issues; CCP Review
Georgia Shirilla, Branch Chief, Refuge Acquisition	Advice on realty issues; CCP review
David Patte, ARD External Affairs	Communications plan review, assistance with tribal coordination meetings
Joan Jewett, External Affairs	News release review and distribution
Scott Aikin, Tribal Liaison	Identification of Tribes in the planning area, tribal coordination planning
Pat Gonzales-Rogers, Tribal Liason	Coordination with Tribes
Maura Naughton, Seabird Biologist	Advice on seabirds and development of biological goals
Greg Hagedorn, District Fire Management Officer	Advice on fire management

Public Involvement

Public involvement was sought throughout the development of the Draft CCP. During initial scoping, summer of 2007 to April of 2008, outreach efforts emphasized face-to-face meetings with key state and federal agencies, marine resource committees, federally elected officials, tribal governments, and the research community. After initial public scoping, preliminary management options were presented at two public open house meetings and additional agency coordination occurred. The Service also distributed two planning updates, initiated news releases, and gave presentations at community and other non-government organizations to inform the public, invite discussion and solicit feedback. Below is a brief summary of the meetings and other outreach tools that were used in our public involvement efforts.

Federally Elected Officials or their Aides

- March 13, 2008, Port Angeles, WA. Met with Judith Morris, Aide to Congressman Norm Dicks, 6th District
- March 6, 2008, Bellingham, WA. Met with Cherie Little, Aide to Congressman Rick Larson, 2nd District
- March 4, 2008, Federal Building, Seattle, WA. Met with Ardis Dumett, Aide to Senator Patty Murray
- April 4, 2008, Federal Building, Seattle, WA. Met with Christine Endersen-State Director; Sally Hintz –NW WA Director; and Michael English from Senator Maria Cantwell's office.

Tribal Governments

In July 2007, letters were sent to representatives of 14 federally recognized Tribes associated with the Refuges' 2 treaty areas. The letters invited the tribes to participate in the CCP process and to attend their choice of 2 meetings:

- August 15, 2007 in Mount Vernon, WA
- August 16, 2007 in Quilcene, WA.

Follow up calls were made to encourage their participation. No tribes attended these meetings and no comments from tribal representatives were received before, during, or after these two meetings. A follow-up letter asking if the Tribes wished to participate in the planning process and/or had comments to send us was sent along with Planning Update #1 during the first week of October, 2007. Planning Update #2 was also sent to the Tribes in August 2008. Some tribal representatives have attended Marine Resource Committee and Northwest Straits Commission meetings (see below) when the CCP was being discussed.

State Agency Representatives

Washington Department of Fish and Wildlife, Region 6, Coastal Washington

- October 16, 2007, Montesano WA. Met with Regional Director and District Wildlife Biologist
- July 2008, Field trip to Protection Island with District Wildlife Biologist

Washington Department of Fish and Wildlife Region 4, North Puget Sound

- October 22, 2007, Mill Creek, WA. Met with Regional Director, Wildlife Program Manager, District Biologist and 5 other biologists.

Washington Department of Fish and Wildlife Headquarters

- November 1, 2007, Olympia, WA. Statewide FWS CCP coordination meeting, met with Don Kraege, Dave Brittell, and several others.
- September 16, 2009, Olympia, WA. Statewide FWS CCP coordination meeting, met with Don Kraege and several others.

Washington Department of Natural Resources

- November 16, 2007, Seattle, WA. Met with Dave Roberts, Assistant Regional Manager; Larry Dominguez, Stewardship Program; Kyle Murphy, Aquatic Reserve Program: Terry Carton, San Juan District.
- July11, 2008, Sedro Woolley, WA. Met with Dave Roberts.

Washington State Parks, Northwest Regional Office

- November 27, 2007, Burlington, WA. Met with Terry Doran, NW Regional Director, Jim Neal; Supervisor to the San Juan Islands; Dave Castor, Ranger/Manager to Matia Island area.
- July 11, 2008, Burlington, WA. Met with Eric Watilo, NW Regional Director, and Jim Neal.
- July 17, 2008. Field trip to San Juan Islands with Jim Neal to review visitor services.
- October 16, 2009, Burlington, WA. Met with Jim Neal.

Federal Agency Representatives

NOAA/NMFS, Office of Protected Resources

- November 16, 2007 Seattle, WA - Met with Donna Darm, Assistant Regional Director and Brent Noberg, Marine Mammal Coordinator

USCG, 13th District Aids to Navigation

- January 24, 2008, Seattle, WA. Met with Lieutenant Commander Matthew Walker; Seaton; John Moriarty; John Barberi.

Marine Resource Committees (MRC) and Northwest Straits Commission

Jefferson County MRC

- June 5, 2007. Briefly introduced CCP at regular MRC meeting.
- June 9, 2007. Gave boat tour of Protection Island to 2 boat loads (~12 people).
- October 2, 2007. Gave presentation about CCP at regular MRC meeting of approximately 16 MRC members, guests, and staff.

Clallam County MRC

- February 11, 2008, Port Angeles, WA. Met with approximately 20 people met to discuss proposed aquatic reserve around Protection Island.

Island County MRC

- November 6, 2007, Coupeville, WA. Gave presentation about CCP at regular MRC meeting with 9 MRC members and 1 State Parks staff.

Skagit County MRC

- October 11, 2007, Anacortes, WA. Gave presentation about CCP at regular MRC meeting with 20 MRC members, guests, and staff.

San Juan County MRC

- October 17, 2007, Friday Harbor, WA. Gave presentation about CCP at regular MRC meeting with 19 MRC members, guests, and staff.
- May 18, 2009, Friday Harbor, WA. Gave brief update of CCP at Marine managers Workshop.

Northwest Straits Commission

- January 25, 2008, Jamestown S'Klallam Tribal Office, Sequim, WA. Gave presentation about CCP at regular meeting with Ginny Broadhurst and 2 others from Northwest Straits Commission, Kathy Fletcher of Puget Sound Initiative, one person from each of the 7 MRCs and a few others.

Research Community

Researchers Focus Groups

- December 6, 2007, Washington Maritime NWRC, Port Angeles, WA. Met with WA Department of Fish and Wildlife Researchers Scott Pearson and Steve Jeffries.
- December 6, 2007, Washington Maritime NWRC, Port Angeles, WA. Met with Julia Parrish professor at UW; Scott Pearson- WDFW; Peter Hodum, professor at University of Puget Sound, Tom Good, NOAA Fisheries.
- March 21, 2008. Met with Jim Hayward, Andrews University; Joe Galusha, Walla Walla College; Shandelle Henson, Andrews University.
- September 3, 2009. Conference call with seabird professionals to gather information and advice regarding deer impacts on seabird nesting islands, 12 participants representing FWS from other refuges and the migratory birds program, U S Geological Survey , Washington Dept. of Fish and Wildlife, University of Washington, University of Puget Sound, Andrews University, The Nature Conservancy, and Parks Canada.
- June 9, 2010. Met with researchers conducting operations on Protection Island and/or San Juan Islands NWR on Protection Island and gave short briefing on status of CCP and range of alternatives. Participants included Scott Pearson (WDFW), Tom Good (NOAA), Peter Hodum (U of Puget Sound), and Jim Hayward and Shandelle Henson (Andrews U).

Conferences

- Georgia Basin Puget Sound Research Conference, March 25-29, 2007, Vancouver, BC Canada. Refuge biological technician gave a poster presentation about CCP planning issues and invited participants to sign up for the CPP mailing list. Audience included Canadian and U.S scientific and conservation community interested in Puget Sound including government and tribal representatives.
- Pacific Seabird Conference, February 27- March 1, 2008. Refuge biological technician gave a poster presentation about CCP planning issues and invited participants to sign up for the CPP mailing list. Audience included people interested in seabirds, including state and federal agency staff; university professors and students; and many others.

Non-government Organizations

- *The Nature Conservancy* – Washington Field Office, Seattle WA, January 26, 2007. Met to discuss early CCP planning issues and species of concern. Additional informal coordination throughout 2007 and 2008 to share information regarding native plant communities especially in the San Juans.

- *Admiralty Audubon Society,* Port Townsend, WA, January 17, 2008. Gave CCP presentation at regularly scheduled meeting with approximately 30 Audubon members and guests. Additional coordination August 2008 ith chapter founder Eleanor Stopps.
- *Peninsula College,* Museum and Arts Center, Sequim, WA – February 15, 2008. Gave CCP presentation to approximately 30 students and instructors.
- *Kiwanis Club,* Port Townsend, WA, November 21, 2008. Gave CCP presentation to 35-40 Kiwanis Club members.

Public Open House Sessions

September 23, 2008, Mullis Community Center, Friday Harbor, WA
Presented preliminary management options and took comments

September 24, 2008, Fort Worden State Park, Port Townsend, WA
Presented preliminary management options and took comments

U.S. Fish and Wildlife Service Coordination
The core planning team coordinates frequently among themselves during the planning process. The core team also relies on specialists from various Service programs for their expertise. Additional coordination occurs with the Regional Office Management and the Washington Office at key phases in the process including:

Washington Office briefings
- Scoping briefing statement - April 28, 2008
- Alternatives briefing statement - March 23, 2009

R1, Pacific Regional Office Management Reviews
- Preplanning Briefing meeting March 13, 2007
- Alternative Briefing meeting June 3, 2008
- Administrative draft Briefing meeting March 10, 2010

Planning Updates
A mailing list of approximately 500 persons and organizations is maintained at the Refuge and was used to distribute planning updates. Additional hardcopy planning updates were provided to refuge office visitors, handed out or available at meetings, available at libraries, and mailed to additional interested parties. Electronic copies are posted and available for downloading on the Service's Region 1 planning website.

1. October 2007– Background information on the refuges, preliminary issues and goals, and initiation of public scoping including a mail-in comment form.
2. August 2008 – Results of initial scoping, preliminary management options, and invitation to public open house meetings.
3. Summer 2010 – Announces release of Draft CCP/WSP/EA.

Media Outreach and Press Coverage

Refuge staff sent news releases to local media contacts and made follow up calls to maximize likelihood of press coverage. News releases were also electronically sent to Service's Region 1 list of nearly 400 regional and WA state media contacts and were posted on the Service's Region 1 Website. Press coverage included the following:

News release #1: Initial Scoping, September-October 2007
- October 3, 2007. The Islands' Sounder.
- October 10, 2007. Port Townsend & Jefferson County Leader
- October 11, 2007. Peninsula Daily News
- February 8, 2008. Whidbey Examiner

News release #2: Preliminary Management Options, August-Sept 2008
- August 24, 2008. Peninsula Daily News
- September 17, 2008. Journal of the San Juans

News release #3: Draft CCP/WSP/EA – Summer 2010

Federal Register Notices

- Notice of Intent to prepare a Comprehensive Conservation Plan and Environmental Assessment published - August 14, 2007
- Notice of Availability of a Draft Comprehensive Conservation Plan and Environmental Assessment in progress - summer 2010

Additional Outreach Tools Used
- A one page flyer was produced to announce the planning process and let people know where to get more information and where to send their comments. This was posted in August of 2008 at many State Marine Parks including Turn, Matia, and Jones; at The Whale Museum in Friday Harbor; at the Port Townsend Marine Science Center; and other locations where both summer visitors and residents were likely to see it.
- Partners including SoundWatch, and State Parks assisted in getting messages out through their normal venues regarding CCP public meetings and opportunities to comment.

STATEMENT OF COMPLIANCE
for Implementation of Protection Island and San Juan Islands National Wildlife Refuges, Comprehensive Conservation Plan and San Juan Islands Wilderness Stewardship Plan Jefferson, Clallam, Island, Skagit, and San Juan Counties, Washington

The following executive orders and legislative acts have been reviewed as they apply to implementation of Protection Island and San Juan Islands National Wildlife Refuges Comprehensive Conservation Plan and San Juan Islands Wilderness Stewardship Plan.

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

An environmental assessment (EA) was prepared for the project that integrated the CCP management objectives and alternatives into the NEPA document and process. The Draft CCP and EA shall be released for a 30-day public comment period. The public shall be notified of the availability of these documents through a Federal Register notice, news releases to local newspapers, the Service's refuge planning website, and a planning update. Copies of the Draft CCP/EA and/or planning updates shall be distributed to an extensive mailing list. The CCP shall be revised based on public comment received on the draft documents.

National Historic Preservation Act (1966). The Service will continue to uphold the National Historic Preservation Act during implementation of the CCP. If any management actions have the potential to affect any historic properties, an inventory will be conducted as necessary and appropriate actions to mitigate effects will be identified prior to implementation of the project.

Executive Order 12372. Intergovernmental Review. Coordination and consultation with affected Tribal, local and State governments, other Federal agencies, and the landowners has been completed through personal contact by Service Planners, Refuge managers and Supervisors.

Executive Order 13175. Consultation and Coordination with Indian Tribal Governments. As required under Secretary of the Interior Order 3206 American Indian Tribal Rights, Federal-Tribal Responsibilities, and the Endangered Species Act, the Project Leader and Regional Office staff informed the 14 Federally recognized tribes associated with the refuges planning area about the planning process and provided opportunities for participation and commenting on the proposed action. Specifically, the Service invited Tribes to 2 coordination meeting during initial scoping, made phone calls, sent planning updates, and provided other CCP related materials throughout the Service's planning process over the past three years during development of the Comprehensive Conservation Plan.

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

Wilderness Act (1964). 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. 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. This CCP is also the updated San Juan Islands Wilderness Stewardship Plan. Protection Island NWR and the portions of San Juan Islands NWR that are not already designated wilderness were evaluated for suitability as wilderness. These areas were determined to not be suitable due to their altered nature, presence of structures, and/or strong evidence of humans.

A Minimum Requirement Analysis (MRA) was prepared for research, monitoring and management and another MRA was prepared for signs management within the San Juan Islands Wilderness Area. These were prepared in a manner consistent with the Wilderness Act of 1964 (16 U.S.C. 1131-1136). The MRAs clarify the need for and determines the potential impacts of a proposed action to wilderness resources. The Service will authorize an activity within designated wilderness only if it is demonstrated that the activity meets the minimum requirement for administering the area as wilderness and accomplishes the purposes for which the refuge was established, including Wilderness Act purposes.

National Wildlife Administration Act of 1966, as amended by The National Wildlife Refuge System Improvement Act of 1997 (16 U.S.C. 668dd-668ee). During the CCP process the Refuge Manager evaluated all existing and proposed refuge uses on Protection Island and San Juan Islands Refuges. Priority wildlife-dependent uses (hunting, fishing, wildlife observation and photography, environmental education and interpretation) are considered automatically appropriate under Service policy and thus exempt from appropriate uses review. Appropriate Use Findings have been prepared for the following uses: research, camping, and pets. Research and camping were found to be appropriate but pets were not appropriate. Compatibility determinations have been prepared for the following uses: wildlife observation and photography, and interpretation; environmental education; research; and camping. All of these uses were found to be compatible with Refuge purposes and the System mission with stipulations specified in each of the compatibility determinations.

EO 13186. Responsibilities of Federal Agencies to Protect Migratory Birds. The CCP is consistent with Executive Order 13186 because the CCP and NEPA analyses evaluate the effects of agency actions on migratory birds. Implementation of the CCP is expected to enhance conditions for migratory birds on the Refuges

Endangered Species Act. This Act provides for the conservation of threatened and endangered species of fish, wildlife, and plants by federal actions and by encouraging the establishment of state programs. Section 7 of the Act requires consultation before initiating projects which affect or may affect endangered species. The only federally threatened or endangered species know to occur on the refuges is the Steller sea lion. Marbled murrelets are not found on refuge islands but forgage in the waters near the San Juan Islands NWR. Consultation for Steller sea lion research conducted on refuge lands is covered by NOAA as part of their ongoing multi-state research program. The most recent biological opinion for Steller seal lion and northern fur seal research activities on the west coast including WA is dated June 2007. Other research and monitoring activities conducted by refuge staff or partners avoid going near areas where Steller sea lions reside and therefore should not affect them or their habitat. Law enforcement and educational activities aimed at reducing human disturbance to refuge wildlife including T&E species will maintain a low human disturbance environment on and near the refuges. If any research, monitoring, or management actions have the potential to affect Steller sea lions or marbled murrelets they will be the subject of separate Endangered Species Act (ESA) section 7 consultations prior to commencement.

Coastal Zone Management Act, Section 307. Section 307(c)(1) of the Coastal Zone Management Act of 1972 as amended, requires each Federal agency conducting or supporting activities directly affecting the coastal zone, to conduct or support those activities in a manner which is, to the maximum extent practicable, consistent with approved state coastal management programs. The implementation of the Protection Island and San Juan Islands NWRs CCP is consistent with the Coastal Zone Management Act.

Executive Order 11990. Protection of Wetlands. The CCP is consistent with Executive Order 11990 because CCP implementation would protect and potentially enhance existing wetlands.

Integrated Pest Management (IPM), 517 DM 1 and 7 RM 14
In accordance with 517 DM 1 and 7 RM 14, an integrated pest management (IPM) approach has been adopted to eradicate, control, or contain pest and invasive species on the refuge. In accordance with 517 DM 1, only pesticides registered with the US Environmental Protection Agency (USEPA) in full compliance with the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and as provided in regulations, orders, or permits issued by USEPA may be applied on lands and waters under refuge jurisdiction.

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Chief, Division of Refuge Planning, Visitor Services, and Transportation	Date

Appendix L. Abbreviations and Glossary

L. Abbreviations

ARPA	Archaeological Resources Protection Act
ATBA	Area to be avoided
BBS	Breeding bird survey
BCC	Birds of Conservation Concern
BIDEH	Biological Integrity, Diversity and Environmental Health
BLM	Bureau of Land Management
BLOY	Black oystercatcher
BRCO	Brandt's cormorant
CASE	California sea lion
CBC	Christmas Bird Count
CCP	Comprehensive Conservation Plan
CEQ	Council of Environmental Quality
CFR	Code of Federal Regulations
C-MAN	Coastal-Marine Automated Network
COMU	Common murre
Complex	Washington Maritime National Wildlife Refuge Complex
CR	Cultural resource
DAHP	Department of Archaeology and Historic Preservation
DCCO	Double-crested cormorant
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
DO	Dissolved oxygen
DOD	Department of Defense
EA	Environmental Assessment
Ecology	Washington State Department of Ecology
EE	Environmental education
ELSE	Elephant seal
ENSO	El Niño – Southern Oscillation
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FR	Federal Register
FTE	Full-time employee
GB/PS	Georgia Basin/Puget Sound
GIS	Geographic information system
GPS	Global positioning system
GWGU	Glaucous-winged gull
HASE	Harbor seal
IAC	Interagency Committee for Outdoor Recreation

Improvement Act	National Wildlife Refuge System Improvement Act of 1997
IPCC	Intergovernmental Panel on Climate Change
IPM	Integrated pest management
IOSA	Island Oil Spill Association
MAMU	Marbled murrelet
MESA	Marine Ecosystem Analysis
MHHW	Mean higher high water
MLLW	Mean lower low water
MMPA	Marine Mammal Protection Act
MSL	Mean sea level
MOU	Memorandum of Understanding
MRA	Minimum Requirement Analysis
NADB	National Archaeological Database
NAGPRA	Native American Graves Protection and Repatriation Act
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOAA	National Oceanic and Atmospheric Administration (also NOAA Fisheries)
NPS	National Park Service
NRHP	National Register of Historic Places
NSRE	National Survey on Recreation and the Environment (Pacific Region)
NWR	National Wildlife Refuge
NWRS	National Wildlife Refuge System
OMB	Office of Management and Budget
OSU	Oregon State University
PAH	Polycyclic aromatic hydrocarbons
PBDE	Polybrominated diphenyl ether
PBT	Persistent bioaccumulative toxic
PCB	Polychlorinated biphenyl
PECO	Pelagic cormorant
PI	Protection Island
PIGU	Pigeon guillemot
PL	Public Law
PLO	Public Land Order
PRPA	Paleontological Resources Preservation Act
PSAT	Puget Sound Action Team
PSAMP	Puget Sound Ambient Monitoring Program
PUP	Pesticide Use Proposal
RCO	Recreation and Conservation Committee (Washington State)
RCW	Revised Code of Washington
RHAU	Rhinoceros auklet
RONS	Refuge Operational Needs System
SCORP	State Comprehensive Outdoor Recreation Planning
Service	U.S. Fish and Wildlife Service (also, FWS)
SHPO	State Historic Preservation Office

SJI	San Juan Islands
SJIVB	San Juan Islands Visitors Bureau
STSE	Steller (northern) sea lion
SUP	Special use permit
TNC	The Nature Conservancy
TUPU	Tufted puffin
USC	United States Code
USCG	U.S. Coast Guard
USC&GS	U.S. Coast and Geodetic Survey
USCS	U.S. Coast Survey
USDA	United States Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
UW	University of Washington
UWCIG	University of Washington Climate Impacts Group
VS	Visit Seattle
WAC	Washington Administrative Code
WDOE	Washington Department of Ecology
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WRCC	Western Regional Climate Center
WSDOT	Washington State Department of Transportation
WSP	Wilderness Stewardship Plan
WSPRC	Washington State Parks and Recreation Commission
WWTA	Washington Water Trails Association
WWU	Western Washington University
YHONA	Yaquina Head Outstanding Natural Area

Glossary

Adaptive Management. Refers to a process in which policy decisions are implemented within a framework of scientifically driven experiments to test predictions and assumptions inherent in a management plan. Analysis of results help managers determine whether current management should continue as is or whether it should be modified to achieve desired conditions.

Alcid. A family of seabirds that includes tufted puffin, rhinoceros auklet, Cassin's auklet, common murre, ancient and marbled murrelet, and pigeon guillemot. They are colonial nesters, fish eaters, long-lived, and have low reproductive output.

Alternative. 1. A reasonable way to fix the identified problem or satisfy the stated need (40 CFR 1500.2). 2. Alternatives are different means of accomplishing refuge purposes and goals and contributing to the System mission (Service Manual 602 FW 1.6).

Anadromous. A fish that hatches in freshwater, migrates to the ocean to live and grow, and returns to freshwater to spawn.

Ballast Water. Water added to the ballast tanks of cargo vessels when empty to increase propeller immersion, to improve steering, and to control trim and draft.

Bedland. Aquatic lands that are submerged at all times, including all navigable salt and fresh waters.

BIDEH. Biological integrity, diversity and environmental health represented by native fish, wildlife, plants and their habitats as well as those ecological processes that support them.

Bioaccumulative toxin. Contaminants, such as heavy metals, that are accumulated in the tissue of organisms that live or forage in the environment.

Biological Diversity. The variety of life and its processes, including the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur (Service Manual 052 FW 1.12B). The System's focus is on indigenous species, biotic communities, and ecological processes. Also referred to as Biodiversity.

Bycatch. Marine organisms that are incidentally caught, along with the target fish species, by commercial and recreational fishing operations. Common bycatch species include seabirds, marine mammals, and fish species.

Carrying Capacity. The maximum population of a species a habitat or area can support.

Compatible Use. A proposed or existing wildlife-dependent recreational use or any other use of a national wildlife refuge that, based on sound professional judgment, will not materially interfere with or detract from the fulfillment of the National Wildlife Refuge

System mission or the purposes of the national wildlife refuge (Service Manual 603 FW 2.6). A compatibility determination supports the selection of compatible uses and identifies stipulations or limits necessary to ensure compatibility.

Comprehensive Conservation Plan (CCP). A document that describes the desired future conditions of a refuge or planning unit and provides long-range guidance and management
direction to achieve the purposes of the refuge; helps fulfill the mission of the Refuge System; maintains and, where appropriate, restores the ecological integrity of each refuge and the Refuge System; helps achieve the goals of the National Wilderness Preservation System; and meets other mandates. (Service Manual 602 FW 1.6).

Concern. See definition of issue.

Cover Type. The type of vegetation in an area. Often referred to as percent cover or the % of ground covered by vegetation type (e.g. 20% shrub cover).

Cultural Resources. The remains of sites, structures, or objects used by people in the past.

Cultural Resource Inventory. A professionally conducted study designed to locate and evaluate evidence of cultural resources present within a defined geographic area. Inventories may involve various levels, including a background literature search, a comprehensive field examination to identify all exposed physical manifestations of cultural resources, or a sample inventory to project site distribution and density over a larger area. Evaluation of identified cultural resources to determine eligibility for the National Register follows the criteria found in 36 CFR 60.4 (Service Manual 614 FW 1.7).

Demography. The study of life-history parameters such as adult survival, fledgling success, number of broods raised per year.

Disturbance. Significant alteration of wildlife behavior or habitat structure and composition. May be natural (e.g., fire) or human-caused events (e.g., aircraft over flight).

Ecosystem. A dynamic and interrelating complex of plant and animal communities and their associated non-living environment.

Ecosystem Management. Management of natural resources using system-wide concepts to ensure that all plants and animals in ecosystems are maintained at viable levels in native habitats and basic ecosystem processes are perpetuated indefinitely.

Endangered Species (Federal). A plant or animal species listed under the Endangered Species Act that is in danger of extinction throughout all or a significant portion of its range.

Endangered Species (State). A plant or animal species in danger of becoming extinct or extirpated in Washington within the near future if factors contributing to its decline continue. Populations of these species are at critically low levels or their habitats have been degraded or depleted to a significant degree.

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

Finding of No Significant Impact (FONSI). A document prepared in compliance with the National Environmental Policy Act, supported by an environmental assessment, that briefly presents why a federal action will have no significant effect on the human environment and for which an environmental impact statement, therefore, will not be prepared (40 CFR 1508.13).

Fire Regime. A natural fire regime is a general classification of the role fire would play across a landscape in the absence of modern human mechanical intervention, but including the influence of aboriginal burning.

Focal Resources. Plant and animal species that are most representative of refuge purposes, BIDEH and other FWS and ecosystem priorities. Conservation and management of these species will guide refuge management in the future. See Priority Resources of Concern and Other Benefiting Species.

Forb. A broad-leaved, herbaceous plant; for example, a columbine.

Gillnet. A fishing net stretched between a weighted leadline on the bottom and a floatline on the top to support it vertically in the water column. A pelagic drift gillnet may be attached to free floating buoys at one end and a vessel at the other end. The species of fish targeted determines the size of the mesh in a gillnet. The fish can get its head through the net, but when it tries to back out, the fish is caught on the net by its gills.

Goal. A descriptive, open-ended, and often broad statement of desired future conditions that conveys a purpose, but does not define measurable units (Service Manual 602 FW 1.6).

Habitat. Suite of existing environmental conditions required by an organism for survival and reproduction. The place where an organism typically lives.

Habitat Type. See Vegetation Type.

Habitat Restoration. Management emphasis designed to move ecosystems to desired conditions and processes, and/or to healthy ecosystems.

Invasive Species. A nonnative species whose introduction causes or is likely to cause economic or environmental harm. Also referred to as exotic or non-native species.

Inventory. A survey that documents the presence, relative abundance, status and/or distribution of abiotic resources, species, habitats, or ecological communities at a particular time. Often referred to as baseline inventory.

Issue. Any unsettled matter that requires a management decision (e.g., a Service initiative, opportunity, resource management problem, a threat to the resources of the unit, conflict in uses, public concern, or the presence of an undesirable resource condition) (Service Manual 602 FW 1.6).

Lacustrine. Relating to a lake.

Kleptoparasitism. A form of feeding in which one animal takes prey from the animal that caught or collected it.

Management Alternative. See Alternative.

Migration. The seasonal movement from one area to another and back.

Mission Statement. Succinct statement of a unit's purpose and reason for being.

Monitoring. A survey repeated through time to determine changes in the status and/or demographics of abiotic resources, wildlife or plants, habitat, or ecological communities.

National Environmental Policy Act of 1969 (NEPA). Requires all agencies, including the Service, to examine the environmental impacts of their actions, incorporate environmental information, and use public participation in the planning and implementation of all actions. Federal agencies must integrate NEPA with other planning requirements, and prepare appropriate NEPA documents to facilitate better environmental decision making (40 CFR 1500).

National Wildlife Refuge. A designated area of land, water, or an interest in land or water within the National Wildlife Refuge System.

National Wildlife Refuge System. All lands, waters and interests therein administered by the Service as wildlife refuges, wildlife ranges, wildlife management areas, waterfowl production areas, and other areas for the protection and conservation of fish and wildlife, including those that are threatened with extinction.

National Wildlife Refuge System Mission. The mission 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.

Native Species. Species that normally live and thrive in a particular ecosystem.

Noxious species. Any plant or plant product that can directly or indirectly injure or cause damage to crops (including nursery stock or plant products), livestock, poultry, or other interests of agriculture, irrigation, navigation, the natural resources of the United States, the public health, or the environment. Control of these species is mandated by law.

Objective. An objective is a concise target statement of what will be achieved, how much will be achieved, when and where it will be achieved, and who is responsible for the work. Objectives are derived from goals and provide the basis for determining management strategies. Objectives should be attainable and time-specific and should be stated quantitatively to the extent possible. If objectives cannot be stated quantitatively, they may be stated qualitatively (Service Manual 602 FW 1.6).

Obligate Species. Species that require a specific habitat type or plant species for their existence.

Ocean Acidification. The ongoing decrease in the pH of the Earth's oceans, caused by their uptake of anthropogenic carbon dioxide from the atmosphere.

Other Benefiting Species. Native species, other than priority resources of concern and focal resources, that will benefit from management actions.

Paleontology. The study of prehistoric life, including organisms' evolution and interactions with each other and their environments.

Passerine. See songbird

Pinniped. A suborder of carnivores that are marine mammals, have flippers, and eat mostly fish and marine invertebrates (e.g., sea lions, seals).

Plant Association. A classification of plant communities based on the similarity in dominants of all layers of vascular species in a climax community.

Plant Community. An assemblage of plant species unique in its composition; occurs in particular locations under particular influences; a reflection or integration of the environmental influences on the site such as soils, temperature, elevation, solar radiation, slope, aspect, and rainfall; denotes a general kind of climax plant community (e.g., Sitka spruce).

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

Priority Resources of Concern. Habitats that are most representative of refuge BIDEH, as well as other FWS and ecosystem priorities that were chosen as resources that will guide refuge management in the future. See Focal Resources.

Priority Species. Fish and wildlife species that the Washington Department of Fish and Wildlife believe require protective measures and/or management guidelines to ensure their perpetuation. Priority species include the following: (1) state listed and candidate species; (2) species or groups of animals susceptible to significant population declines within a specific area or statewide by virtue of their inclination to aggregate (e.g., seabird colonies); and (3) species of recreational, commercial, and/or Tribal importance.

Public. Individuals, organizations, and groups; officials of Federal, state, and local government agencies; Indian tribes; and foreign nations. It may include anyone outside the core planning team. It includes those who may or may not have indicated an interest in Service issues and those who do or do not realize that Service decisions may affect them.

Puget Sound. Estuarine system of interconnected marine waterways and basins extending from Deception Pass and Admiralty Inlet in the North to Olympia, Washington in the south and Hood Canal to the west.

Purpose(s) of the Refuge. The purpose of a refuge is specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge subunit (Service Manual 602 FW 1.6).

Refuge Goal. See Goal.

Refuge Purposes. See Purposes of the Refuge.

Salish Sea. 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).

San Juan Archipelago. The San Juan Archipelago is split into two groups of islands based on national sovereignty. The San Juan Islands are part of the U.S. state of Washington within San Juan, Whatcom and Skagit counties. The Gulf Islands are part of the Canadian province of British Columbia. There are over 450 rocks (with minimal vegetation) and islands (with vegetation) in the entire archipelago at high tide. Within this document, we refer to the U.S. portion of the archipelago when using this term.

Seabird. A group of birds that obtain at least some food from the ocean by traveling some distance over its surface. They also typically breed on islands and along coastal areas. Seabirds include: gulls, alcids, penguins, albatrosses, storm-petrels, and cormorants, among others.

Songbirds. (Also Passerines) A category of birds that are medium to small, perching land birds. Most are territorial singers and migratory.

Step-down Management Plans. Step-down management plans provide the details necessary to implement management strategies identified in the Comprehensive Conservation Plan (Service Manual 602 FW 1.6).

Strategy. A specific action, tool, or technique or combination of actions, tools, and techniques used to meet unit objectives (Service Manual 602 FW 1.6).

Succession. The observed process of change in the species structure of an ecological community over time.

T-sheet. A historic type of topographic map produced by the U.S. Coast and Geodetic Survey.

Threatened Species (Federal). Species listed under the Endangered Species Act that are likely to become endangered within the foreseeable future throughout all or a significant portion of their range.

Threatened Species (State). A plant or animal species likely to become endangered in Washington within the near future if factors contributing to population decline or habitat degradation or loss continue.

Tidelands. Submerged lands and beaches that are located between ordinary high tide and extreme low tide.

U.S. Fish and Wildlife Service Mission. The mission of the U.S. Fish and Wildlife Service is working with others to conserve, protect, and enhance fish and wildlife and their habitats for the continuing benefit of the American people.

Vegetation Type, Habitat Type, Forest Cover Type. A land classification system based upon the concept of distinct plant associations.

Vision Statement. A concise statement of the desired future condition of the planning unit, based primarily upon the System mission, specific refuge purposes, and other relevant mandates (Service Manual 602 FW 1.6).

Wilderness. "…an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvement or human habitation..." (Wilderness Act 1964)