U.S. Fish & Wildlife Service

Siletz Bay National Wildlife Refuge

Comprehensive Conservation Plan

A Vision of Conservation

At Siletz Bay National Wildlife Refuge we will preserve in perpetuity a dynamic mixture of tidal marsh, sloughs, mudflats, and forest. The refuge will be a place where salmon and trout find shelter near large woody debris; where birds of prey hunt from perches on starched skeleton trees; and where herons, egrets, and waterfowl safely forage in the tidally influenced waters.

Tidal marshes and woodlands will be restored to their historic conditions and invasive plants will be eradicated whenever they are found. We will work with our conservation partners to apply sound, scientific principles, and adaptive management strategies to sustain the integrity of the estuary in the face of a changing climate. Paddling through the open waters that nourish the refuge, visitors will experience unique opportunities to connect with nature.

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

Nesting osprey
Roy W. Lowe/USFWS

Siletz Bay
National Wildlife Refuge

Comprehensive Conservation Plan

Prepared by:
U.S. Fish and Wildlife Service
Oregon Coast National Wildlife Refuge Complex
2127 SE Marine Science Drive
Newport, Oregon 97365

U.S. Fish and Wildlife Service
Pacific Northwest Planning Team
911 NE 11th Avenue
Portland, Oregon 97232

April 2013

Approved: ______________________________ Dec. 21, 2012
Acting Regional Director, Region 1 Date
Portland, Oregon

U.S. Fish and Wildlife Service
Siletz Bay National Wildlife Refuge
Comprehensive Conservation Plan
Approval Submission

In accordance with the National Wildlife Refuge System Administration Act, as amended, the U.S. Fish and Wildlife Service completed a Comprehensive Conservation Plan (CCP) for Siletz Bay National Wildlife Refuge. The purpose of this CCP is to specify a management direction for the Refuge for the next 15 years. The goals, objectives, and strategies for improving Refuge conditions – including the types of habitat we will provide, partnership opportunities, and management actions needed to achieve desired future conditions – are described in the CCP. The Service's preferred alternative for managing the Refuge is described in this CCP and the environmental consequences of implementing the CCP were described in the Draft CCP and Environmental Assessment.

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

Rebecca G. Chuck Acting ____________________ 12/18/12 ________
Roy Lowe, Project Leader — Date
Oregon Coast National Wildlife Refuge Complex

Concur: ____________________ 12/18/12 ________
Bob Flores — Date
Refuge Supervisor

Concur: Robin L. West ____________________ 12-19-12 ________
Robin West — Date
Regional Chief, National Wildlife Refuge System

Finding of No Significant Impact
for the
Siletz Bay National Wildlife Refuge
Comprehensive Conservation Plan
Lincoln County, Oregon

The U.S. Fish and Wildlife Service (Service) has completed a Comprehensive Conservation Plan (CCP) and Environmental Assessment (EA) for Siletz Bay National Wildlife Refuge (Refuge). The CCP will guide management of the Refuge for 15 years. The CCP/EA describes our proposals for managing the Refuge and their effects on the human environment under three alternatives, including the no action alternative.

Decision

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

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

Summary of the Actions to be Implemented

Implementing the selected alternative will have no significant impacts on the environmental resources identified in the CCP/EA. Refuge management under the selected alternative will protect, maintain, and enhance habitat for priority species and resources of concern, and improve the public's opportunities to enjoy wildlife-dependent recreation.

Under Alternative C, an emphasis on protecting and maintaining estuarine, stream-riparian, and forested habitats would remain; however, an increased level of active habitat management, inventory, monitoring, and research would also be implemented. If feasible, tidal marsh restoration would occur at Siletz Keys and Alder Island, and on any additional diked lands acquired.

Opportunities for wildlife observation and photography would be expanded with the development of a loop trail, viewing platform, and parking lot at Alder Island. Unrestricted walking would be allowed on refuge lands west of Highway 101 for the purpose of wildlife observation and photography. Interpreter-led seasonal paddle trips would continue and potentially expand with the development of a non-motorized boat launch near Alder Island.

Waterfowl hunting would be allowed daily in season on 87 acres of refuge lands west of Highway 101 and 3 days per week on 112 acres of refuge lands south of Millport Slough and east of Highway 101. A small gravel parking lot and kiosk would be developed to support the Millport Slough waterfowl hunting access. Access to clamming would be allowed through Snag Alley and walk-in bank fishing would be allowed from Alder Island only.

Interpretation efforts would be expanded via the development of an interpretive trail around Alder Island and the creation of additional interpretive signs and materials.

Other proposed actions under Alternative C include the consideration of climate change effects in all management; the reduction of the Refuge's carbon footprint; monitoring and control of invasive species; fire management; maintenance of existing structures; coordination with State, Tribal, and other partners to accomplish goals; cultural resources protection; volunteer opportunities; and the continuation of land protection within the approved Refuge boundary. All proposed actions are subject to funding availability.

Public Involvement and Changes Made to the Selected Alternative Based on Comments

We incorporated a variety of public involvement techniques in developing and reviewing the CCP/EA. This included two open houses, several planning updates, numerous meetings with partners and elected officials, and public review and comment on the Draft CCP/EA. The details of our public involvement program are described in the CCP in Appendix J.

Based on the public comments we received and considered, Alternative C as described in the CCP/EA has been slightly modified.

- The waterfowl hunting area acreage on refuge lands west of Highway 101 has been changed from 80 to 87 acres.
- The waterfowl hunting area acreage on refuge lands south of Millport Slough has been changed from 97 to 112 acres.
- Clarification about clamming being subject to Oregon Department of Fish and Wildlife and Oregon Department of Agriculture shellfish safety closures has been added.
- The Compatibility Determination for wildlife observation, photography, and interpretation was modified to improve consistency.
- Some maps were updated to reflect the revised waterfowl hunting areas and above-referenced clarifications.
- Some text changes were made to improve readability and clarity.

Conclusions

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

Richard Hannan

Acting Regional Director

Dec. 21, 2012

Date

Supporting References

U.S. Fish and Wildlife Service. 2012. Siletz Bay National Wildlife Refuge draft Comprehensive Conservation Plan and Environmental Assessment. U.S. Department of the Interior, Fish and Wildlife Service, Region 1, Portland, OR. 418 pp.

Note: This Finding of No Significant Impact and supporting references are available for public review at the Oregon Coast National Wildlife Refuge Complex, 2127 SE Marine Science Drive, Newport, Oregon 97365 and U.S. Fish and Wildlife Service, Division of Planning, Visitor Services, and Transportation, 911 NE 11th Avenue, Portland, Oregon, 97232. These documents can also be found on the Internet at http://www.fws.gov/oregoncoast/. Interested and affected parties are being notified of our decision.

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Chapter 1
Introduction and Background

Roy W. Lowe/USFWS

Chapter 1. Introduction and Background

1.1 Introduction

Siletz Bay National Wildlife Refuge (NWR or Refuge) is managed by the U.S. Fish and Wildlife Service (USFWS or Service) as part of the National Wildlife Refuge System (NWRS or System). The Oregon Coast National Wildlife Refuge Complex (Complex) comprises six individual national wildlife refuges that span most of the coast of Oregon and support a rich diversity of wildlife habitats including coastal rocks, reefs, and islands; forested and grass-covered headlands; estuaries; and freshwater marshes. The six national wildlife refuges include Cape Meares, Oregon Islands, Three Arch Rocks, Bandon Marsh, Nestucca Bay, and Siletz Bay (Figure 1-1). This Comprehensive Conservation Plan (CCP) applies only to Siletz Bay NWR. CCPs for Bandon Marsh and Nestucca Bay NWRs are being developed concurrently, and the CCPs for the Complex's other three NWRs have been completed under a previous planning effort.

Siletz Bay NWR, established in 1991, is located near Lincoln City on the central coast of Oregon (Figure 1-2). The Service originally proposed to establish the Refuge in 1989 by initially accepting a donation of 46 acres of muted salt marsh, further seeking to acquire partial or whole interest in up to 830 acres of land, and cooperatively managing 1,060 acres of tidelands with the State of Oregon. The approved refuge acquisition boundary (defined as the area within which the Service may acquire lands from willing sellers) totals 1,936 acres and encompasses the northern tip of the Siletz Spit, vegetated and unvegetated tidelands of the bay, a portion of the diked former tidelands of the Siletz River floodplain, and forested headlands near the mouth of Schooner Creek and Drift Creek. Approximately 1,060 acres within the authorized boundary are state-owned tidelands. Currently, refuge lands (defined as lands managed and owned or under easement by the USFWS) total 568 acres. The focus of this Refuge is to protect the remaining coastal wetlands and uplands adjacent to Siletz Bay from rapidly encroaching development, and to enhance and restore wetland and upland habitats for a variety of estuarine-dependent fish and wildlife species.

At the time of refuge establishment, commercial and residential encroachments onto coastal wetlands had increased over the past years resulting in lost habitat, increased pollution and human activity, and lower water quality. In view of the decline in Pacific Flyway migratory birds, use by threatened and endangered species, and high wildlife values, most of the unprotected coastal wetland habitats needed to be protected and in some cases restored in order to maintain healthy fish and wildlife populations. The Service's Concept Plan for Waterfowl Habitat Protection – Middle Upper Pacific Coast (USFWS 1989) identified the diked tidelands within the Siletz estuary as a high priority for protection.

Vegetation communities within the approved refuge boundary include estuary; open bay and mudflats; salt marshes and diked freshwater marshes; forested wetland; upland riparian; mixed woodland; and a shore/beach/dune system. The tip of the spit was included in the approved boundary at the recommendation of the State of Oregon because it is a historic snowy plover use area; however, it is part of the lands owned by the homeowners association and is unlikely to become refuge or to be restored to plover habitat. Refuge parcels are not contiguous but rather are spread out over a 6 square mile area around U.S. Highway 101, Millport Slough, the Kernville Highway (Oregon Route 229), Siletz Keys, Drift Creek, and Schooner Creek. On the west side of Highway 101, refuge parcels are for the most part surrounded by or composed of mudflat and/or tidal marsh.

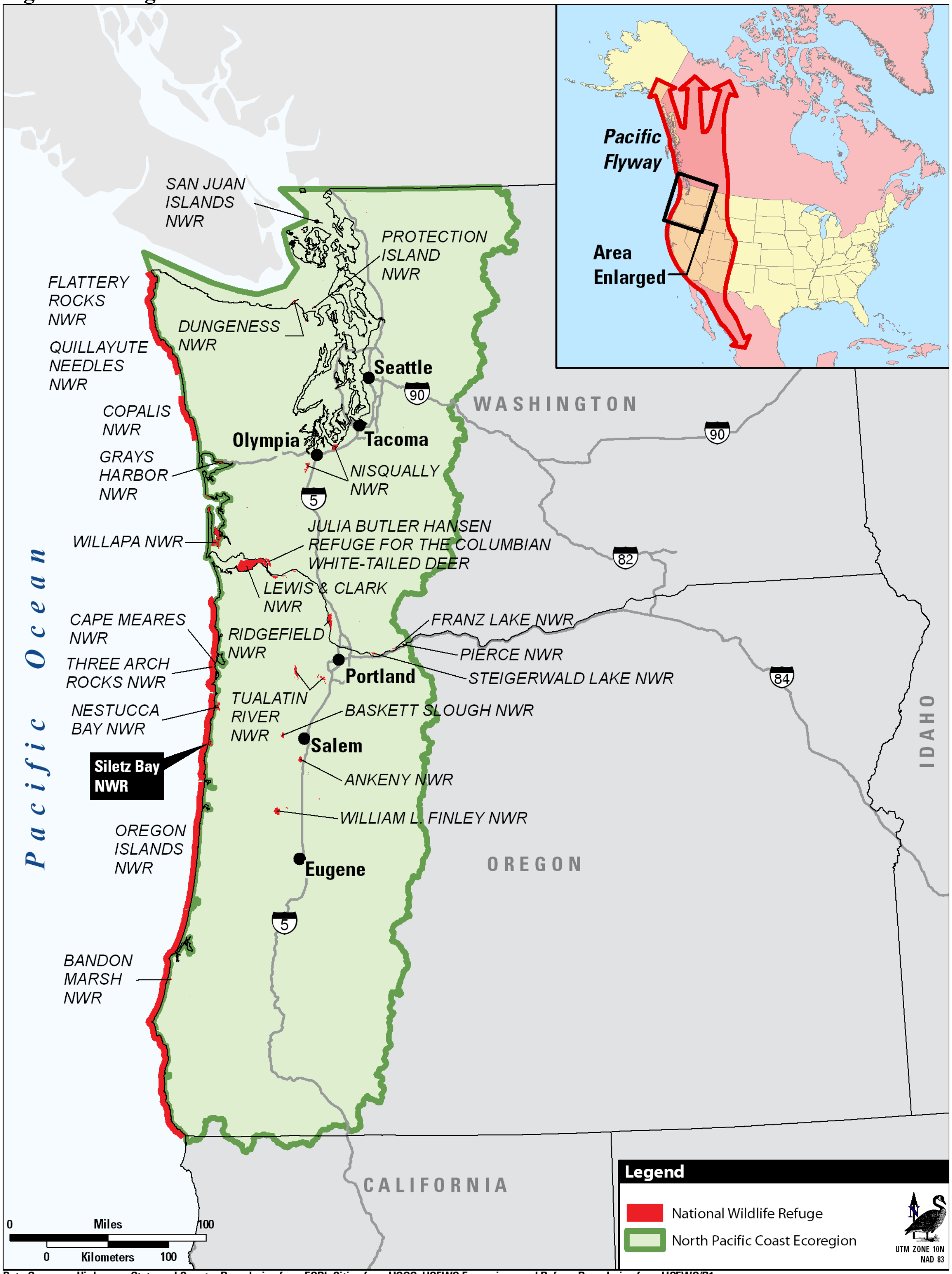
1.2 Significance of the Refuge

Refuge lands consist primarily of tidal marsh, diked former tidal marsh in varying stages of muted tidal action, and several smaller forested parcels both upland and wetland. Salt (or tidal) marshes are vegetated lands which are alternately flooded and exposed by estuary waters; diked marshes are former salt marshes which have been cut off or greatly restricted from tidal action by the construction of levees and water control structures but remain as freshwater wetlands. Tidal marsh plant communities provide highly productive habitat for many species of special concern such as salmonids and other anadromous fish, and juveniles of pelagic and nearshore fishes; however, diking and ditching have altered many tidal marsh plant communities and the food webs they support. Diked tidal marsh generally subsides due to long-term lack of tidal inundation and sediment accretion, and oxidation associated with exposure to the atmosphere, which changes the plant communities and the species that depend on them. Such alterations have directly reduced fish access to habitat and have radically changed the functions of the remaining habitat for all species. The physical structure of intact tidal marsh provides a wider variety of niches for macroinvertebrates and insects than diked marsh. The Siletz Bay and river system supports large runs of anadromous fish including Chinook and threatened coho salmon (Oregon Coast Evolutionarily Significant Unit), coastal cutthroat trout, and steelhead.

Large numbers of migratory birds use the marshes and tidal slough areas. Annual mid-winter waterfowl surveys are conducted in this area and in 2009 over 1,200 waterfowl were counted in the Siletz Bay area (USFWS unpublished data). Waterfowl species such as mallard, northern pintail, American wigeon, green-winged teal, bufflehead, red-breasted merganser, hooded merganser, and Canada geese feed and rest on the marshes. Eelgrass, which grows in dense stands in shallow areas on mud, gravel, or sand, is rare along the Oregon coast. It provides very valuable habitat including attachment surfaces for clinging invertebrates, spawning areas for many fish species, and a highly sought-after food item for black brant and several species of diving ducks. The largest concentrations of eelgrass occupy the southern end of Siletz Bay, with small patches occurring at the mouth of the bay, mouth of Schooner Creek, and the southern end of Snag Alley.

Great blue herons and other wading birds use the bay and there is a small breeding colony of great blue herons on the Refuge. Thousands of gulls and shorebirds including whimbrel, western and least sandpipers, dunlin, greater yellowlegs, semipalmated plover, long-billed dowitchers, and black-bellied plovers use Siletz Bay as stop-over habitat. Virginia rails and sora make use of the freshwater/brackish wetlands and tidal marsh/meadow-nesting species such as savannah sparrow, marsh wren and common yellowthroat are abundant. The marsh and mudflats along lower Drift Creek adjacent to the refuge bunkhouse contain a known mineral spring used by band-tailed pigeons. A diversity of raptors, such as osprey, northern harrier, bald eagle, peregrine falcon, and red-tailed hawk are commonly observed hunting prey within the marshes and mudflats. At present, there are two known bald eagle nests adjacent to Siletz Bay with one of them occurring on refuge lands. A pair of osprey nest annually on an artificial nesting platform near the Refuge on the Siletz River. The recently delisted California brown pelican uses the lower bay for foraging and the spit as a roost site. Aquatic mammals such as marsh shrews, Oregon voles, muskrat, river otter, beaver, and raccoon are common. Harbor seals forage and rest over tide flats with their primary haulout located on the spit. Black-tailed deer and Roosevelt elk forage in the meadows and tidal marshes.

Figure 1-1. Regional context.



Data Sources: Highways, State and Country Boundaries from ESRI; Cities from USGS; USFWS Ecoregions and Refuge Boundaries from USFWS/R1

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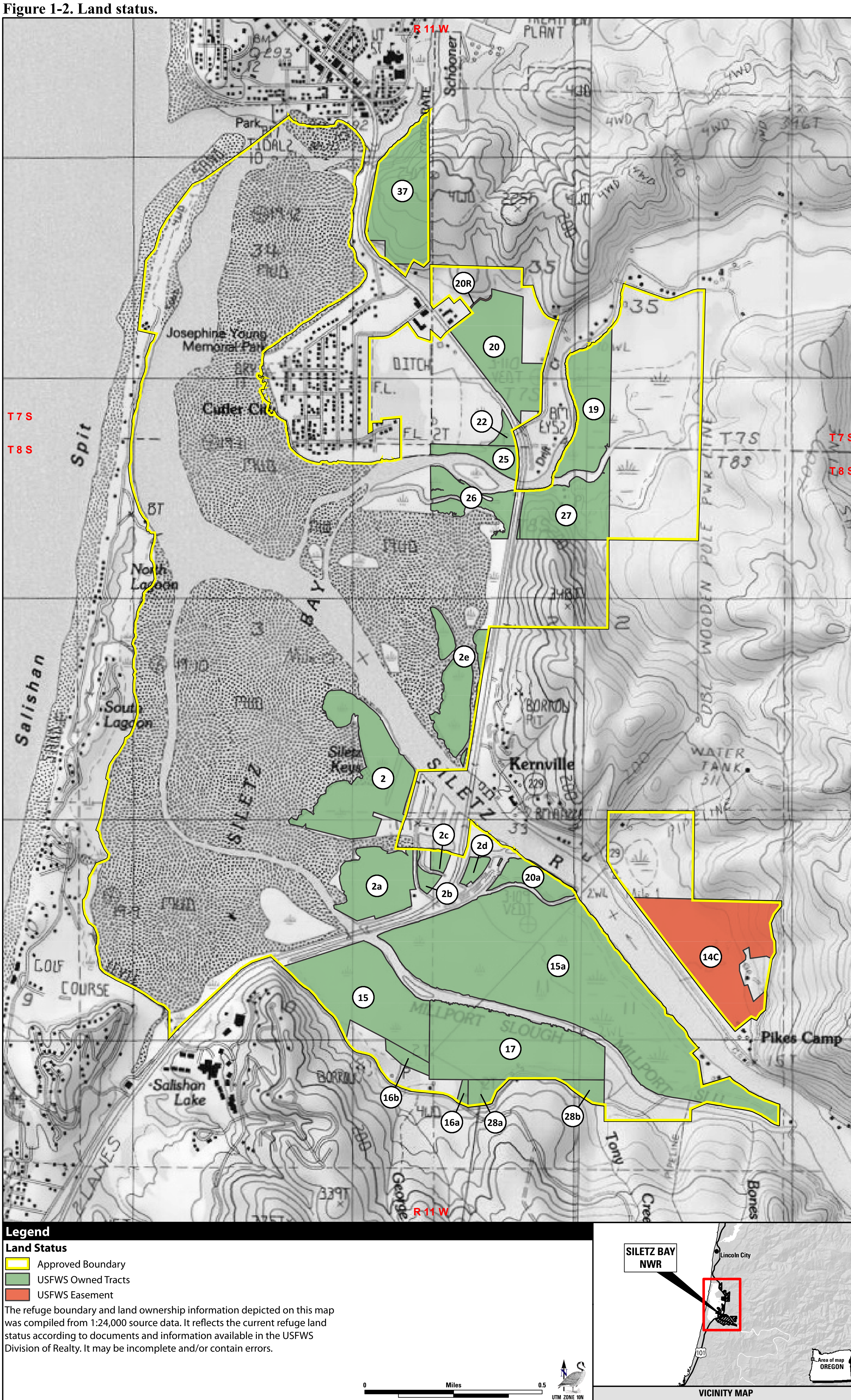
Figure 1-2. Land status.



Data Sources: Refuge Boundaries from USFWS/R1; 1:24,000 scale Topographic Map from USGS

The back sides of maps are blank to improve readability.

The forested areas of the Refuge provide important wildlife habitat. Young riparian alder and understory vegetation in coniferous forests provides browse for deer and elk. Wetland forest and woody riparian habitat support mammals such as beaver, mink, river otter, muskrat, and raccoon as well as numerous small mammals such as deer mice and a variety of species of voles, moles, and shrews. Many amphibians and reptiles such as long-toed and western red-backed salamanders, rough-skinned newts, Pacific tree and red-legged frogs, northern alligator lizards, and garter snakes are also dependent upon these habitats. The forests are used by neo-tropical songbirds including Wilson's and Townsend's, orange-crowned, black-throated gray and yellow-rumped warblers; hermit, Swainson's, and varied thrushes. Chestnut-backed chickadees, Pacific wren, Steller's jay, wrentit, and song sparrows are found year-round in the forest.

1.3 Proposed Action

We, the U.S. Fish and Wildlife Service (Service), manage wildlife refuges as part of the National Wildlife Refuge System. This document is the Refuge's Comprehensive Conservation Plan (CCP). A CCP sets forth management guidance for a Refuge for a period of 15 years, as required by the National Wildlife Refuge System Administration Act (16 U.S.C. 688dd-688ee, et seq.) (Refuge Administration Act), as amended by the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57). The Refuge 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 examined alternatives for future management of Siletz Bay National Wildlife Refuge through the CCP process. These were presented in the Draft Comprehensive Conservation Plan and Environmental Assessment (USFWS 2012a). We developed and evaluated three alternatives for the CCP and selected Alternative C as the preferred alternative.

The goals, objectives, and strategies under the preferred alternative best achieve the purpose and need for the CCP while maintaining balance among the varied management needs and programs. Thus, the preferred alternative represents the most balanced approach for achieving the Refuge's purposes, vision, and goals; contributing to the Refuge System's mission; addressing relevant issues and mandates; and managing the Refuge consistently with sound principles of fish and wildlife management. The preferred alternative was slightly modified between the draft and final documents based upon comments received from the public or other agencies and organizations (see Appendix K). The Service's Regional Director for the Pacific Region made the final decision about the alternative to be implemented. For details on the specific components of management direction for the Refuge over the next 15 years, see Chapter 2

1.4 Purpose and Need for Action

The purpose of developing the CCP is to provide the refuge manager with a 15-year management plan for the conservation of fish, wildlife, and plant resources and their related habitats, while providing opportunities for compatible, wildlife-dependent recreational uses. The CCP, when fully implemented, should achieve refuge purposes; help fulfill the Refuge System mission; maintain and, where appropriate, restore the ecological integrity of each refuge and the Refuge System; help achieve the goals of the National Wilderness Preservation System; and meet other mandates. The CCP must be specific to the planning unit and identify the overarching wildlife, public use, or management needs for the Refuge (602 FW 3.4C1d).

The need for the CCP is to provide reasonable, scientifically grounded guidance for ensuring that over a period of 15 years, Siletz Bay NWR will achieve the following purposes:

- Enhance, maintain, and protect refuge habitats (including upland forests; forested wetlands; and estuarine and stream-riparian habitats) and other lands for the benefit of migratory birds and other wildlife.
- Gather sufficient scientific information to guide responsible adaptive management decisions.
- Provide visitors compatible wildlife-dependent public use opportunities that foster an appreciation and understanding of the Refuge's fish, wildlife, plants, and their habitats, and have limited impacts to wildlife.
- Initiate and nurture relationships and develop cooperative opportunities to promote the importance of the Refuge's wildlife habitat, and support refuge stewardship.
- Protect and manage the Refuge's cultural resources, and identify new ways to gain an understanding of the Refuge's history and cultural resources.

1.5 Legal and Policy Guidance

1.5.1 The U.S. Fish and Wildlife Service

All refuges are managed by the Service, an agency within the Department of the Interior. The Service is the principal Federal agency responsible for conserving, protecting, and enhancing the Nation's fish and wildlife populations and their habitats.

The mission of the Service is "working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people." Although we share this responsibility with other Federal, state, tribal, local, and private entities, the Service has specific trust responsibilities for migratory birds, endangered and threatened species, and certain anadromous fish and marine mammals. The Service has similar trust responsibilities for the lands and waters we administer to support the conservation and enhancement of fish, wildlife, plants, and their habitats. The Service also enforces Federal wildlife laws and international treaties for importing and exporting wildlife, assists with state fish and wildlife programs, and helps other countries develop wildlife conservation programs.

1.5.2 National Wildlife Refuge System

A refuge is managed as part of the National Wildlife Refuge System within a framework provided by legal and policy guidelines. The Refuge System is the world's largest network of public lands and waters set aside specifically for conserving wildlife and protecting ecosystems.

The needs of wildlife and their habitats come first on refuges, in contrast to other public lands that are managed for multiple uses. Refuges are guided by various Federal laws and executive orders, Service policies, and international treaties. Fundamental are the mission and goals of the Refuge System and the designated purposes of the refuge unit as described in establishing legislation, executive orders, or other documents establishing, authorizing, or expanding a refuge.

National Wildlife Refuge System Mission and Goals

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

The goals of the Refuge System, as articulated in the Mission Goals and Purposes policy (601 FW1) 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 inter-jurisdictional 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.

Law and Policy Pertaining to the Refuge System

Refuges are guided by various Federal laws and executive orders, Service policies, and international treaties. Fundamental to the management of every refuge are the mission and goals of the Refuge System and the designated purposes of the refuge unit as described in establishing legislation, executive orders, or other documents establishing, authorizing, or expanding a refuge.

Key concepts and guidance of the Refuge System derive from the National Wildlife Refuge System Administration Act of 1966 (Administration Act) as amended (16 U.S.C. 668dd-668ee); the Refuge Recreation Act of 1962 as amended (16 U.S.C. 460k-460k-4); Title 50 of the Code of Federal Regulations; and the Service Manual. The Administration Act is implemented through regulations covering the Refuge System, published in Title 50, subchapter C of the Code of Federal Regulations and policies contained in the Service Manual. These regulations and policies govern general administration of units of the Refuge System.

Many other laws apply to the U.S. Fish and Wildlife Service and management of Refuge System lands. Examples include the Endangered Species Act of 1973, as amended, and the National Historic Preservation Act of 1966, as amended. Brief descriptions of laws pertinent to Siletz Bay Refuge are included in this chapter. A complete list of laws pertaining to the Service and the Refuge System can be found at http://laws.fws.gov.

Refuge Recreation Act of 1962 (16 U.S.C. 460k-460k-4). The Refuge Recreation Act authorized the Secretary of the Interior to administer refuges, hatcheries, and other conservation areas for recreational use, when such uses do not interfere with the area's primary purposes. It provided for public use fees and permits, and penalties for violating regulations. It also authorized the acceptance of donated funds and real and personal property, to assist in carrying out its purposes. Enforcement provisions were amended in 1978 and 1984 to make violations misdemeanors in accordance with the uniform sentencing provisions of 18 U.S.C. 3551-3586.

National Wildlife Refuge System Administration Act (16 U.S.C. 668dd et seq.) as amended by the National Wildlife Refuge System Improvement Act (Public Law 105-57). Of all the laws governing activities on national wildlife refuges, the Refuge Administration Act exerts the greatest influence. The National Wildlife Refuge System Improvement Act of 1997 (Refuge Improvement Act) amended the Administration Act by defining a unifying mission for all refuges, including a new process for determining compatible uses on refuges, and requiring that each refuge be managed under a comprehensive conservation plan. Key provisions of the Refuge Administration Act follow.

- Comprehensive conservation planning. A CCP must be completed for each refuge by the year 2012, as is required by the Refuge Administration Act. Each CCP will be revised every 15 years or earlier if monitoring and evaluation determine that changes are needed to achieve the refuge's purposes, vision, goals, or objectives. The Refuge Administration Act also requires that CCPs be developed with the participation of the public. Public comments, issues, and concerns are considered during the development of a CCP, and together, with the formal guidance, can play a role in selecting the preferred alternative. Information on public involvement can be found in Appendix J. The CCP provides guidance in the form of goals, objectives, and strategies for refuge programs, but may lack some of the specifics needed for implementation. Therefore, step-down management plans will be developed for individual program areas as needed, following completion of the CCP. The step-down plans are founded on management goals, objectives and strategies outlined in a CCP, and require appropriate NEPA compliance.
- Wildlife conservation; biological diversity, integrity and environmental health. The Refuge Administration Act expressly states that the conservation of fish, wildlife and plants, and their habitats is the priority of Refuge System lands, and that the Secretary of the Interior shall ensure that the biological integrity, diversity, and environmental health of refuge lands are maintained. House Report 105–106 accompanying the Improvement Act states "… the fundamental mission of our System is wildlife conservation: wildlife and wildlife conservation must come first."
- Refuge purposes. Each refuge must be managed to fulfill the Refuge System mission and the specific purpose(s) for which the refuge was established. The purposes of a refuge are 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. When a conflict exists between the Refuge System mission and the purpose of an individual refuge, the refuge purpose may supersede the mission.
- Priority public uses on refuges. The Administration Act superseded some key provisions of the Refuge Recreation Act regarding compatibility, and also provided significant additional guidance regarding recreational and other public uses on units of the Refuge System. The Refuge Administration Act identifies six priority wildlife-dependent recreational uses. These uses are hunting, fishing, wildlife observation and photography, and environmental education

> and interpretation. The Service is to grant these six wildlife-dependent public uses special consideration during planning for, management of, and establishment and expansion of units of the Refuge System. When determined compatible on a refuge-specific basis, these six uses assume priority status among all uses of the refuge in question. The Service is to make extra efforts to facilitate priority wildlife-dependent public use opportunities.

Compatibility and Appropriate Refuge Uses Policies (603 FW 2 and 1). With few exceptions, lands and waters within the Refuge System are different from multiple-use public lands in that they are closed to all public access and use unless specifically and legally opened. No refuge use may be allowed or continued unless it is determined to be appropriate and compatible. Generally, an appropriate use is one that contributes to fulfilling the refuge purpose(s), the Refuge System mission, or goals or objectives described in a refuge management plan. A compatible use is a use that in the sound professional judgment of the refuge manager will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purposes of the refuge.

The six wildlife-dependent recreational uses described in the Refuge Administration Act (hunting, fishing, wildlife observation and photography, and environmental education and interpretation) are defined as appropriate. When determined to be compatible, they receive priority consideration over other public uses in planning and management. Other non-wildlife-dependent uses on a refuge are reviewed by the refuge manager to determine if the uses are appropriate. If a use is determined appropriate, then a compatibility determination is completed.

When preparing a CCP, refuge managers must re-evaluate all general public, recreational, and economic uses (even those occurring to further refuge habitat management goals) occurring or proposed on a refuge for appropriateness and compatibility. Updated appropriate use and compatibility determinations for existing and planned uses for Siletz Bay NWR are in Appendices A (Appropriateness) and B (Compatibility) of this CCP.

Biological Integrity, Diversity, and Environmental Health Policy (601 FW 3). The Refuge Administration Act directs the Service to “ensure that the biological integrity, diversity, and environmental health of the National Wildlife Refuge System are maintained for the benefit of present and future generations of Americans…” The policy is an additional directive for refuge managers to follow while achieving refuge purpose(s) and the Refuge System mission. It provides for the consideration and protection of a broad spectrum of native fish, wildlife, and habitat resources found on refuges and associated ecosystems. When evaluating the appropriate management direction for refuges (e.g., in compatibility determinations), refuge managers will use sound professional judgment to determine their refuge’s contribution to biological integrity, diversity, and environmental health at multiple landscape scales. Sound professional judgment incorporates field experience, knowledge of refuge resources, an understanding of the refuge’s role within an ecosystem, applicable laws, and best available science, including consultation with others both inside and outside the Service. The policy states that “the highest measure of biological integrity, diversity, and environmental health is viewed as those intact and self-sustaining habitats and wildlife populations that existed during historic conditions.”

Wildlife-dependent Recreation Policies (605 FW 1-7). The Refuge Administration Act states that “compatible wildlife-dependent recreation is a legitimate and appropriate general public use of the System.” A series of recreation policies provide additional guidance and requirements to consider after a recreational use has been determined to be compatible. These policies also establish a quality standard for visitor services on national wildlife refuges. Through these policies, we are to simultaneously enhance wildlife-dependent recreational opportunities, provide access to quality visitor experiences, and manage refuge resources to conserve fish, wildlife, plants, and their habitats. New and ongoing recreational uses should help visitors focus on wildlife and other natural resources, and provide an opportunity to display resource issues, management plans, and how the refuge contributes to the Refuge System and the Service's mission. The policies also require development of a visitor services plan.

1.5.3 Other Laws and Mandates

Many other Federal laws, executive orders, Service policies, and international treaties govern the 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. For additional information on laws and other mandates, 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/Lawsdigest.html.

In addition, over the last few years, the Service has developed or revised numerous policies and Director's Orders to reflect the mandates and intent of the Refuge Administration Act. Some of these key policies include the Biological Integrity, Diversity, and Environmental Health Policy (601 FW 3); the Compatibility Policy (603 FW 2); the Comprehensive Conservation Planning Policy (602 FW 3); Mission, Goals, and Purposes (601 FW 1), Appropriate Refuge Uses (603 FW 1); Wildlife-Dependent Public Uses (605 FW 1); wilderness-related policies (610 FW 1-5) and the Director's Order for Coordination and Cooperative Work with State Fish and Wildlife Agency Representatives on Management of the National Wildlife Refuge System. These policies and others in draft or under development can be found at http://refuges.fws.gov/policymakers/nwrpolicies.html.

In developing a CCP, refuges must consider these broader laws and policies as well as Refuge System and ecosystem goals and visions. The CCP must be consistent with these and also with the refuge purpose.

1.6 Refuge Establishment and Purposes

1.6.1 Legal Significance of the Refuge Purpose

The purpose for which a refuge was established or acquired is of key importance in refuge planning. Purposes must form the foundation for management decisions. The refuge purposes are the driving force in the development of the refuge vision statements, goals, objectives, and strategies in a CCP and are critical to determining the compatibility of existing and planned refuge uses.

The purposes of a refuge are 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.

Unless the establishing law, order, or other document indicates otherwise, purposes dealing with the conservation, management, and restoration of fish, wildlife, plants, and the habitats on which they depend, take precedence over other purposes in the management and administration of any unit. Where a refuge has multiple purposes related to fish, wildlife, and plant conservation, the more specific purpose will take precedence in instances of conflict. When an additional unit is acquired under an authority different from the authority used to establish the original unit, the addition takes on the purpose(s) of the original unit, but the original unit does not take on the purpose(s) of the newer addition. When a conflict exists between the Refuge System mission and the purpose of an individual refuge, the refuge purpose may supersede the mission of the System.

1.6.2 Purpose and History of Refuge Establishment

Siletz Bay NWR was established in 1991 under the authority of the Fish and Wildlife Act of 1956 “for the development, advancement, management, conservation, and protection of fish and wildlife resources” [U.S.C. 742f(a)(4)] and “for the benefit of the United States Fish and Wildlife Service, in performing its activities and services” [16 U.S.C. 742f(b)(1)]. Additional establishment authorities include the Emergency Wetlands Resources Act of 1986 [16 U.S.C. 39 100 Stat 3583], with the purpose of acquisition for “the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to fulfill international obligations contained in various migratory bird treaties and conventions”; and the Endangered Species Act of 1973[16 U.S.C. 1534)], with the purpose “to conserve (a) fish or wildlife which are listed as endangered species or threatened species…or (b) plants.” Funding was authorized by the Land and Water Conservation Fund of 1965.

The original acquisition and funding authorities and their accompanying purposes apply to all the tracts within Siletz Bay NWR, with the exceptions of funding authorities for the Gray Tract (15) and Sanders Tract (22), which were acquired through donations; the Meriwether Tract (28 a, b), which was acquired in exchange for Tract 17a; and the Schoen Tract (20a) and Kangas Tract (20/20R), which were acquired under the Federal Land Transaction Facilitation Act (FLTFA). The FLTFA authorizes the Department of Interior and the U.S. Forest Service to use proceeds from sales of Bureau of Land Management lands to acquire inholdings in federally designated areas, such as NWRS.

1.6.3 Land Status and Ownership

Following the identification of the Siletz Bay estuary and associated diked former tidelands as important habitats for waterfowl (USFWS 1989), the Service was offered the donation of 40 acres of muted tidal marsh as the first refuge parcel (Tract 15). Additional tracts nearby were added over the next 5 years. This portion of the Refuge is now bordered by U.S. Highway 101 on the west, Siletz River on the north and east, and Millport Slough Road and Immonen Road on the south, and is bisected by Millport Slough. The marsh to the north of Millport Slough is a relatively undisturbed tidal prairie with diverse plant communities dominated by tufted hairgrass (Tract 15a). These plant communities are typical of undisturbed high marsh and reflect the range of tidal salinities within this area. Evidence of intact tidal hydrology is provided by the condition of tidal channels on the site. Millport Slough South is a tidal wetland that was diked and managed as pasture for many decades until dike failures occurred in the 1980s and 1990s (Tracts 15, 16a, 16b, 17, 28a, and 28b). The western half had been subjected to muted tidal influence since water control structure failure in 1981. A restoration project, completed in fall 2003, included removing as much of the dike system as possible and placing large woody debris in the restoration area as well as in the natural marsh in Millport Slough North.

The Schooner Creek Tract (37), acquired in 1993, is a 38-acre tract on the east side of Highway 101 at the north end of the Refuge. SE 54th Drive, which leads to the Lincoln City waste treatment plant, bisects the northern portion of the tract. It consists primarily of mixed upland forest with red alder, Sitka spruce, and western hemlock. There are a number of large second-growth trees on the tract, but the presence of several very large and decayed stumps are evidence of past logging. The large trees in the west central portion of the forest overlooking the bay are the preferred perching sites of a pair of resident bald eagles, and their nest and a great blue heron rookery are located on the southern end of this tract.

West of Highway 101 and adjacent to the Siletz River entrance into Siletz Bay, refuge ownership consists of high and low saltmarsh, intertidal mudflats, tidal sloughs and small forested wetlands comprised primarily of Sitka spruce (Tracts 2, 2a, 2b, 2c, and 2e). Along the west side of the marsh extending west into the mudflats are numerous large drift trees and logs that have accumulated, which provide aquatic habitat diversity as well as perching sites for raptors and wading birds. The state-owned mudflats and bay to the north and west of this tract, and particularly the western edge of the tract, are popular for waterfowl hunting. The refuge wetlands west of the Siletz Keys residential development are in good ecological condition and support a diverse native tidal prairie which is a rare habitat type in Siletz Bay. Several old dikes occur on the southern portion of this parcel (Tract 2) that inhibit natural tidal hydrology, and it is desirable to remove the old dikes and allow natural tidal action. The tidal wetland rises to an upland area that was created in the 1970s when the Keys were being constructed. The two smaller tracts closest to Highway 101 are comprised of high saltmarsh with tidal sloughs, and are hydrologically connected via a culvert under the highway (Tracts 2c and 2d).

Refuge lands in the Drift Creek area of the Refuge are located on the east and west side of U.S. Highway 101 at Drift Creek. East of the highway, the tracts are primarily muted tidal wetlands dominated by Lyngby's sedge and slough sedge. Historically, these areas were comprised of tidal marsh; floodplain overflow areas were dominated by Sitka spruce. These parcels were diked and drained and converted to pastureland for grazing of livestock. A severe flood event in the late 1990s resulted in the complete loss of the water control structure on private land located adjacent to the southeast corner of the Shaffer Tract (19). The loss of this water control structure, along with subsequent breaches in the dikes adjacent to Drift Slough and along Drift Creek, now allow significant but muted tidal flows on the property. Grazing is no longer allowed on the refuge property and a seasonal electric fence is installed in the late-spring through fall along the east boundary to prevent cattle from entering from the adjoining property although some trespass grazing occurs when the fence fails. The portion of the refuge tract located south of the Drift Slough tidal channel and east of the refuge residence is also a diked tidal marsh with muted tidal flow (Tract 27). A tidegated culvert formerly existed at the northwest corner of the site. Upon failure, limited tidal flow restricted by beaver dams now enters the site.

West of Highway 101 on the south bank of Drift Creek is the Kromer Tract, which was formerly the site of a fish buying station and dock prior to 1940 and a cedar shake and shingle lumber mill from 1952 through the 1970s (Tract 26). This parcel contains a band-tailed pigeon mineral spring on the south side. The refuge bunkhouse is located on this parcel. West of Highway 101 on the north bank of Drift Creek is the Schnuelle Tract on which the Service breached the dikes in four places in 2000 to restore tidal flows into the marsh (Tract 25). Adjacent to the Schnuelle Tract is the Sanders Tract (22), which is a muted tidal wetland with tidal flows coming through a tidegate located on private property that failed in the late 1990s and was never repaired.

A fairly recent refuge acquisition is the former Kangas Tract that is bound to the west by U.S. Highway 101; on the north by SE 64th Street; and on the east by S. Drift Creek Road (Tract 20). Private lands within the authorized refuge boundary occur along the north, northeast, and south ends. This tract is considered part of the Drift Creek area of the Refuge, and the majority of the tract is classified as freshwater wetlands. Historically, this entire lowland area was intertidal wetlands providing habitat to a host of migratory birds, salmonids, and other estuarine-dependent fish and wildlife species. The area is now diked, ditched, and drained and until the late 1990s was heavily grazed and hayed for cattle forage. When it was grazed and hayed, this action maintained a short-grass condition and provided habitat for a variety of waterfowl, shorebirds, and wading birds. Large numbers of birds are attracted to the area following heavy rainfall when the fields are flooded with freshwater runoff. Upon termination of grazing by the landowner, vegetation has grown in considerably and sedges now occur over much of the site; however, invasive vegetation such as reed canarygrass and Scotch broom is also present. The ditches on the property receive muted tidal flows originating from a failed tidegate on private property west of Highway 101. An undersized and damaged culvert under the highway formerly restricted flows into and out of the Kangas Tract; however, in 2012, the Oregon Department of Transportation completed replacement of the undersized culvert with a 12’ box culvert which allows for greater flow into and out of this tract. Prior to the construction of the new box culvert, the Refuge documented use of the ditches by juvenile coho salmon.

In 2008 the Refuge acquired the 10-acre Schoen Tract, located on an island on the south bank of the Siletz River as it empties into Siletz Bay just east of U.S. Highway 101 (Tract 20a). It is bounded to the south and east by refuge lands, to the west by the old abandoned Highway 101, and to the north by the Siletz River. Immediately south of the parcel is a large area of undisturbed intertidal marsh within the Refuge. This tract contains a dike running around the perimeter of the property. The upland portion of the property was used as a dredged spoil site for the Siletz Keys in 1998 and the dredge spoils were approved through permits by the Army Corps of Engineers (ACOE) and Oregon Department of Environmental Quality (ODEQ). This dredge spoil area is currently comprised of a young red alder forest, although invasive blackberry and Scotch broom are present but are being treated. The lower portion of the property serves as marsh habitat that receives some tidal flows during extreme high tides. Riparian forest occurs on the perimeter dike. The property was zoned to allow for marina development prior to acquisition by the Refuge in 2008. Since acquisition, the Service has renamed this tract Alder Island. Under the CCP’s management direction, the Service will restore the wetlands to tidal flow by breaching the dike and placing footbridges over the breaches to develop a trail to allow limited public use on the site.

Siletz Bay NWR includes one 57-acre tract which is under a perpetual Conservation Easement (Tract 14c). This tract is located along the Kernville Highway (Oregon Route 229) and consists of formerly diked tidal marsh and forested upland. This tract is bordered on the west by a tract of private land that is also a former tidal marsh and contains the tidegated culvert under the highway that drains this area. In fall 2000, the tidegate was only partly functional and as a result, a brackish-water tolerant Lyngby’s sedge community has become established in the west end of the wetland near the culvert (Brophy 2002). The remainder of the wetland is occupied by freshwater slough sedge, soft rush, and reed canarygrass wetland communities. A strong pattern of remnant tidal channels exists on this wetland, particularly in the southeast third of the site. The eastern portion of this tract grades up into forest land and the boundary, with the exception of two inholdings, parallels South Drift Creek Road. The major tidegate on this unit is located on the adjoining private property on the west boundary.

1.7 Relationship to Other Planning Efforts

When developing a CCP, the Service considers the goals and objectives of existing national, regional, state, and ecosystem plans and/or assessments. The CCP is expected to be consistent, as much as possible, with existing plans and assist in meeting their conservation goals and objectives (602 FW 3). This section summarizes some of the key plans reviewed by members of the core team while developing the CCP.

1.7.1 Refuge Plans

Key plans utilized for the Siletz Bay NWR include the Environmental Assessment for the proposed Siletz Bay National Wildlife Refuge, produced in 1990 by the Service (USFWS 1990). This plan includes a history of the area and its various ownerships, the rationale for proposing its inclusion into the Refuge System, a description of historical and current uses and threats, detailed descriptions of wildlife and habitats included in the proposed refuge, and an evaluation of the biological, social, and economic effects of establishing this Refuge.

Information useful for the Physical Environment (Chapter 3), Biological Environment (Chapter 4), and Socioeconomic Environment (Chapter 5) was found in the Wildland Fire Management Plan (USFWS 2004). The Fire Plan contains climate data, plant and wildlife species and community descriptions, refuge facilities and infrastructure information updated through 2004, information on wildfire risk and suppression options, and identification of sensitive habitats to be considered in planning for fire risk reduction and suppression actions.

1.7.2 Other Plans and Assessments

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 list identifies some of the key plans and assessments that were reviewed by members of the core team while developing the CCP.

- Birds of Conservation Concern (USFWS 2008a)
- Birds of Management Concern (BMC) – Region 1 (USFWS 2005)
- Siletz Estuary Plant Community Mapping (Brophy 2001)
- Siletz Bay NWR and Nestucca Bay NWR Tidal Marsh Restoration and Reference Sites: Baseline Plant Community Monitoring and Mapping (Brophy 2002)
- Development of a Salt Marsh Assessment Tool to Monitor System Integrity and Provide Management Priorities for Wildlife Conservation in Response to a Hierarchy of Threats: Global Change, Invasive Species and Local Stressors (Guntenspergen et al. 2009)
- Rising to the Challenge: Strategic Plan for Responding to Accelerating Climate Change (USFWS 2010a)
- Strategic Plan for Inventories and Monitoring on National Wildlife Refuges: Adapting to Environmental Change (USFWS 2010b)
- Important Fish and Wildlife Habitats in Oregon (USFWS 1980)
- Plant Communities and Succession in Oregon Coastal Salt Marshes (Jefferson 1975)
- Coastal Coho Habitat Factors for Decline and Protective Efforts in Oregon (National Marine Fisheries Service [NMFS] 1997b)
- Endangered and Threatened Species: Final Threatened Listing Determination, Final Protective Regulations, and Final Designation of Critical Habitat for the Oregon Coast

Evolutionarily Significant Unit of Coho Salmon (National Oceanic and Atmospheric Administration [NOAA] 2008)
- North American Waterfowl Management Plan (NAWMP Plan Committee 2004)
- North American Waterbird Conservation Plan (Kushlan et al. 2002)
- Northern Pacific Coast Regional Shorebird Management Plan (Drut and Buchanan 2000)
- Oregon's Salt Marshes (Oberrecht 1997)
- Oregon Biodiversity Information Center (ORBIC 2010)
- Partners In Flight Species Assessment Database (PIF 2010)
- State of Oregon Conservation Strategy (ODFW 2006)
- Threatened, Endangered, and Candidate Fish and Wildlife Species in Oregon (ODFW 2012a)
- Identifying Resources of Concern and Management Priorities for a Refuge: A Handbook (USFWS 2008b)

1.8 Special Designation Lands

1.8.1 Important Bird Areas (IBA)

The Important Bird Areas (IBA) program is a global effort to identify the most important areas for maintaining bird populations and focusing conservation efforts on protecting these sites. Within the U.S., the program has been promoted and maintained by the American Bird Conservancy (ABC) and the National Audubon Society (NAS). The ABC is coordinating the identification of nationally significant IBAs while NAS is working to identify sites in individual states. NAS is working within each state to identify a network of sites across the U.S. that provide critical habitat for birds. This effort recognizes that habitat loss and fragmentation are the most serious threats to birds across North America and around the world. By working through partnerships, principally the North American Bird Conservation Initiative, to identify those places that are critical to birds during some part of their life cycle (breeding, wintering, feeding, migrating), the intent is to minimize the effects that habitat loss and degradation have on bird populations. The IBA program has become a key component of many bird conservation efforts. More information is available at http://www.audubon.org/bird/iba/index.html.

The goals of the IBA program are to identify the sites that are the most essential for long-term conservation of birds and to take action to ensure the conservation of these sites (Cullinan 2001). An IBA is a site that provides essential habitat for one or more species of birds. The IBA selection process examines sites based on the presence and abundance of birds and/or the condition and quality of habitat. IBAs are chosen using standard biological criteria and expert ornithologists' review. All sites nominated as potential IBAs are rigorously evaluated to determine whether they meet the necessary qualifications. IBAs represent discrete sites, both aquatic and terrestrial, that are critically important to birds during their annual life cycle (e.g., breeding, migration, and/or wintering periods).

The mudflats and lower salt marshes of Siletz Bay NWR are included within the 1,186-acre Siletz Bay Important Bird Area. This IBA also contains other habitats, including submerged areas and sandflats, within the larger bay. Bird numbers at this site regularly surpass, in season, more than 100 California brown pelicans and thousands of waterfowl (in marine estuarine habitats) and shorebirds. Occasionally, usually due to large schools of anchovy entering the bay, huge pulses of gulls, pelicans, and other species swarm into the bay to make use of the bountiful resources.

1.9 Planning Process and Issue Identification

1.9.1 Planning Process

Planning Team: The core planning team for Siletz Bay NWR consists of the project leader, deputy project leader, refuge manager, visitor services manager, wildlife biologist, and natural resource planner. An extended team consisting of biologists; cultural resource, public use, and realty specialists; economists; and law enforcement officers from the Regional Office, other Federal agencies, State agencies, the Confederated Tribes of Siletz Indians, and a private environmental consultant assisted in the development of this CCP, particularly in providing comments at key milestones. The full list of core and extended team members and their roles is provided in Appendix I.

Resources of Concern: The planning process began when the planning team reviewed refuge purposes and considered other plans and reports, and sought input from Oregon State conservation agencies, non-governmental organizations and tidal marsh experts. The planning team then identified the top priority species, groups, and communities for the Refuge. A comprehensive list of potential resources of concern was compiled based upon review of the plans referenced above, many of which highlight priority species or habitats for conservation. From this list, those species and habitats that are most representative of refuge purposes and habitats, BIDEH, as well as other FWS and ecosystem priorities, were chosen as priority resources of concern (habitat types) and focal resources (plant and animal species). This list was then provided to participants in the Wildlife and Habitat Review, which was held on the Refuge on March 18, 2010, and included the extended team, Oregon Department of Fish and Wildlife biologists, Department of State Lands representatives, and several tidal wetland restoration specialists. The participants raised important issues and provided feedback that was used to refine the Priority Resources of Concern table. This table includes focal species, also called conservation targets, which were selected as representatives or indicators for the overall condition of important refuge habitats. Most of the biological emphasis of the CCP is focused on protecting and restoring these species. See Appendix E for the Comprehensive Resources of Concern and Priority Resources of Concern.

Public Use Planning: Public use planning centered on developing goals, objectives, and strategies around the six wildlife-dependent recreational uses that are defined in Service policy as priority, appropriate public uses for refuge lands. A Visitor Services Review for Siletz Bay NWR was held on the Refuge on April 15, 2010, with representatives from the extended team and public use specialists from USGS and one other national wildlife refuge. A background document including existing uses and visitor facilities was provided to participants prior to the Visitor Services Review. The participants' input was used by the planning team to assess past, current, and future management issues surrounding public use while developing objectives and strategies during the Comprehensive Conservation Plan process. In addition, the Service hired a contractor to conduct a Facilities Review, which provided insight and conceptual plans for the future of administrative and visitor facilities at Siletz Bay NWR. This information was also incorporated into the alternatives, and some ideas were included as strategies to achieve broader goals for future management of this Refuge.

Public Involvement: Public scoping began in November 2010 with a notice in the Federal Register [November 29. 2010, Volume 75, Number 228] and a public meeting November 29, 2010 in Lincoln City. Public input was also solicited through distribution of planning updates to our mailing list and meetings with key stakeholder groups. The comments and suggestions made through this process helped further develop and refine the management alternatives for the CCP, including the preferred alternative. A second planning update containing preliminary draft alternatives was distributed in November 2011 and another public open house meeting was held on November 10, 2011 in Lincoln City to explain the alternatives and take comments. The Siltez Bay National Wildlife Refuge Draft Comprehensive Conservation Plan and Environmental Assessment (DCCP/EA) was issued for public review and comment on September 17, 2012. The availability of the plan was announced through a notice in the Federal Register [September 17, 2012, Volume 77, Number 180] and via direct contact with approximately 600 people on our mailing list. The plan was made available for downloading on the Oregon Coast National Wildlife Refuge Complex Planning website and was made available upon request in CD or printed format. Printed copies of the DCCP/EA were available at local public libraries, and upon request. All changes made as a result of public and agency comments were documented. A summary of public involvement is included in Appendix J; public comments on the DCCP/EA and the Service's responses to comments are included in Appendix K.

1.9.2 Key Issues Addressed in the CCP

The core planning team evaluated the issues and concerns raised during public scoping. 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)." Issues are important to the planning process because they identify topics to be addressed in the CCP, pinpoint the types of information to gather, and help define alternatives for the CCP. It is the Service's responsibility to focus planning and the analysis on the major issues. Major issues typically suggest different actions or alternative solutions, are within a refuge's jurisdiction, and have a positive or negative effect on the resource. The following issues are within the scope of the CCP and were considered by the Service to be the major issues to address in this planning process:

Wildlife and Habitat Management: What actions should the Service take to sustain and restore priority species and habitats over a period of 15 years? How should the Service prioritize the restoration of hydrologic function, historic water flows, tidal flows, and floodplain functions on the Refuge, and how can partners most efficiently be involved in this restoration? Are there opportunities to restore upland forest, forested wetlands, and riparian areas? How will the Service prioritize inventory, control and monitoring of invasive species?

Climate Change: What actions should the Service take to address anticipated impacts to refuge resources from climate change/sea level rise, including species range shifts, phenological changes, decoupling of species assemblages, hydrological changes, ocean acidification, and changes in disturbance regimes? Are there focal species that will be adversely affected (directly or indirectly) by climate change, and what might be done to mitigate for that? How can cumulative stresses be reduced (e.g., among climate stress and other anthropogenic stresses, which do we have most control over)? Many of these threats are much larger in scope than just Siletz Bay NWR. They will be addressed at various scales depending on available information and what is most appropriate and relevant to the Refuge.

Public Uses: What public use opportunities will best support refuge purposes and increase visitor awareness of the Service's and Refuge System's mission and goals? Should the Service consider opening new areas of the refuge to public access, and what activities should be allowed in these areas? Where would new trails and other wildlife observation facilities be compatible and desirable on Siletz Bay NWR, and if constructed, how can these be designed to enhance public enjoyment, understanding, appreciation, and stewardship of refuge resources? Should the Service consider opening portions of the Refuge to waterfowl hunting, fishing, and clamming, and if so, where?

Facilities: Is there a need for a Service-owned visitor and education center at Siletz Bay NWR? Should the Service pursue the establishment of a visitor or environmental education center at Siletz Bay NWR, or would it be more efficient and productive to pursue partnerships with existing information outlets?

1.10 Refuge Vision and Goals

1.10.1 Vision Statement

At Siletz Bay National Wildlife Refuge we will preserve in perpetuity a dynamic mixture of tidal marsh, sloughs, mudflats, and forest. The refuge will be a place where salmon and trout find shelter near large woody debris; where birds of prey hunt from perches on starched skeleton trees; and where herons, egrets, and waterfowl safely forage in the tidally influenced waters.

Tidal marshes and woodlands will be restored to their historic conditions and invasive plants will be eradicated whenever they are found. We will work with our conservation partners to apply sound, scientific principles, and adaptive management strategies to sustain the integrity of the estuary in the face of a changing climate. Paddling through the open waters that nourish the Refuge, visitors will experience unique opportunities to connect with nature.

1.10.2 Refuge Goals

Refuge management goals are descriptive, open-ended, and often broad statements of desired future conditions that convey a purpose, but do not define measurable units. Goals must support the refuge vision and describe the desired end result.

Wildlife and Habitat Goals:

1. Protect and maintain upland forests characteristic of the North Pacific Coastal Ecosystem.
2. Restore, enhance, protect, and maintain estuarine habitats characteristic of the Pacific Coastal Ecosystem.
3. Protect and maintain forested wetlands and stream-riparian habitat characteristic of the North Pacific Coastal Ecosystem.
4. Enhance, protect, and maintain instream aquatic habitat for all dependent species including anadromous and estuary-dependent fish.
5. Research and monitoring. Gather scientific information (surveys, research, and assessments) to support adaptive management decisions.

Public Use Goals:

6. Provide opportunities for people of all ages to observe, photograph, and learn about waterfowl, waterbirds, and other estuarine wildlife of the Pacific Coast and increase their interest in and connection with nature.

7. Provide and manage safe, enjoyable, and quality waterfowl hunting and fishing opportunities in Siletz Bay for people of varying ages and resources that further the tradition of wildlife conservation and stewardship.
8. Provide facilities and materials and conduct outreach that welcomes and orients children and adults to Siletz Bay National Wildlife Refuge so they can easily and safely learn about its abundant fish and wildlife resources.

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USFWS

Chapter 2 Management Direction

Chapter 2. Management Direction

2.1 Overview

During development of this CCP, the Service reviewed and considered a variety of local and regional physical and biological resource conditions, as well as social, economic, and organizational aspects important for managing the Refuge. 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 (Public Law 105-57) states "…the fundamental mission of our System is wildlife conservation: wildlife and wildlife conservation must come first." Toward this end, the refuge planning team reviewed scientific reports and studies to better understand ecosystem trends and the latest scientific recommendations for species and habitats.

Public involvement was an important part of the planning process. Local, State, and Federal agencies, Tribes, and elected officials were contacted by the Refuge Complex planning team to ascertain priorities and problems as perceived by others. In addition to holding a public scoping meeting to explain the process and accept comments and suggestions, the team contacted refuge users, nonprofit groups, and community organizations to ensure 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 a public meeting in fall 2011. Based on all of the information gathered and feedback from others through the public involvement process, the Service developed three draft alternatives for the Draft Comprehensive Conservation Plan and Environmental Assessment (Draft CCP/EA) for Siletz Bay National Wildlife Refuge (USFWS 2012a), which was released in September 2012. Alternative C was selected as the preferred alternative.

The CCP planning team reviewed and evaluated all of the comments received during the 30-day Draft CCP/EA comment period. Alternative C within the Draft CCP/EA was selected for implementation. In some cases, the management direction has been either clarified or modified based upon public feedback. The details of public participation can be found in Appendix J, Public Involvement, and Table K-2 within Appendix K, Comments Received during Public/Agency Review Period and Service Responses, shows the major changes between the draft and the final CCP.

2.2 Management Directions 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.

Development of a Visitor Center. During the public scoping process the Service received comments from the public and one conservation organization regarding the development of a visitor contact station on a site that is currently serving as a dentist office. Specifically it was requested that the Service purchase the property and convert the dentist office into a visitor contact station. This parcel of land is in private ownership and it is outside of the approved refuge boundary. The Service also believes that this site is extremely vulnerable to sea level rise and storm surge resulting from climate change and is therefore an inappropriate location for this type of development. For these reasons the Service did not develop this option as an alternative.

Substantial Participation in a Community-based Visitor Center. During the public scoping process the Service received comments requesting our extensive participation in a community-based visitor center that is yet to have a determined location. Specifically the comments stated that the Service should build and manage the visitor center and the community would respond by assisting in the staffing of the center. Due to the small size of the Refuge, limited staff, the inadequacy of available locations owned by the Service in the vicinity of Siletz Bay NWR, and the availability of other resource-related material in the local community, the Service made the decision not to develop this as an alternative.

2.3 Description of Management Direction

A brief description of the management direction follows. Table 2-1 contains additional details regarding actions associated with the CCP. A map displaying management direction for the Refuge is located at the end of this chapter (Figure 2-1).

Wildlife and Habitat Management. Refuge management actions will continue to emphasize protecting and maintaining estuarine, stream-riparian, and forested habitats; however, an increased level of active habitat management and monitoring will also be implemented. If feasible, tidal marsh restoration will occur at Siletz Keys and Alder Island, and on any additional diked lands acquired. Inventory, monitoring, and research programs will be expanded.

Public Use Management. Opportunities for wildlife observation and photography will be established throughout the Refuge including the development of a loop trail, a viewing platform, and a parking lot at Alder Island. Unrestricted walking will be allowed on refuge lands west of Highway 101 for the purpose of wildlife observation and photography. Interpreter-led seasonal paddle trips will continue and potentially expand with the development of a non-motorized boat launch near Alder Island.

Waterfowl hunting will be allowed daily in season on 87 acres of refuge lands west of Highway 101, and 3 days per week on 112 acres of refuge lands south of Millport Slough and east of Highway 101. A 100-yard no-hunting zone will be established to prohibit waterfowl hunting on refuge lands that extend westward from the refuge property line on the west side of the housing development of Siletz Keys. A small gravel parking lot and kiosk will be developed to support the Millport Slough waterfowl hunting access. Access to clamming will be allowed through Snag Alley and walk-in bank fishing will be allowed from Alder Island only.

Adaptive Management. Adaptive management is a management philosophy and decision process that incorporates flexibility and continual learning. It involves monitoring and evaluation of refuge accomplishments, comparing accomplishments to objectives, and changing management strategies or objectives as necessary to achieve desired results. In the presence of accelerated climate change, adaptive management is an increasingly important management-decision process. The Refuge will employ adaptive management as a standard operating procedure.

Appropriateness and Compatibility. Consistent with relevant laws, regulations, and policies, prior to allowing any public use of the Refuge (including commercial use), each use will first need to be found appropriate and determined compatible (16 U.S.C. 668dd-668ee, 50 CFR 25, 26, and 29; and

603 FW 1 and 2). In the Draft CCP/EA, the Service made preliminary findings and determinations regarding the appropriateness and compatibility of each planned use. Appropriateness findings and compatibility determinations have been finalized for each use included in the Service's management direction. Appropriateness and compatibility are further discussed in Appendices A and B.

Climate Change. As stated in the Department of the Interior's Secretarial Order 3226 and the Service's Climate Change Strategic Plan (USFWS 2010a), the Service considers and analyzes climate change in its decisions, long-range plans and other activities. Habitat conditions and wildlife populations are directly and indirectly sensitive to climatic conditions, namely precipitation and temperature and changes to hydrologic conditions, sea level rise, and ocean acidification. As described in greater detail in Chapter 3, the Refuge is potentially affected by sea level rise in spite of upward vertical land movement and estimated sediment and vegetative accretion rates. The Refuge may be also be affected by storm surges, increases in extreme precipitation events, higher water temperatures, and ocean acidification.

The combined changes can affect the Refuge's habitats and species directly, such as the timing of arrival of migratory birds and many other phenologic responses, changes in species' ranges and physiology, and indirectly such as added vulnerability to other stressors including increasing invasive species and pathogens. Predicting biological response at the population level, however, requires complex research and information and sophisticated models that can be validated with field studies over time. This highlights the importance of monitoring habitat and species to establish potential correlations and adaptation options.

Knowledge and monitoring of regional and local climate trends on refuge resources will be used to assess potential changes or enhancements to the Refuge's management actions and techniques and/or their timing, using the adaptive management approach described above.

The Refuge Complex staff will participate in and contribute to climate change and sea level rise assessment efforts, including those underway at a landscape scale. Participation in the North Pacific Coast Landscape Conservation Cooperative (LCC) will provide refuge staff with a means to tie in with a larger scale assessment of the impacts of climate change (USFWS 2010a). LCCs are formal science-management partnerships between the Service, Federal agencies, states, tribes, non-government organizations (NGOs), universities, and other entities to address climate change and other biological stressors in an integrated fashion. LCCs provide science support, biological planning, conservation design, research, and design of inventory and monitoring programs.

As needed, objectives and strategies will be adjusted to assist in enhancing the resiliency of refuge resources to climate change. Specific management goals, objectives, and strategies, based on climate change impact projections, will be identified for refuge habitats most vulnerable to climate change and sea level rise.

The Service has developed a Strategic Plan for Responding to Accelerating Climate Change in the 21st Century (USFWS 2010a), and an Action Plan outlining specific actions needed to implement the Strategic Plan. The Action Plan calls for the Service to make its operations carbon-neutral by 2020. The Refuge will work toward this goal by continuing to pursue and engage in mechanisms to conserve energy in refuge operations, including the use of fuel-efficient vehicles and building appropriately sized, energy-efficient facilities, as funding becomes available. The Refuge will also reduce the carbon footprint of land management activities by using energy-efficient techniques, where feasible and in line with management goals. The Refuge will also explore ways of offsetting any remaining carbon balance, such as carbon sequestration.

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.

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. Fire Management Plans (FMPs) were completed for the entire Complex, including Siletz Bay Refuge, in 2004. The FMP details response to the threat of wildfire and under what circumstances the refuges will use wildland fire as a tool on refuge lands.

Implementation Subject to Funding Availability. Actions described in this CCP will be implemented over the life of the plan as funding becomes available. Project priorities and projected staffing/funding needs are included in Appendix C.

Integrated Pest Management (IPM). In accordance with 517 Departmental Manual (DM) 1 and 569 Fish and Wildlife Service Manual (FW) 1, an integrated pest management (IPM) approach will be utilized, where practicable, to eradicate, control, or contain pest and invasive species (herein collectively referred to as pests) on refuge lands. IPM will involve using methods based upon effectiveness, cost, and minimal ecological disruption, which considers minimum potential effects to non-target species and the refuge environment. Pesticides may be used where physical, cultural, and biological methods or combinations thereof, are impractical or incapable of providing adequate control, eradication, or containment. If a pesticide is needed on refuge lands, the most specific (selective) chemical available for the target species will be used unless considerations of persistence or other environmental and/or biotic hazards would preclude it. In accordance with 517 DM 1, pesticide usage will be further restricted because 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.

Appendix G contains the Refuge’s IPM program documentation to manage pests for this CCP. Along with a more detailed discussion of IPM techniques, this documentation describes the selective use of pesticides for pest management on refuge lands, where necessary. Throughout the life of the CCP, most proposed pesticide uses on refuge lands will be evaluated for potential effects to refuge biological resources and environmental quality. These potential effects will be documented in “Chemical Profiles” (see Appendix G). Pesticide uses with appropriate and practical best management practices (BMPs) for habitat management as well as facilities maintenance will be approved for use on refuge lands where there likely would be only minor, temporary, and localized effects to species and environmental quality based upon non-exceedance of threshold values in Chemical Profiles. However, pesticides may be used on refuge lands where substantial effects to species and the environment are possible (exceed threshold values) in order to protect human health and safety (e.g., mosquito-borne disease).

Because invasive plants and animals currently represent the greatest threat to the Refuge's wildlife and habitat, control of invasive species will be a high priority management activity. Invasive species such as Scotch broom, Himalayan blackberry, English ivy, and reed canarygrass will continue to be a primary management concern and will be controlled to the degree that funding permits. Invasive species control will be initiated prior to or concurrently with all habitat restoration efforts.

The magnitude of pest problems on the Refuge is beyond the available capital resources to expect control or eradication during any single field season; therefore it is essential to prioritize treatment of infestations. Some non-native species which are pervasive on refuge lands are the subject of long-term control efforts and will continue to be a high priority. Also, the Service will find and verify the identity of new invasive species as early after entry as possible, when eradication and control are still feasible and less costly. Regardless of whether the invasive species is well established or newly introduced, the Refuge will prioritize 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.

Land Protection. The Service has the authority to acquire land or negotiate agreements on behalf of the National Wildlife Refuge System only within an approved refuge boundary. The Service can make offers to purchase land, purchase conservation easements or enter into management agreements with willing landowners within the approved boundary. Lands or interests therein do not become part of the National Wildlife Refuge System unless they are purchased from or are placed under a management agreement with the individual landowner. Service authority over any use of lands within an approved refuge boundary is limited to lands the Service has acquired in fee title, conservation easement, or entered into an easement or management agreement. Private landowners within an approved refuge boundary retain all of the rights, privileges, and responsibilities of private land ownership and are under no obligation to sell their property to the Service. Service policy for land acquisition is to work on a one-on-one basis with a willing seller/interested landowner. Based on the availability of funds, the Service will continue to negotiate with willing sellers to acquire lands within the existing approved refuge boundary.

Maintenance of Existing Facilities. Periodic maintenance of refuge buildings and facilities will be necessary. 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.

Regulatory Compliance. Prior to implementation, all planned activities will undergo appropriate reviews and consultations, and permits and clearances will be secured, as necessary, to comply with legal and policy requirements. This includes water quality permits required under Section 401, and dredge and fill permits required under Section 404 of the Federal Water Pollution Control Act of 1982, as amended (33 U.S.C. 1251-1382); appropriate evaluations and documentation under the National Environmental Policy Act; and, as noted above, evaluation and consultation required by Section 7 of the Endangered Species Act, and review and consultation required by Section 106 of the National Historic Preservation Act.

Response to Mosquito-borne Diseases. Under draft refuge policy (72 Federal Register 71939), mosquito populations on refuge lands are allowed to fluctuate and function unimpeded unless they pose a threat to wildlife and/or human health. While the Service recognizes that mosquitoes are a natural component of most wetland ecosystems which provide food for some fish and wildlife including migratory birds, we also recognize they can be a nuisance and may represent a threat to human and/or wildlife health. To protect human and wildlife health and safety, the state or a local vector control agency would be allowed to control mosquito populations on refuge lands using pesticide treatments (larvicides, pupacides, or adulticides) only if local, current population monitoring and/or disease surveillance data indicate refuge-based mosquitoes pose a health threat to humans and/or wildlife. As previously described, mosquito treatments would be allowed on refuge lands in accordance with IPM principles applicable to all pests (see Appendix G). Proposed pesticide uses for mosquito control will utilize appropriate and practical BMPs, where possible, given potential effects documented in Chemical Profiles. If mosquitoes are determined to be posing a threat to wildlife and/or human health, a refuge compatibility determination (CD) will be written, which will provide details regarding mosquito population monitoring, disease surveillance, and treatments.

A disease contingency plan (DCP) will be prepared addressing response to mosquito-borne disease outbreaks on and/or adjacent to refuge lands. Much of the information will be evaluated and described in the previously mentioned CD (e.g., IPM treatment options) and will be incorporated with additional specificity, where necessary, into this plan. The DCP also will include other information such as the history of mosquito-borne diseases on and/or adjacent to the Refuge as well as measures to protect refuge visitors, Service-authorized agents, and Service employees when a health threat or emergency is identified by health officials.

Participation in Regional Planning and Conservation Efforts. The Refuge Complex staff will actively participate in and contribute to planning and conservation efforts for ongoing and future monitoring and research associated with tidal marsh restoration, invasive species detection and rapid response, and other activities that may affect refuge wildlife resources and habitats. Refuge Complex staff will cultivate working relationships with pertinent local, county, State, and Federal agencies to stay abreast of current and potential developments; and will utilize outreach, education, and information as needed to raise awareness of refuge resources and their dependence on a healthy local environment.

Partnerships. Partnerships on the Refuge are critical components in maintaining and continuing efforts to enhance recreation opportunities or implement resource management improvements, such as restoring habitat for threatened and endangered species. These partnerships typically involve joining forces with Federal, state, and local agencies and organizations. The Service will continue to devote time and effort towards maintaining existing and developing new partnerships to enhance collaboration on support of fish and wildlife resources, wildlife-dependent recreational opportunities, and educational programs, and to explore ways to share funding and seek grants on projects of mutual interest. Specifically, the Service will work with local and state agencies to promote mutual understanding, encourage environmentally friendly development, and promote eco-tourism opportunities.

Refuge Revenue Sharing. Annual payments to Lincoln County under the Refuge Revenue Sharing Act (16 U.S.C. 715s) will continue according to the established formula and subject to congressional appropriations.

State Coordination. The Refuge Complex will continue to coordinate with Oregon State agencies regarding areas of mutual interest. This includes communications with ODFW regarding public recreation, fish passage, and habitat restoration and management priorities identified through the Oregon Conservation Strategy.

Tribal Coordination. The Service will coordinate and consult with Native American Tribes on a regular basis regarding issues of shared interest. Currently 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.

Volunteer Opportunities and Partnerships. Volunteer opportunities and partnerships are recognized as key components of the successful management of public lands and vital to implementation of refuge programs, plans, and projects.

Wilderness Review. The Service's CCP policy requires that a wilderness review be completed for all CCPs. If it is determined that the potential for wilderness designation is found, the process moves on to the wilderness study phase. As part of the process for this CCP, the planning team completed a wilderness review which can be found in Appendix D. This review concluded that the Refuge is not suitable for wilderness designation.

Table 2-1. Summary of Management Direction

Key Theme/issue	Future Management
Forested Habitat	
Upland forest	122 acres protected and actively managed. Inventory and assess existing conditions and manage for late-successional forest.
Estuarine Habitat	
Intertidal mudflats	Continue to protect and maintain 0.8 acre, using IPM techniques, plus work with the Oregon Department of State Lands to cooperatively manage intertidal mudflats and to monitor and treat invasive species.
Tidal marsh	Protect and maintain 314 acres of tidal marsh. Work with private landowners and partners to acquire lands within the authorized refuge boundary to facilitate full tidal restoration. Work with ODOT and ODFW to repair or replace culverts to achieve normal tidal function. If feasible, restore tidal flow to Siletz Keys and Alder Island (Schoen Tract) and any additional diked lands acquired. Outplant rare, native species (e.g., Henderson's checkermallow) to increase native vegetation presence.
Forested Wetlands and Stream-Riparian Habitat	
Forested wetlands and stream-riparian corridor	18 acres protected. Control invasive species with IPM techniques.
Monitoring and Research	
Status monitoring	Continue and expand existing data collection. Collect data on fish, amphibians, small mammals, plants, migratory songbirds.

Table 2-1. Summary of Management Direction

Key Theme/issue	Future Management
Effectiveness monitoring	Monitor CCP and other step-down plan objectives.
Research	Continue current research, plus identify priority and long-term research needs and cooperate with partners to accomplish.
Wildlife Observation and Photography	
Wildlife observation and photography	Open Alder Island (Schoen Tract) to observation and photography through development of accessible loop trail. Allow unrestricted walking on refuge lands west of Highway 101. Develop viewing platform off Highway 101.
Interpretation	
Interpretation	Open Alder Island (Schoen Tract) and develop interpretive trail, parking lot, and boat launch, and continue with interpreter-led seasonal paddle trips.
Hunting	
Waterfowl hunting	Allow waterfowl hunting on lands west of Highway 101 (87 acres) 7 days per week. Allow waterfowl hunting 3 days per week on lands south of Millport Slough (112 acres). Establish a 100-yard no-hunting zone to prohibit waterfowl hunting on refuge property that extends westward from the refuge property line on the west side of the housing development of Siletz Keys. Develop gravel parking lot and kiosk.
Fishing	
Fishing	Allow bank fishing from Alder Island—walk in only.
Access for clamming	Allow access to clamming through Snag Alley.
Facilities	
Facilities	Keep current refuge facilities and do not build a visitor center. Utilize habitat-appropriate native plants for landscaping around public use facilities.
Climate Change Adaptation	
Reduce carbon footprint	Replace current vehicles with more fuel-efficient vehicles. Any new or replaced facilities will be appropriately sized and energy-efficient. Use energy-efficient land management techniques where feasible and in line with management goals. Explore ways of offsetting carbon balance, such as carbon sequestration.

2.4 Goals, Objectives, and Strategies

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

The goals for Siletz Bay NWR 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 location. 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.

Readers, please note the following:

Below each objective statement are the strategies that could be employed in order to accomplish the objectives. Symbols used in the following tables include:

% percent sign
> greater than
< less than

2.4.1 Goal 1: Protect and maintain upland forests characteristic of the North Pacific Coastal Ecosystem.

Objective 1.1 Protect and maintain Sitka spruce-western hemlock forest
Protect and maintain 122 acres of Sitka spruce-western hemlock forest on Siletz Bay NWR for the benefit of migratory landbirds (e.g., chestnut-backed chickadee, pileated woodpecker) and a diverse assemblage of other forest-dependent species (e.g., black-tailed deer, bald eagle, Roosevelt elk, bobcat, Pacific giant salamander) throughout the life of the CCP. The desired attributes of this forested habitat are the following: • 30-95% (73% average) canopy cover of Sitka spruce and western hemlock with DBH 24-36" • 25-95% (83% average) cover of a mosaic of native shrubs (e.g., salmonberry, huckleberry, salal), ferns, and herbaceous species (e.g., sedges) in understory. Shrub height averages 3 meters (9.84 feet) • 600 square feet/acre density of nurse logs • 6/acre density of snags • <5% cover of invasive plants (e.g., Himalayan blackberry, Scotch broom) • <1% cover English ivy
Strategies Applied to Achieve Objective
Management Strategies:
a. Use appropriate forest management techniques (e.g., girdling, falling) to thin trees using multiple entry approach, where needed
b. Utilize appropriate IPM techniques including mechanical/physical, chemical, biological, and cultural means (see IPM Appendix)
Monitoring Strategies (see also Objective 5.1 Survey):
c. Monitor migratory landbirds (e.g., chestnut-backed chickadee, pileated woodpecker) and other forest-dependent species (e.g., black-tailed deer, bald eagle, bobcat, Pacific giant salamander) populations to determine distribution and abundance

d. Estimate canopy cover and DBH of Sitka spruce and western hemlock to determine percent cover by species
e. Estimate understory cover of a mosaic of native shrubs (e.g., salmonberry, huckleberry, salal), ferns, and herbaceous species (e.g., sedges) to determine percent cover by species
f. Monitor snags to determine density and location
g. Monitor invasive plant species (e.g., Himalayan blackberry, Scotch broom, English ivy) to determine percent cover, and location
h. Monitor tree density and thinning efforts to determine areas that need attention
i. Monitor bald eagles to determine distribution, population, and reproductive success
Rationale: The long-term target is production of late-successional Sitka spruce and western hemlock forest characteristics and restoration of up to 100% of the historic extent of this forest type within the Refuge. Numerous definitions of late-successional or old growth forest exist and vary by location and dominant tree species. However, most definitions indicate four important structural components: number and minimum size of large live trees; canopy conditions; number and minimum size of snags; and number and size of downed large woody debris (LWD). Late-successional Sitka spruce-western hemlock forests provide nesting habitat, forage, and shelter to a variety of wildlife species including the bald eagle. Migratory landbirds (e.g., chestnut-backed chickadee, pileated woodpecker) use the conifer forests because of the presence of other birds and rodents, bark and wood-boring insects, and conifer seeds. This habitat will also benefit a diverse assemblage of other forest-dependent species (e.g., black-tailed deer, bobcat, Pacific giant salamander). Much of this habitat type has been removed from the Oregon coast due to extensive logging and development. The Refuge currently contains 122 acres of Sitka spruce-western hemlock forest. The forested stands exist within the Schooner Creek Tract, Drift Creek area, Millport Slough North, and Erickson/Schaffer Easement. There are a number of large second-growth trees within these areas, but the presence of several very large and decayed stumps are evidence of past logging. While this objective emphasizes allowing natural processes (e.g., windfall and natural regeneration in openings) to drive vegetative changes, additional techniques such as thinning, girdling, and falling will also be used to promote the development of late-successional characteristics. Thinning (girdling, falling) trees reduces competition for the resources needed for growth thus promoting larger DBH of late-successional Sitka spruce and western hemlock. Snags are also an important component of a late-successional forest and tree girdling (strip of bark removed from circumference of trunk) can be used to kill trees and create snags. Maintenance measures, primarily invasive plant control, will be regularly implemented using appropriate IPM techniques including mechanical/physical, chemical, biological, and cultural means. Invasive plants compete with desired tree and shrub species, limit native vegetation production, and cause impacts to food, nesting, and cover for wildlife. Controlling and treating invasive species on a consistent basis will allow the Refuge to continue to provide quality habitat to improve fish and wildlife health and survival.

2.4.2 Goal 2: Restore, enhance, protect, and maintain estuarine habitats characteristic of the North Pacific Coastal Ecosystem.

Objective 2.1 Enhance, protect, and maintain salt marsh
Enhance, protect, and maintain 314 acres of salt marsh on Siletz Bay NWR for the benefit of migratory birds (e.g., mallard, American wigeon, bufflehead, green-winged teal, wood duck, Canada geese, savannah sparrow, great blue heron, northern harrier), salmonids (e.g., Chinook, cutthroat, coho), and diverse assemblage of other species (e.g., river otter, black-tailed deer) throughout the life of the CCP. Salt marsh is characterized by the following attributes: • Diverse elevations ranging from about 3 feet below mean lower low water (MLLW) to 9 feet above MLLW for tidal flats and tidal marshes. Hydrological flows are affected by high flows in the rivers and tidal cycles • Low elevation areas are a mosaic of native species including salt grass and pickleweed • Upper elevation includes Lyngby's sedge, slough sedge, tufted hairgrass, Pacific silverweed and occasional Henderson's checkermallow • Interspersed tidal channels of different orders with LWD component • Lands completely submerged during high seasonal tidal cycles • No cordgrass species
Strategies Applied to Achieve Objective
Management Strategies:
a. Utilize appropriate IPM techniques including mechanical/physical, chemical, biological, and cultural means (see IPM Appendix)
b. Outplant rare, native species (e.g., Henderson's checkermallow) to increase native vegetation presence
c. Clean and disinfect clothing and boating equipment before and after entering salt marsh
d. Apply public outreach to inform public about invasive or exotic animal species introductions, transport, and control methods
Monitoring Strategies (see also Objective 5.1 Survey):
e. Monitor migratory birds (e.g., savannah sparrow, great blue heron, northern harrier), and other mammal species (e.g., river otter, black-tailed deer) populations to determine distribution and abundance
f. Monitor waterfowl to determine populations and habitat use
g. Monitor salt marsh to determine stop-over (feeding and loafing) and breeding habitat parameters for waterfowl
h. Monitor hydrological flows and tidal elevations/cycles to understand hydrological influence and parameters
i. Survey native plant species (salt grass, pickleweed, Lyngby's sedge, slough sedge, tufted hairgrass, Pacific silverweed and Henderson's checkermallow) to determine distribution and density
j. Monitor LWD to determine location and composition and vegetation response
k. Monitor salmonid and estuary-dependent fish to determine distribution, biological characteristics, and use of LWD installations
l. Monitor water quality to describe water quality parameters
m. Monitor composition and relative abundance of macro invertebrates to determine abundance and distribution

n. Monitor invasive plant (e.g., cordgrass, reed canarygrass, Himalayan blackberry) and animal species to determine distribution and abundance
o. Monitor sedimentation rates and vegetation response within the bay or salt marsh
p. Monitor public use programs (i.e., waterfowl hunting, fishing) to determine fish and wildlife impact and response
q. Work with partners to monitor environmental factors that are climate change related stressors (e.g., changes to hydrology, acidification, storm intensity, floods)
Rationale: The salt marshes at Siletz Bay NWR are functionally connected with mudflat habitat and riverine habitats and act as a transition zone between aquatic and terrestrial sites. These marshes provide shoreline stability against wave and wind erosion, reduce flood peaks, trap nutrients, sediment, and pollutants. Salt marshes are also good for sequestering carbon and, unlike freshwater wetlands, do not produce methane. Tidal wetlands are considered essential habitat for many marine and anadromous fish (including threatened coho salmon) and migratory birds. Salt marshes also provide food and nursery areas for numerous young fish, crabs, shrimp, clams, and other invertebrates. Migratory waterfowl such as mallard, American wigeon, northern pintail, bufflehead, and green-winged teal, and Canada geese use the Siletz Bay wetlands. Migratory waterfowl and shorebirds in turn provide an important prey base for the recently delisted bald eagle and the peregrine falcon. Slough sedge, tufted hairgrass, Pacific silverweed, and Henderson's checkermallow are native salt marsh species and are often associated with unaltered estuarine habitat in Oregon. The 314 acres of salt marsh at Siletz Bay NWR provide critical ecosystem services, especially considering the status of this habitat type in the state. In Oregon's seventeen largest estuaries, tidal wetland acreage has declined considerably based on pre-settlement estimates. Fourteen of these estuaries have experienced tidal wetland decreases of 40 percent or more (Good 2000). Based on Scranton (2004) and Hawes et al. (2008), Brophy (2011) estimated 16,173 acres of tidal marsh statewide in the 1850s and by 2005 80% of those acres were no longer tidal marsh. As much as 90 percent of these losses have been for agricultural development and consist of diking and draining of salt marshes to convert them to pastures and crop-growing fields. Within the Siletz Bay estuary, the comparison of 1850s historic vegetation with recent vegetation mapping indicates a 47% loss of tidal marsh (ibid.). If unaltered or restored to a more natural hydrologic state (i.e., characterized by sinuous, deeply-incised, and complex tidal channel networks; and the absence of alterations such as ditching, diking, tidegates, restrictive culverts, and roads), salt marsh habitat such as that located at Millport Slough will maintain itself with very little or no input from land managers. Outplanting of rare, native species, such as Henderson's checkermallow, on refuge lands is needed to reestablish a healthy population since this species is nearly absent at Siletz Bay. Invasive species degrade habitats that support a diverse community of estuarine organisms including aquatic migratory birds and anadromous fish, and the invertebrate and plant communities that support them. For example, the widespread colonization by cordgrass, which is not currently present on the Refuge, would induce major modifications of physical, hydrological, chemical, and biological estuarine functions. Cordgrass displaces eelgrass on mudflats and native vegetation in salt marshes. This invasive plant must be controlled using IPM techniques including mechanical/physical, chemical, biological, and cultural means.

Introduced native and non-native animal species in salt marshes (New Zealand mudsnail, nutria) 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, animal invasive species can result in considerable impact to native wildlife and the habitat they are dependent upon. Limiting invasive and exotic animal species will provide improved quality habitat and wildlife health and survival. Actions will be taken to reduce competition between native and non-native animal species. Monitoring sedimentation rates and vegetation response within the bay and salt marsh is important to the understanding of the potential resilience of these habitats to sea level rise, storm surges and flood events.

Objective 2.2 Protect and maintain intertidal mudflats
Protect and maintain 0.8 acre of intertidal mudflats on Siletz Bay NWR for the benefit of migratory birds (e.g., American wigeon, mallard, great blue heron, peregrine falcon,), salmonids (e.g., Chinook, cutthroat, coho), shellfish (e.g., ghost shrimp, benthic worms, native clams), and a diverse assemblage of intertidal mudflat species (e.g., river otter) throughout the life of the CCP. Shorebirds common in the Pacific Flyway system that utilize mudflats include least and western sandpiper, dunlin, short and long-billed dowitcher, greater yellowlegs, black-bellied plover, red-necked phalarope, whimbrel, long-billed curlew, and black turnstone. Intertidal mudflats are characterized by the following attributes: • Diverse elevations ranging from about 3 feet below MLLW to about 4 feet MLLW that is completely inundated during two daily tidal cycles • Sandy/muddy substrate that is sparsely vegetated by widgeon grass and seasonal algae blooms • Presence of LWD • Presence of biofilm on muddy substrate • No Japanese eelgrass • No cordgrass species
Strategies Applied to Achieve Objective
Management Strategies:
a. Utilize appropriate IPM techniques including mechanical/physical, chemical, biological, and cultural means (see IPM Appendix)
b. Work with Oregon Department of State Lands to cooperatively manage resources, treat/monitor invasive species
Monitoring Strategies (see also Objective 5.1 Survey):
c. Monitor migratory birds (e.g., American wigeon, mallard, great blue heron, peregrine falcon, western sandpiper, short-billed dowitcher), salmonids (e.g., Chinook, cutthroat, coho), shellfish (e.g., sand shrimp, benthic worms, native clams), and mammal species (e.g., river otter) to determine populations, biological characteristics, and use of intertidal mudflats
d. Monitor invasive plant species (e.g., Japanese eelgrass, cordgrass) to determine percent cover and location
e. Monitor shorebirds to determine distribution, populations, and habitat use
f. Monitor habitat parameters to determine stop-over feeding and loafing habitat quality for shorebirds

g. Monitor composition and relative abundance of macro invertebrates to determine abundance and distribution
h. Monitor/survey biofilm/algae to determine abundance and composition
i. Monitor sedimentation rates and vegetation response within the bay or intertidal mudflats
j. Monitor water quality on the Refuge to ensure contaminant levels are not exceeded and aquatic resources are protected
k. Monitor LWD to determine rate of deposition
l. Work with partners to monitor environmental factors that are climate change related stressors (e.g., changes to hydrology and salinity)
Rationale: The 0.8 acre of intertidal mudflats are functionally connected with salt marsh and riverine habitats, which contain a rich invertebrate community that supports diversity of native fishes, shorebirds, and waterfowl. Algae and diatoms are the principal plant types; vascular plants are rare or absent. Invertebrates such as snails, shrimp, clams, worms, and crabs are locally common or abundant. The most common and important non-fish species occupying the mudflats include Dungeness crab, softshell clams, and sand shrimp. Waders such as great blue heron and great egret, and shorebirds such as least and western sandpiper, dunlin, short and long-billed dowitcher, greater yellowlegs, black-bellied plover, and whimbrel make extensive use of the mudflats for foraging on macro-invertebrates and in some cases biofilm. Dabbling ducks, diving ducks, gulls, peregrine falcons, and bald eagles also forage there. Harbor seals forage on inundated mudflats at high tide and in the lower bay, or they haul out on the flats and spit to rest. LWD provides perch sites for migratory birds including raptors and waders. Intertidal mudflats tend to maintain their integrity naturally, and managers typically need to conduct very little active management. As a result, to accomplish this objective, the Refuge primarily needs to pursue invasive species control. Invasive species such as Japanese eelgrass and cordgrass are of primary concern; their impacts are discussed in the rationale section for Objective 2.1. Actions will be taken to reduce competition between native and non-native vegetation species. These invasive plants must be controlled using IPM techniques including mechanical/physical, chemical, biological, and cultural means. Since land owned by the state is adjacent to refuge lands, we will work cooperatively with the State of Oregon to control invasives. Eradication efforts will be attempted on an annual basis on properties within Siletz Bay to remove and prevent further spread of invasive species. Sedimentation is a natural event that occurs in bays and estuaries and can alter plant communities and hydrology. The rate of sedimentation should be monitored and the habitat changes due to sedimentation documented. Monitoring sedimentation rates and vegetation response for intertidal mudflats is important to the understanding of the potential resilience of this habitat type to sea level rise, storm surges, and flood events.

Objective 2.3 Protect and maintain muted tidal marsh until restored to salt marsh
Protect and maintain 111 acres of muted (restricted) tidal marsh until additional lands are acquired within the approved refuge boundary from willing sellers to facilitate eventual full tidal restoration. Restored tidal marshes will benefit migratory birds (e.g., marsh wren, common yellowthroat, mallard, great blue heron) and salmonids (e.g., coastal cutthroat, coho). Restored

tidal marsh is characterized by the following attributes (see also Objective 2.2):

- Presence of native plant species such as slough sedge and Pacific silverweed
- Non-limited fish passage
- <5% cover of invasive/undesirable plants (Himalayan blackberry, reed canarygrass, Scotch broom)
- No cordgrass species

Strategies Applied to Achieve Objective

Management Strategies:

a. Work with private landowners and partners to acquire lands within the authorized refuge boundary from willing sellers to facilitate eventual full tidal restoration

b. Work with ODOT and ODFW to repair/replace culverts to achieve normal tidal function

c. Investigate restoration potential of Siletz Keys, Alder Island (Schoen Tract) and any additional diked lands acquired. If feasible, restore tidal flows and tidal marsh function

d. Utilize appropriate IPM techniques including mechanical/physical, chemical, biological, and cultural means (see IPM Appendix)

Monitoring Strategies (see also Objective 5.1 Survey):

e. Monitor salmonids (e.g., coastal cutthroat, coho) and other fish species to determine presence/absence, distribution, and use of the area

f. Monitor resident and migratory birds (e.g., marsh wren, common yellowthroat, mallard, great blue heron) to determine distribution and abundance

g. Monitor native vegetation (e.g., slough sedge and Pacific silverweed) within the restored area to determine plant growth rates and species composition

h. Monitor invasive plant species (e.g., reed canarygrass, Himalayan blackberry, Scotch broom, *Spartina*) to determine infestation extent and location

Rationale: Muted tidal marshes are areas of diked tidal marsh that receive partial or restricted water flows and are only partially inundated with salt water. Breached dikes and restrictive culverts or failed tidegates allow tidal exchange but flows are reduced and water circulation limited. Even though tidal influence and action is limited, these areas support a diverse plant community characteristic of tidal marsh and have slightly more freshwater-influenced vegetation (Brophy 2002).

Our objective is to eventually restore 111 acres of muted or restricted tidal marsh to full tidal action; however, restoration is contingent upon acquiring private lands from willing sellers within the authorized refuge boundary. Full restoration is beyond the scope of the CCP at this time because of ownership issues within the approved refuge boundary.

In the interim, native vegetation will be maintained and invasive plant species controlled using appropriate IPM techniques including mechanical/physical, chemical, biological, and cultural means. Salmonids common in the Siletz system including Chinook salmon, coho salmon (a threatened species), steelhead, and cutthroat trout currently utilize the muted tidal wetlands. These species will greatly benefit from full restoration of the tidal flows. In the interim, restrictive culverts will be replaced or removed where possible to improve fish passage. USFWS will work with ODOT and ODFW on replacement projects on and adjacent to the Refuge.

2.4.3 Goal 3: Protect and maintain forested wetlands and stream-riparian habitat characteristic of the North Pacific Coastal Ecosystem.

Objective 3.1 Protect and maintain wet-mesic Sitka spruce-western hemlock forest
Protect and maintain 18 acres of wet-mesic Sitka spruce-western hemlock forest on Siletz Bay NWR and adjacent riparian habitat throughout the life of the CCP for the benefit of migratory landbird (e.g., chestnut-backed chickadee, pileated woodpecker, Wilson's warbler) and a diverse assemblage of other forest-dependent species (e.g., black-tailed deer, bobcat, northwestern salamander). The desired attributes of wet-mesic Sitka spruce-western hemlock forest are the following (based on Brophy 2009, Brophy et al. 2011, Brophy and van de Wetering 2012, NatureServe 2012): • Periodic freshwater tidal and/or seasonal riparian flooding • Flat topography with local microrelief caused by logs, stumps, and buttressed roots of spruce trees • High organic content of soils (>20% organic matter) • Woody vegetation dominated by native trees and shrubs (e.g., Sitka spruce, red alder, Hooker willow, Sitka willow, twinberry, Pacific crabapple). Dominant herbaceous species include slough sedge and skunk cabbage with non-wetland species (e.g., salal, huckleberry) growing on fallen logs or spruce root platforms • <5% cover of invasive plants (e.g., blackberry, gorse, Scotch broom) • No English ivy
Strategies Applied to Achieve Objective
Management Strategies:
a. Utilize appropriate IPM techniques including mechanical/physical, chemical, biological, and cultural means (see IPM Appendix)
Monitoring Strategies (see also Objective 5.1 Survey):
b. Monitor migratory landbird (e.g., chestnut-backed chickadee, pileated woodpecker, Wilson's warbler) and other forest-dependent species (e.g., black-tailed deer, bobcat, northwestern salamander) population and use
c. Monitor plant community composition (i.e., percent cover of trees, shrubs, ferns, and herbaceous species)
d. Determine woody species stem density and basal area
e. Monitor salmonids and other fish to determine use and distribution
f. Monitor invasive plant species (e.g., Himalayan blackberry, Scotch broom, reed canarygrass, English ivy) to determine abundance and distribution
g. Monitor hydrology to determine beaver effects on water flow
Rationale: For the purposes of this CCP, wet-mesic Sitka spruce-western hemlock forests are defined as woody habitats that consist of valley forested wetlands and riparian forest along rivers, salt marsh, or mudflats (e.g., National Vegetation Classification Standard *Tsuga heterophylla - Picea sitchensis*/*Lysichiton americanus* Hardwood-Conifer Rich Swamp Group, NatureServe 2012). Riparian and wetland forests are highly variable in their composition, size, and structure. Periodic freshwater tidal and/or seasonal riparian flooding are the major natural processes that drive this system. Soils are perennially wet, usually with high organic content. Historically, many of the areas located in the lower brackish (mesohaline to oligohaline) and freshwater tidal zones of Oregon's estuaries were likely Sitka spruce and/or shrub tidal swamp. Tidal swamps were also found on the margins of the marine salinity zone where freshwater dilutes ocean water, such as

along tributary streams, on high natural levees, and in hillslope seepage zones.

Sitka spruce is the dominant tree species of this forest type. Early seral stage deciduous trees, such as red alder, typically make up younger forests or frequently disturbed areas along stream bottom lands. Most riparian forests have been impacted directly and indirectly by adjacent timber harvests and road construction. Harvest of large-diameter trees, and removal of adjacent forests, have created increases in sediment input and loss of LWD. Dike construction, land clearing for agricultural purposes, and urbanization has reduced the amount of coastal forested wetlands.

The 18 acres of wet-mesic Sitka spruce-western hemlock (lowland riparian) forest are found on the Refuge adjacent to the Millport Slough tidal marshes, around the perimeter of Alder Island, and by Siletz Keys. Migratory landbirds (e.g., chestnut-backed chickadee, pileated woodpecker, Wilson's warbler) and a diverse assemblage of other forest-dependent species are present and use the surrounding habitat for hunting, foraging, and resting. This area also provides off-river habitat for salmonids during high waters, including the threatened coho salmon.

Invasive plant species such as Himalayan blackberry and English ivy present challenges. Himalayan blackberry readily invades riparian areas, forest edges, oak woodlands, meadows, roadsides, clear-cuts, and any other relatively open area, including all open forest types. Once it becomes well established, it out competes low stature native vegetation and can prevent establishment of shade intolerant trees, leading to the formation of apparently permanent blackberry thickets with little other vegetation present. Invasive species treatment has been initiated on the Himalayan blackberry that infests much of the refuge uplands, roadsides, and trail edges. English ivy is a vigorous growing vine that impacts all levels of disturbed and undisturbed forested areas, growing both as a ground cover and a climbing vine. As the ivy climbs in search of increased light, it engulfs and kills branches by blocking light from reaching the host tree's leaves. Due to lack of funding and staff, efforts to date have been sporadic and not sufficient to halt the spread of these species on the Refuge.

2.4.4 Goal 4: Enhance, protect, and maintain instream aquatic habitat for all dependent species including anadromous and estuary-dependent fish.

Objective 4.1 Enhance, protect, and maintain instream aquatic habitat

Enhance, protect, and maintain instream aquatic habitat within the Refuge throughout the life of the CCP for anadromous fish and other estuary-dependent fish common in the Siletz River estuary and refuge tributaries including fall Chinook salmon, chum salmon, coho salmon, summer and winter steelhead, and cutthroat trout. Instream aquatic habitat is characterized by the following attributes:

- Instream and estuary channel presence of woody and organic debris
- Meandering estuary channels and fresh water creeks (e.g., complex and braided) with unimpeded fish access
- Water quality that will meet life-history needs for salmonids (e.g., water temperature 12.8°-17.8°C, dissolved oxygen levels >7.0 mg/l)
- Instream substrate (spawning gravel),<5% cover, pool/riffle ratio suitable for cutthroat trout
- <1% non-native of invasive fish (e.g., smallmouth bass, bluegill) and plants

Strategies Applied to Achieve Objective
Management Strategies:
a. Installation of LWD (i.e., logs and root wads) in stream channels to promote diverse hydrological and physical structure
b. Provide spawning (cutthroat trout) and rearing habitat (salmon)
c. Plant and maintain stream side vegetative cover to reduce water temperatures
d. Work cooperatively with ODFW and adjacent landowners to address fish passage and water quality issues
e. Coordinate with ODFW, USFS, and other partners to implement Siletz Bay component of ODFW coho and multi-species conservation plans, particularly the physical habitat restoration actions listed in the Oregon Coast Coho Conservation Plan (http://www.dfw.state.or.us/fish/CRP/docs/coastal_coho/final/Coho_Plan.pdf)
f. Work cooperatively with ODFW and USFWS Fisheries Program to understand, monitor, and control non-native invasive fish (e.g., smallmouth bass, bluegill, bullhead) that are competitive with native fishes
g. Work cooperatively with researchers to inventory, monitor, determine species composition and richness of estuary and instream invertebrate community
Monitoring Strategies (see also Objective 5.1 Survey):
h. Monitor salmonids to determine distribution, biological characteristics, and use of LWD installations
i. Monitor water quality (e.g., temperature, turbidity, dissolve oxygen, pH, toxins, nutrients, organic loading, dissolved and suspended solids) to detect presence of off-site contaminants (point and non-point sources
j. Monitor estuary and instream benthic invertebrates to determine species composition, diversity and abundance
k. Monitor riparian and estuary invasive plant and animal species to determine infestation, abundance, and distribution
Rationale: Protection and enhancement of aquatic habitat is important to anadromous and estuary-dependent fish species. The Siletz River watershed is a productive fishery resource for the state of Oregon. Salmonids common in the Siletz system include spring and fall Chinook salmon, chum salmon, coho salmon (threatened species), summer and winter steelhead, and coastal cutthroat trout. Threats currently facing salmonids and other estuary-dependent fish include the present or threatened destruction, modification, or curtailment of habitat or range. In many Oregon coastal streams, past human activities (e.g., logging, agriculture, gravel mining, urbanization) have resulted in impediments to fish passage, degradation of stream complexity, increased sedimentation, reduced water quality and quantity, loss and degradation of riparian habitats, and loss and degradation of lowland, estuarine, and wetland salmonid rearing habitats. Most anadromous fish species in the Pacific Northwest have been in decline for decades. Spring Chinook salmon, coho salmon, chum salmon, and coastal cutthroat trout all have depressed populations. Coho salmon on the Oregon Coast are listed as “Threatened” on the federal Threatened and Endangered Species List. Conserving and restoring salmonid populations is an important goal, not only for their own sake,

but also because of their cultural, historical, and ecological value. Salmonids are an important food source for numerous other wildlife species. Sixty-seven wildlife species of the Pacific Northwest, including many known to inhabit the Refuge, have been known to have a “strong” or “recurrent” relationship with salmon (Cederholm et al. 2000). For a full list of benefitting species, see Appendix E, Biological Resources of Concern.

For successful production, juvenile salmonids that live at the edges of streams or in backwater areas depend on the presence of streambank vegetation and abundant instream structure created by logs and root wads, as well as adequate water quality. LWD has been placed at the Millport Slough restoration and reference sites to provide cover and to increase channel diversity quality, which improves health and survival of estuary-dependent and juvenile salmonids.

To control invasive non-native fish (e.g., largemouth bass, bluegill) the Refuge will work cooperatively with ODFW and other fisheries biologists to detect the presence of and remove and control these species to reduce competition between native and non-native fish species. Invasive plant species have been noted on the Refuge; however, very limited control efforts have been conducted and these species may be continuing to invade and spread through refuge aquatic habitat. Limiting invasive species will provide quality forage to improve fish health and survival. Invasive species will be controlled using appropriate IPM techniques including mechanical/physical, chemical, biological, and cultural means to prevent them from competing with desired native species.

2.4.5 Goal 5: Research and monitoring. Gather scientific information (surveys, research, and assessments) to support adaptive management decisions.

Objective 5.1 Conduct inventory and monitoring 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 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 through 4 in CCP. These surveys have the following attributes:

- Data collection techniques will have minimal animal mortality or disturbance and minimal habitat destruction
- Minimum number of samples (e.g., water, soils, vegetative litter, plants, macroinvertebrates, vertebrates) to meet statistical analysis requirements will be collected for identification and/or experimentation in order to minimize long-term or cumulative impacts
- Proper cleaning of investigator equipment and clothing as well as quarantine methods, where necessary, will minimize the potential spread or introduction of invasive species
- Projects will adhere to scientifically defensible protocols for data collection, where available and applicable

Strategies Applied to Achieve Objective
a. Prepare inventory and monitoring plan
b. Early detection and rapid response monitoring to identify new or spreading invasive plant and

animal problems
c. Collect data and samples of fish, wildlife, and habitat parameters to determine overall health of the Refuge
d. Utilize scientific survey protocols for data collection to ensure quality results
e. Utilize most recent and up-to-date survey equipment to ensure reliable data are collected
f. Implement management strategies as needed as identified by survey data to maintain biological integrity, diversity, and environmental health
g. Monitor invasive/nuisance plant and animal species in mudflats, salt marsh, freshwater wetlands, uplands, and forested habitats to determine distribution and infestation
h. Monitor forest diseases and pests to determine presence and extent
i. Monitor salmonids to determine distribution, biological characteristics, and use of LWD
j. Monitor mammals, migratory landbirds, shorebirds, waterfowl, insects, and amphibians to determine populations, distributions, and habitat use
k. Conduct long-term hydrological, biological, and physical monitoring to determine effectiveness of salt marsh restoration projects
l. Monitor water quality returning to river and bay to determine pollution levels
m. Conduct periodic soil testing to maintain optimal pH levels and soil condition
n. Monitor habitat parameters including vegetation associated with respective habitat types to determine health of ecosystem
o. Monitor sedimentation rates and vegetation response within the bay or salt marsh
p. Monitor public use programs (i.e., waterfowl hunting) to determine waterfowl impact and response
q. Monitor Sitka spruce and western hemlock to determine growth rate, density, canopy cover and DBH
r. Monitor a mosaic of native shrubs (e.g., salmonberry, huckleberry, salal, wax myrtle), ferns, and herbaceous species (e.g., sedges) to determine understory cover
s. Monitor snags to determine density
t. Monitor existing and planted trees and shrubs to determine survival rate
u. Monitor tree density and thinning efforts to determine areas that need attention
v. Monitor/survey biofilm/algae to determine abundance and composition
w. Monitor hydrological parameters (e.g., flow regime—timing and magnitude) and associated physical attributes (e.g., water temperature, dissolved oxygen levels) to determine if parameters are within water quality standards
x. Monitor hydrology to determine beaver effects on water flow
y. Monitor hydrological flows and tidal elevations/cycles to understand hydrological influence and parameters
z. Monitor wetland native vegetation to determine species composition
aa. Monitor vegetation and wildlife to determine response to IPM techniques
Rationale: National Wildlife Refuge System Administration Act of 1966, as amended (16 U.S.C. 668dd-ee) set a requirement to "… monitor the status and trends of fish, wildlife, and plants in each refuge." Surveys will be used primarily to evaluate resource response to assess progress toward achieving refuge management objectives (under Goals 1 through 4 in this CCP) derived from the NWRS Mission, refuge purpose(s), and maintenance of biological integrity, diversity, and

environmental health (601 FW 3).

Determining resource status and evaluating progress toward achieving objectives is essential to implementing adaptive management on Department of Interior lands as required by policy (522 DM 1). Specifically, results of surveys will be used to refine management strategies, where necessary, over time in order to achieve resource objectives. Surveys will provide the best available scientific information to promote transparent decision-making processes for resource management over time on refuge lands.

The Service will provide staff to adequately address biological complexity of the Refuge with the goal of hiring an additional Permanent Full Time (PFT) Wildlife Biologist. Currently, the Complex has only one PFT Wildlife Biologist. The Wildlife Biologist will design and implement scientific studies.

Objective 5.2 Conduct research

Throughout the life of the CCP, conduct high-priority research projects that provide the best science for habitat and wildlife management on- and off-Refuge. Scientific findings gained through these projects will expand knowledge regarding life-history needs of species and species groups as well as identify or refine habitat and wildlife management actions. Wildlife and habitat responses to refuge management actions will be monitored through research projects, and as a result, resource management objectives and adaptive management will be facilitated to achieve desired outcomes. 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 will have minimal animal mortality or disturbance and minimal habitat destruction
- Collect the minimum number of samples (e.g., water, soils, vegetative litter, plants, macroinvertebrates, vertebrates) 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 reviewed articles in scientific journals and publications and/or symposiums

Strategies Applied to Achieve Objective
a. Identify and articulate priority management-oriented research needs to a wide scientific audience
b. Collect data and samples of fish, wildlife, and habitat parameters to meet statistical analysis requirements
c. Utilize scientific survey protocols for data collection to ensure quality results
d. Utilize most recent and up-to-date survey equipment to ensure reliable data are collected
e. Quarantine or clean investigator equipment and clothing to prevent spread of invasive plant and animals
f. Conduct research on salt marshes to determine accretion and subsidence rates
g. Conduct research on the potential effects of climate change and sea level rise on salt marshes

Rationale: Like monitoring, results of research projects will expand the best available scientific information and potentially reduce uncertainties to promote transparent decision-making processes for resource management over time on refuge lands. In combination with results of surveys, research will promote adaptive management on refuge lands. Scientific publications resulting from research on refuge lands will help increase the visibility of the NWRS as a leader in the development of the best science for resource conservation and management.

Research projects on refuge lands will address a wide range of natural and cultural resource as well as public-use management issues. Examples of management-oriented research projects include habitat use and life-history requirements for specific species/species groups, practical methods for habitat management and 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, modeling of wildlife populations, and assessing response of habitat/wildlife to disturbance from public uses. Projects may be species-specific, refuge-specific, or may evaluate the relative contribution of the Refuge to larger landscape (e.g., ecoregion, region, flyway, national, international) issues and trends.

The findings from two ongoing projects may elicit new fields of inquiry and research, and influence priorities for inventory and monitoring on the Refuge. The Refuge will monitor the results of coastal and marine species climate sensitivity analyses (in progress, Dr. Deborah Reusser, USGS, lead researcher, funded by the North Pacific Landscape Conservation Cooperative) and a North Pacific birds sensitivity analysis (in progress, PRBO-Conservation Science, funded by the North Pacific Landscape Conservation Cooperative).

Objective 5.3 Conduct scientific assessments

Throughout the life of the CCP, conduct scientific assessments to provide baseline information that will expand our knowledge regarding the status of refuge resources and better inform resource management decisions. The scientific assessments will contribute to the development of refuge resource objectives and they will also be used to facilitate habitat restoration through selection of appropriate habitat management strategies based upon site-specific conditions.

- Utilize accepted standards, where available, for completion of assessments
- Scale and accuracy of assessments will appropriate for development and implementation of refuge habitat and wildlife management actions

Strategies Applied to Achieve Objective
a. Utilize scientific assessment results to implement management strategies to benefit ecosystems
b. Complete water resource assessment for the Refuge – Division of Engineering, Water Resources Branch
c. Develop a National Vegetation Classification Standard vegetation data layer for use in GIS
d. Conduct baseline assessment of water chemistry and monitor changes over time to determine acidification rate

Rationale: In accordance with the Service policy for implementing adaptive management on refuge lands (522 DM 1), appropriate and applicable environmental assessments are necessary to determine resource status, promote learning, and evaluate progress toward achieving objectives whenever using adaptive management. These assessments will provide fundamental information about biotic (e.g., vegetation data layer) as well as abiotic processes and conditions (e.g., soils, topography, hydrology) that are necessary to ensure that implementation of on-the-ground resource management achieve resource management objectives identified under Goals 1 through 4. For example, a baseline estuary water chemistry analysis is lacking and needed to monitor the long-term potential effects of ocean acidification, a high risk to refuge resources.

2.4.6 Goal 6: Provide opportunities for people of all ages to observe, photograph, and learn about waterfowl, waterbirds, and other estuarine wildlife of the Pacific Coast and increase their interest in and connection with nature.

Objective 6.1 Provide high quality wildlife observation and wildlife/nature photography opportunities at Siletz Bay NWR
Throughout the life of the CCP, provide visitors of all ages and different abilities with a variety of safe and accessible opportunities at Siletz Bay to successfully observe or photograph wildlife while limiting the impacts of wildlife and habitat disturbance. Quality wildlife observation and wildlife/nature photography programs at Siletz Bay are defined by several elements including: • Focus on major wildlife species and groups of wildlife species, including estuarine birds and fish. • Emphasize activities on a year-round basis • Satisfy a range of skill sets, from casual and beginning observers/photographers to more advanced observers/photographers.
Strategies Applied to Achieve Objective
a. Allow wildlife observation and photography on Alder Island by creating an Architectural Barriers Act (ABA) accessible loop trail
b. Develop a parking lot on the old Highway 101 spur road to provide visitors with walk-in access to Alder Island
c. Work with refuge volunteers and other partners e.g., Lincoln City Audubon Society and Oregon Youth Authority to improve and maintain trail on Alder Island
d. Work with refuge volunteers and other partners to offer guided wildlife observation and photography hikes and programs
e. Provide signs and brochures that promote appropriate self-guided use of Alder Island trail
f. Develop a bird checklist for the Siletz Bay
g. Build a viewing platform off of the old Highway 101 spur road in conjunction with parking lot and non-motorized boat launch
h. Allow unrestricted walking on refuge lands west of Highway 101 for the purpose of observing and photographing wildlife
Rationale: Wildlife and nature photography promote public understanding and appreciation for the Refuge's natural resources. The Service will allow wildlife observation and photography on or from Alder Island and on refuge lands west of Highway 101. To facilitate wildlife observation and photography on Alder Island, the Service will provide infrastructure including development of a

non-motorized boat launch, a parking lot, and a trail that is accessible for people of all abilities. The parking lot will be located along the former Highway 101 spur road and will be designed to provide safe access to Alder Island from Highway 101. This location has been selected to be enhanced for wildlife observation, photography, and interpretation based on a variety of factors including the ability for the Refuge to provide safe access from Highway 101 and the topography of the island, which lends itself to designs that minimize wildlife disturbance. The island contains habitat that is used by an assortment of birds and mammals and will provide a reliable wildlife observation and photography opportunity for visitors.

The loop trail will traverse along the existing dike that surrounds Alder Island. It will provide visitors with a designated route of travel, which will provide protection for sensitive resources through proper routing and construction techniques. The trail will be open to these wildlife-dependent recreational activities year-round during daylight hours only. Wildlife observation and photography will largely be self-guided and will be restricted to the Alder Island Nature Trail and the parking lot.

The Service will also open refuge lands west of Highway 101 unstructured wildlife observation and photography year-round (Figure 2-1). These lands consist of 97 acres of salt marsh where the Siletz River empties into the bay near the development of Siletz Keys and near the mouth of Drift Creek. The Service will not provide infrastructure on these lands to enhance these public uses, and visitors using the area will be advised to use caution since no parking on the west side of Highway 101 will be provided.

Objective 6.2 Provide high-quality interpretive opportunities at Siletz Bay NWR.

Throughout the life of the CCP, provide visitors with opportunities for self-guided and refuge-led interpretation at Siletz Bay NWR. A high-quality interpretive program should:

- Engage people of all ages and abilities
- Emphasize learning about estuarine wildlife, tidal marsh restoration, and invasive species
- Emphasize non-guided activities but also periodic guided programs

Strategies Applied to Achieve Objective

a. Offer a minimum of 10 interpretive led paddle trips annually

b. Provide interpretive panels with an estuarine habitat based theme along the Alder Island Trail

c. Build a non-motorized boat launch along the old Highway 101 spur road to provide visitors with safe access to Millport Slough

d. Hire a permanent, full-time refuge volunteer coordinator

e. Hire a permanent, full-time north coast refuge manager

Rationale: Opening the Refuge to public use will allow the Service to offer interpretive programs and opportunities to a varied and interested audience. Siletz Bay NWR is close to Lincoln City, a coastal city that is popular with tourists in the spring and summer. Development of an ABA-accessible interpretive loop trail surrounding Alder Island will provide the public with an opportunity to learn about wildlife, especially salmonids, that use and in many cases depend on estuaries. In addition it will provide the Service with an opportunity to teach people about invasive species that threaten wildlife and habitat. Once visitors learn about wildlife and the threats they face, visitors will be able to act with greater understanding to maximize their role in preventing the spread of invasive species.

Because so much of Siletz Bay NWR is tidally influenced, one of the best ways for visitors to

experience refuge resources is via the navigable waters that flow through or adjacent to the Refuge including Millport Slough, the Siletz River, and No Name Slough. Although these waters are not refuge-owned and can be accessed by anyone at any time, the Refuge has offered seasonal, guided interpretive trips on these waterways via canoe/kayak since 2005. The Refuge will continue to offer this program during the 15-year timeframe of the CCP. Currently, along the Siletz River a private moorage is used to launch both motorized and non-motorized boats to access the Siletz River, the open bay or Millport Slough for the purpose of fishing, wildlife observation, and relaxation. To provide visitors with a different perspective and/or refuge-related recreation, the Service will develop a non-motorized boat launch along the old Highway 101 spur road on the east side of U.S. Highway 101. The Refuge will also provide information on paddle routes as well as wildlife and habitat viewing that can be experienced during the trip. The availability of this new boat launch and the associated interpretive materials will allow visitors who do not own a motorized boat to more readily access these waters and come to a greater understanding about the use of the area by wildlife. The launch will be open during daylight hours on a year-round basis. Use is expected to be heaviest from May through September when the weather is more conducive to non-motorized boat use (e.g., calmer winds, warmer air temperatures, less water chop).

2.4.7 Goal 7: Provide and manage safe, enjoyable, and quality waterfowl hunting and fishing opportunities in Siletz Bay for people of varying ages and resources that further the tradition of wildlife conservation and stewardship.

Objective 7.1 Provide opportunities for quality waterfowl hunting at Siletz Bay NWR
Throughout the life of the CCP, provide an opportunity for waterfowl hunters of all ages and abilities to hunt geese, coots, and a variety of dabbling and diving ducks on 199 acres while minimizing impacts to other wildlife, and other recreational users. Provide a quality, safe waterfowl hunt program that: • Place a priority on safety • Include clear and concise regulations and makes them readily available • Pose minimal conflict with wildlife and habitat objectives • Pose minimal conflict with other priority public use activities • Pose minimal conflict with neighboring lands
Strategies Applied to Achieve Objective
a. Prepare waterfowl hunt plan and opening package
b. Allow hunting on refuge lands west of Highway 101 in Siletz Bay seven days a week according to ODFW regulations
c. Allow hunters to access refuge lands open to hunting via boat or foot
d. Establish a 100-yard no-hunting zone to prohibit waterfowl hunting on refuge property that extends westward from the refuge property line on the west side of the housing development of Siletz Keys
e. Allow hunting on refuge lands south of Millport Slough three days per week
f. Develop an informational tear sheet on the rules and regulations of waterfowl hunting in Siletz Bay
g. Improve the graveled parking lot along Millport Slough road to provide hunters with walk-in

access
h. Develop an informational kiosk and place at Millport Slough parking lot to convey refuge rules and regulations regarding waterfowl hunting
i. Conduct law enforcement patrols on a regular basis to ensure compliance with state and federal waterfowl hunting regulations
Rationale: Hunting is identified as a priority public use by the NWRS Improvement Act because it promotes appreciation for and conservation of natural resources. The Service will allow the hunting of waterfowl, defined here as ducks, geese, and coots on portions of Siletz Bay NWR. Hunting will be permitted in accordance with State and Federal regulations and seasons. There is a demand for public hunting around Siletz Bay, especially in areas that have walk-in access and do not require the use of a boat. During the public scoping process there were many requests to allow waterfowl hunting on refuge lands both west and east of Highway 101. Opening the Refuge to waterfowl hunting and providing walk-in opportunities, at both Millport Slough and on refuge lands west of Highway 101, will enhance and slightly increase waterfowl hunting opportunities in the area. Lands west of Highway 101 get the most use by waterfowl, and since the state tidelands adjacent to the Refuge are already hunted, opening the Refuge will effectively expand this hunting area and therefore will likely provide the highest quality waterfowl hunting opportunity on the Refuge. The Service will allow waterfowl hunting seven days per week on 87 acres of refuge-owned lands that are west of Highway 101 (Figure 2-1). These lands consist of salt marsh where the Siletz River empties into the bay near the development of Siletz Keys and uplands and wetlands at the mouth of Drift Creek. Waterfowl hunting has occurred on the state-owned tidelands of Siletz Bay west of U.S. Highway 101 for many decades. The tidelands are managed by the Department of State Lands and are legally open to hunting so long as the hunter remains 200 yards or more from the shoreline/road. However, refuge-owned lands west of U.S. Highway 101 in Siletz Bay have been closed to waterfowl hunting since the Refuge was established in 1991. Though it has been surveyed, the seaward boundary of the tidal marsh near Siletz Keys has not been posted with official refuge boundary signs due to the difficulty in keeping posts upright and intact in the marsh where tides inundate the site twice daily. Consequently, there is often confusion among hunters as to where the refuge boundary ends and the state-owned tidelands begin. The Refuge has maintained that as long as hunters were in the mudflats and not east of the vegetation line they were most likely on state tidelands; however, this boundary has been difficult to legally enforce. Opening refuge lands west of U.S. Highway 101 will not only enhance waterfowl hunting in Siletz Bay but it will also decrease the uncertainty of legal hunt boundaries and eliminate the issue of hunters trespassing over refuge lands to access the state hunting area. The Service will establish a 100-yard no-hunting zone to prohibit waterfowl hunting on refuge property that extends westward from the refuge property line on the west side of the housing development of Siletz Keys. Access to the Refuge will be allowed for hunting from one hour before sunrise to one hour after sunset. Hunters accessing lands west of U.S. Highway 101 will be directed to use caution since no parking would be provided by the Refuge. The Service will also allow waterfowl hunting three days per week on 112 acres of refuge lands that are east of Highway 101 and south of Millport Slough (Figure 2-1). Specifically, hunters will

be allowed to hunt ducks, geese, and coots on Wednesday, Saturday, and Sunday during the ODFW established hunt season. Hunters accessing lands east of U.S. Highway 101 and south of Millport Slough will access the site by using a short trail and a small gravel parking lot located on South Millport Slough Road or by boat. The parking lot and trail will be constructed by the Service to support this planned use. To minimize potential conflict between refuge users, reduce associated safety issues, and to provide sanctuary to waterfowl on non-hunt days the refuge lands south of Millport Slough that are open to waterfowl hunting will remain closed to wildlife observation, photography, and interpretation. For boat access, hunters can reach refuge lands on both the east and west side of Highway 101 during high tides from a private boat launch on the Siletz River.

Objective 7.2 Provide opportunities for quality fishing and clamming at Siletz Bay NWR

Throughout the life of the CCP, provide opportunities for visitors to dig for clams and fish from refuge lands in accordance with state fishing regulations, while minimizing impacts to other resources. Provide a quality fishing program that:

- Includes clear and concise regulations that are readily available
- Poses minimal conflict with wildlife and habitat objectives
- Poses minimal conflict with other priority public use activities

Strategies Applied to Achieve Objective

a. Prepare fishing plan and opening package

b. Allow anglers to bank fish from Alder Island nature trail and develop dedicated locations along the trail for this activity

c. Allow clammers access through refuge-owned Snag Alley to reach clamming beds on state-owned tidelands

d. Develop an informational kiosk to share information on fishing access and regulations

e. Provide containers for anglers to discard their used monofilament line

Rationale: Fishing is identified as a priority public use and it is a popular visitor activity that occurs at many locations along the Oregon coast. Currently, there is no fishing program on the Refuge. The Service will open recreational bank fishing from Alder Island and allow clamming access to state-managed tidelands near Drift Creek. All recreational fishing and clamming will be permitted in accordance with State, Federal, and refuge-specific regulations and seasons to ensure that it will not interfere with the conservation of fish and wildlife and their habitats, or conflict with other wildlife-dependent recreational activities.

Recreational fishing is a very popular sport on the navigable waters of the Siletz River and takes place mainly from boats. The Service will allow bank fishing for fish such as salmonids, surfperch, and sturgeon along the south bank of the Siletz River from Alder Island. The Service will develop one or more dedicated sites along the trail where anglers can access the Siletz River. The designated sites along the trail will concentrate anglers and potentially generate trash including monofilament line, which can entangle wildlife and is therefore a hazard. The Service will provide containers for anglers to discard their used monofilament line. Anglers will access the island itself by using the paved public parking lot and trailhead that will be developed by the Service and located on the east side of Highway 101 along the abandoned Highway 101 spur. Access to bank fishing will require users to access the riverbank from the Alder Island Nature Trail. The Alder Island Nature Trail will be open for anglers to access during daylight hours only. Camping, overnight use, and fires will be prohibited. Pets will be prohibited on the Alder Island trail to prevent wildlife disturbance. Pets will be required to remain inside vehicles at all times.

Clamming is currently allowed in Siletz Bay on state-owned tidelands on the west side of U.S. Highway 101. Clamming provides a recreational experience to harvest softshell clams by digging with a hand shovel or using a clam gun (i.e., aluminum or PVC piped suction device). In addition to the harvest of clams, the harvest of shrimp other marine invertebrates for bait is included within the term clamming.

The Service will allow clammers to cross refuge lands on foot to access state-owned tidelands where clamming beds occur. This access will eliminate refuge trespass issues associated with clamming in this location and provide clammers with an easier route to clamming beds. Clamming access to state-managed tidelands will require users to observe daily tide cycles and walk across mudflats and/or small tidal channels. The Service will not provide infrastructure on these lands to enhance clamming or any other public use. Visitors using the area will be advised to use caution since no parking on the west side of Highway 101 will be provided.

The Service will develop a fishing information tear sheet and an informational kiosk, and will share information about fishing and other available wildlife-dependent recreational uses with refuge visitors through the internet via a refuge website and/or social media site. These forms of interpretive material will help educate the public on refuge regulations and how they can minimize wildlife and habitat disturbance.

2.4.8 Goal 8: Provide facilities and materials and conduct outreach that welcomes and orients children and adults to Siletz Bay National Wildlife Refuge so they can easily and safely learn about its abundant fish and wildlife resources.

Objective 8.1 Provide facilities that welcome and orient visitors to Siletz Bay NWR.
Throughout the life of the CCP, provide an integrated set of welcome and orientation facilities for visitors to: • Feel welcomed • Easily find accurate, timely, and appropriate orientation materials and information • Be aware of their options (available activities and experiences, where and when to go, how to get there, etc.) • Safely pursue self-guided activities
Strategies Applied to Achieve Objective
a. Develop a welcome and orientation panel at Alder Island
b. Maintain bunkhouse along Drift Creek to house refuge interns and volunteers
c. Utilize habitat-appropriate native plants for landscaping around public use facilities
Rationale: As described in the Oregon State Parks Regional Interpretive Framework (OPRD 2005), the Oregon Coast is considered one of the world’s most stunning landscapes. It features dramatic rocky shoreline, historic lighthouses, endless beaches, quaint seaside towns, and scenic bridges. The U.S. Highway 101 National Scenic Byway follows the shoreline and is the main route used by visitors who come to the coast from Portland and other inland population centers including Corvallis, Eugene, Roseburg, Medford, and Grants Pass.

According to OPRD, bird watching, walking and day hiking will be the most popular recreation activities over the next ten years (OPRD 2008). Visitors to the Oregon Coast NWR Complex will likely stop for a couple of reasons: a short 20-minute stop made to look at a view and take a picture, or a longer, one- to three-hour, stop allowing visitors to leave the car and stretch their legs. Interpretive signs and spotting scopes may enhance observation, interpretation, and education during short stops. Visitors making longer stops may be more interested in learning about the site and the Refuge will develop the Alder Loop trail and associated interpretive panels to capitalize on this interest.

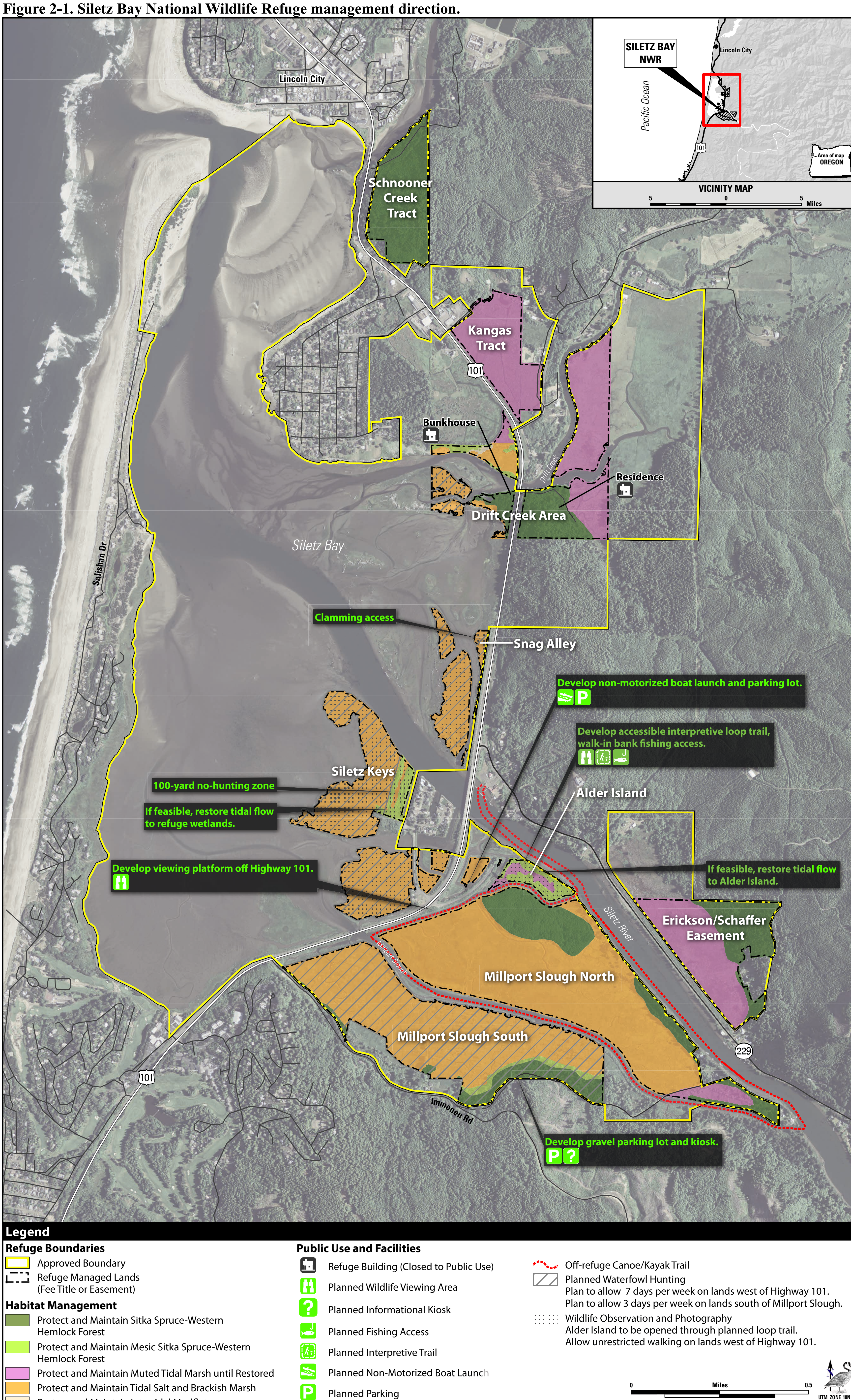
The Service will develop a welcome and orientation panel located in the parking lot at Alder Island, which will serve to orient visitors and provide them with information about how to safely enjoy the Refuge.

Objective 8.2 Conduct public outreach
Throughout the life of the CCP, conduct outreach to the public in an effort to: • Describe the Refuge and its place as part of the National Wildlife Refuge System • Provide current information about refuge management, biology, volunteer opportunities, public use events, and rules and regulations
Strategies Applied to Achieve Objective
a. Maintain an up-to-date brochure on the Refuge Complex
b. Partner with media outlets in Oregon to market public use opportunities on the Refuge
c. Participate in social media outreach
d. Maintain a refuge website
e. Maintain online photo sharing database
f. Partner with non-profit conservation organizations and appropriate media outlets in Oregon to disseminate information about refuge management, fish, wildlife and habitats
g. Maintain a refuge presence at community events that have high potential to deliver refuge messages to key audiences
Rationale: Outreach is critical in educating the public, volunteers, and partners about how refuges protect and conserve natural resources and what we are doing to provide economic benefits to communities. When people know and understand about the mission of the Service and the NWRS they are more likely to support the Refuge. Outreach can also improve visitors' awareness of regulations and policies and the reasons behind them. Our outreach efforts will focus on providing specific information about Siletz Bay NWR including important news and events and it will be used as a means of building an online community of support for the Oregon coast refuges. Specific examples of outreach involve maintaining a refuge website and utilizing social media to advertise volunteer opportunities, announce interpretative and environmental education events, relate news releases, share photos and videos, and provide an engaging view of what employees and volunteers do for the Service's Oregon Coast NWR Complex.

Objective 8.3 Work with the community and volunteers
Throughout the life of the CCP, increase the volunteer program to assist with public use programs, monitoring, research, and maintenance on the Refuge throughout the life of the CCP.

Strategies Applied to Achieve Objective
a. Solicit for volunteers
b. Develop public use and habitat-related projects that support refuge needs
c. Hire a full-time Volunteer Coordinator
d. Work with volunteers to have them assist with maintenance of public use facilities and trails
e. Work with volunteers to have them assist with invasive species monitoring and removal
Rationale: Volunteers are recognized as key components in the successful management of public lands and are vital to implementation of refuge wildlife, habitat, and public use programs. During these times of declining budgets the National Wildlife Refuge System faces a growing shortage of staff, and in many cases funding for key conservation programs has been reduced. The Service will recruit volunteers to assist in refuge management and these volunteers will in turn play a critical role in providing support for the Refuge and serve as an advocate for protecting refuge wildlife and habitat.

Figure 2-1. Siletz Bay National Wildlife Refuge management direction.



Data Sources: Refuge Boundaries from USFWS/R1; Roads from ESRI; Imagery from 2009 NAIP

The back sides of maps are blank to improve readability.

Chapter 3
Physical Environment

USFWS

Chapter 3. Physical Environment

3.1 Climate and Climate Change

3.1.1 General Climate Conditions

The climate at Siletz Bay National Wildlife Refuge (NWR or Refuge) is greatly influenced by the Pacific Ocean on the west and the Coast Range to the east. The Coast Range rises between 2,000 and 3,000 feet (610-914 meters) above sea level in the north and between 3,000 and 4,000 feet (914-1,219 meters) in the southwestern portion of the state with occasional mountain peaks rising an additional 1,000 to 1,500 feet (305-457 meters). The coastal zone is characterized by wet winters, relatively dry summers, and mild temperatures throughout the year. Because of the moderating influence of the Pacific Ocean, extremely high or low temperatures are rare and the annual temperature range is lower here than in any other Oregon climate zone. Precipitation is heavier and more persistent during the winter but regular moisture occurs from rain and fog throughout the year (Western Regional Climate Center [WRCC] 2011a). The area's heavy precipitation during winter results from moist air masses moving from the Pacific Ocean onto land. The lower elevations along the coast receive annual precipitation of 65 to 90 inches (165-229 centimeters), which can cause flood events if abundant rainfall is consistent for several days. Occasional strong winds (50-70 miles per hour) occur along the coast, usually in advance of winter storms. Wind speeds have been recorded to exceed hurricane force and have caused substantial damage to structures and vegetation in exposed coastal locations (Taylor and Hannan 1999, Taylor 2008). Skies are usually cloudy in the winter during the frequent storms and clear to partly cloudy during summer, with localized fog along the coastline. As a result of persistent cloudiness, total solar radiation is lower along the coast than in any other region of the state.

Climate Change Trends

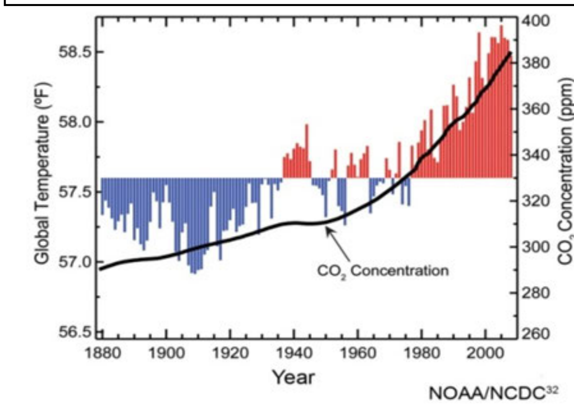
The greenhouse effect is a natural phenomenon that assists in regulating and warming the temperature of our planet. Just as a glass ceiling traps heat inside a greenhouse, certain gases in the atmosphere, called greenhouse gases (GHG), absorb and emit infrared radiation from sunlight. The primary greenhouse gases occurring in the atmosphere include carbon dioxide (CO_2), water vapor, methane, and nitrous oxide. CO_2 is produced in the largest quantities, accounting for more than half of the current impact on the Earth's climate.

A growing body of scientific evidence has emerged to support the fact that the Earth's climate has been rapidly changing during the 20th century and the magnitude of these alterations is largely due to human activities (Intergovernmental Panel on Climate Change [IPCC] 2007a, National Academy of Sciences [NAS] 2008, U.S. Global Change Research Program [USGCRP] 2009). Increasingly, the role of human activities in the concentrations of heat-trapping greenhouse gases have increased significantly over the last several hundred years due to human activities such as deforestation and the burning of fossil fuels (Ibid).

Although climate variations are well documented in the Earth's history, even in relatively recent geologic time (e.g., the Ice Age of 10,000 years ago), the current warming trend differs from shifts earlier in geologic time in two ways. First, this climate change appears to be driven primarily by human activity which results in a higher concentration of atmospheric GHG. Second, atmospheric CO_2 and other greenhouse gases, levels of which are strongly correlated with Earth temperature, are now higher than at any time during the last 800,000 years (USGCRP 2009). Prior to the start of the Industrial Revolution in 1750, the amount of CO_2 in the atmosphere was about 280 parts per million (ppm). Current levels are about 390 ppm and are increasing at a rate of about 2 ppm/year (U.S. Department of Energy [DOE] 2012). The current concentration of CO_2 and other greenhouse gases as well as the rapid rate of increase in recent decades are unprecedented in the prehistoric record (Ibid).

The terms “climate” and “climate change” are defined by the IPCC. The term “climate” refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007b). The term “climate change” thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (Ibid).

Figure 3-1. Global annual average temperature and CO_2 from 1880-2008 (NOAA 2012c).



Global annual average temperature (as measured over both land and oceans). Red bars indicate temperatures above and blue bars indicate temperatures below the average temperature for the period 1901-2000. The black line shows atmospheric carbon dioxide (CO_2) concentration in parts per million (ppm). While there is a clear long-term global warming trend, each individual year does not show a temperature increase relative to the previous year, and some years show greater changes than others.[33] These year-to-year fluctuations in temperature are due to natural processes, such as the effects of El Niños, La Niñas, and the eruption of large volcanoes.

Scientific measurements spanning several decades demonstrate that changes in climate are occurring, and that the rate of change has been faster since the 1950s (Figure 3-1). Examples include warming of the global climate system, and substantial increases in precipitation in some regions of the world and decreases in other regions (e.g., IPCC 2007b, Solomon et al. 2007). In the Pacific Northwest, increased greenhouse gases and warmer temperatures have resulted in a number of physical and chemical impacts. These include changes in snowpack, stream flow timing and volume, flooding and landslides, sea levels, ocean temperatures and acidity, and disturbance regimes such as wildfires, insect, and disease outbreaks (USGCRP 2009). All of these changes will cause major perturbations to ecosystem conditions, possibly imperiling species that evolved in response to local conditions.

Results of scientific analyses presented by the IPCC show that most of the observed increase in global average temperature since the mid-20th century cannot be explained by natural variability in climate, and is “very likely” (defined by the IPCC as 90 percent or higher probability) due to the observed increase in greenhouse gas (GHG) concentrations in the atmosphere as a result of human activities, particularly carbon dioxide emissions from use of fossil fuels (IPCC 2007b, Solomon et al. 2007). Further confirmation of the role of GHGs comes from analyses by Huber and Knutti (2011), who concluded that it is extremely likely that approximately 75 percent of global warming since 1950 has been caused by human activities.

In the Northern Hemisphere, recent decades appear to be the warmest since at least about A.D. 1000, and the warming since the late 19th century is unprecedented over the last 1,000 years. Globally, including 2011, all 11 years in the 21st century so far (2001 to 2011) rank among the 13 warmest years in the 130-year instrumental record (1880 to present) according to independent analyses by National Oceanic and Atmospheric Administration (NOAA) and National Aeronautics and Space

Administration (NASA). 2010 and 2005 are tied as the warmest years in the instrumental record and the new 2010 record is particularly noteworthy because it occurred in the presence of a La Niña and a period of low solar activity, two factors that have a cooling influence on the planet. However, in general, decadal trends are far more important than any particular year's ranking.

Trends in global precipitation are more difficult to detect than changes in temperature because precipitation is generally more variable and subject to local topography. However, while there is not an overall trend in precipitation for the globe, significant changes at regional scales can be found. Over the last century, there have been increases in annual precipitation in the higher latitudes of both hemispheres and decreases in the tropical regions of Africa and southern Asia (USGCRP 2009). Most of the increases have occurred in the first half of the 20th century and it is not clear that this trend is due to increasing greenhouse gas concentrations.

Just as important as precipitation totals are changes in the intensity, frequency, and type of precipitation. Warmer climates, owing to increased water vapor, lead to more intense precipitation events, including more snowstorms and possibly more flooding, even with no change in total precipitation (Dominguez et al. 2012). The frequency of extreme single-day precipitation events has increased, especially in the last two decades. Paradoxically more droughts and heat waves have occurred because of hotter, longer-lasting high pressure systems.

3.1.2 Air Temperatures

As a result of the ocean's proximity, winter minimum and summer maximum temperatures along the coast are moderated. It is rare for Siletz Bay NWR to experience temperatures below freezing. No days are on record with temperatures at or below 0°F. Also, it is only in the extreme occurrences that temperatures have been recorded to exceed 90°F (WRCC 2011b, WRCC 2011c).

There is no climate/weather station established on Siletz Bay NWR; however, temperature data have been consistently collected since July 1948 at the Otis station (number 356366) located approximately 8 miles north of the Refuge and since January 1893 at the Newport station (number 356032) located approximately 18 miles south of the Refuge. The proximity of these stations to the Refuge provides valuable regional data. Table 3-1 provides a summary of the periods of record.

Table 3-1. Air Temperature Summaries near Siletz Bay NWR (WRCC 2011b, WRCC 2011c)

Temperatures (°F)	Otis July 1948 – Sept. 2010	Newport Jan. 1893 – Sept. 2010
Average Monthly Temperature – High	59	57.7
Average Monthly Temperature – Low	42.6	43.9
Monthly Mean Winter Temperature – High	48.6	51
Monthly Mean Winter Temperature – Low	36.7	38.8
Monthly Mean Summer Temperature – High	68.8	63.7
Monthly Mean Summer Temperature – Low	49.3	49.6
Daily Maximum Extreme – High	99	100
Daily Maximum Extreme – Low	64	73
Daily Minimum Extreme – High	39	33
Daily Minimum Extreme – Low	4	1

Future Trends

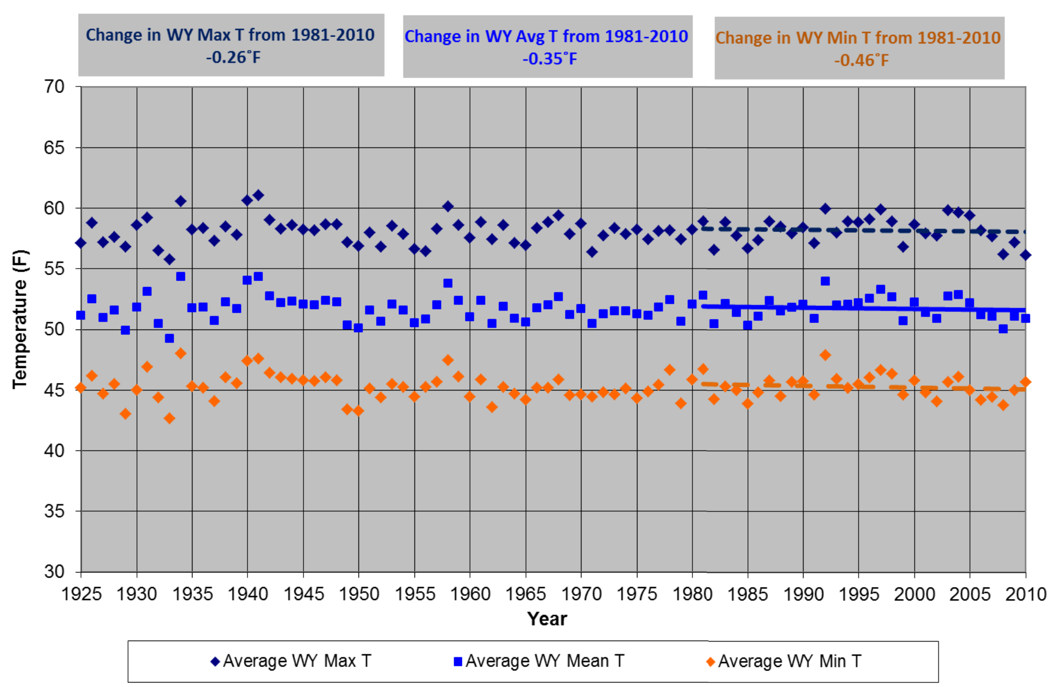
Mote (2003) observed that the Pacific Northwest region experienced warming of approximately 1.5°F during the 20th century. For trends local to the Refuge we turn to the United States Historical Climatology Network (USHCN), which provides a high-quality data set of daily and monthly records of basic meteorological variables from 1,218 observing stations throughout the continental U.S. The data have been corrected to remove biases or heterogeneities from non-climatic effects such as urbanization or other landscape changes, station moves, and instrument and time of observation changes. The closest station is Newport and trends are provided in Table 3-2 and Figure 3-2. The average yearly temperature change has decreased 0.35°F over the past 30 years (Table 3-2).

Table 3-2. Seasonal Temperature Trends, 1981-2010 (USHCN 2012)

Newport, Oregon United States Historical Climatology Network Observation Station			
Monthly Absolute Change	**Maximum Temp.**	**Average Temp.**	**Minimum Temp.**
Winter (Dec-Feb)	+0.08°F	-0.03°F	-0.13°F
Spring (March-May)	-0.83°F	-1.14°F	-1.49°F
Summer (Jun-Aug)	-0.08°F	+0.26°F	+0.59°F
Fall (Sept-Nov)	-0.33°F	-0.47°F	-0.65°F

The graphs below illustrate a sample of these temperature trends using monthly data. The most recent 30-year period is calculated using the slope of the linear trendline, and temperature change is shown as an absolute change over the 30-year period. A water year is defined as the 12-month period from October 1, for any given year, through September 30 of the following year. The water year is designated by the calendar year in which it ends and which includes 9 of the 12 months.

Figure 3-2. Water year temperature 1925-2010 at Newport, Oregon (USHCN 2012).

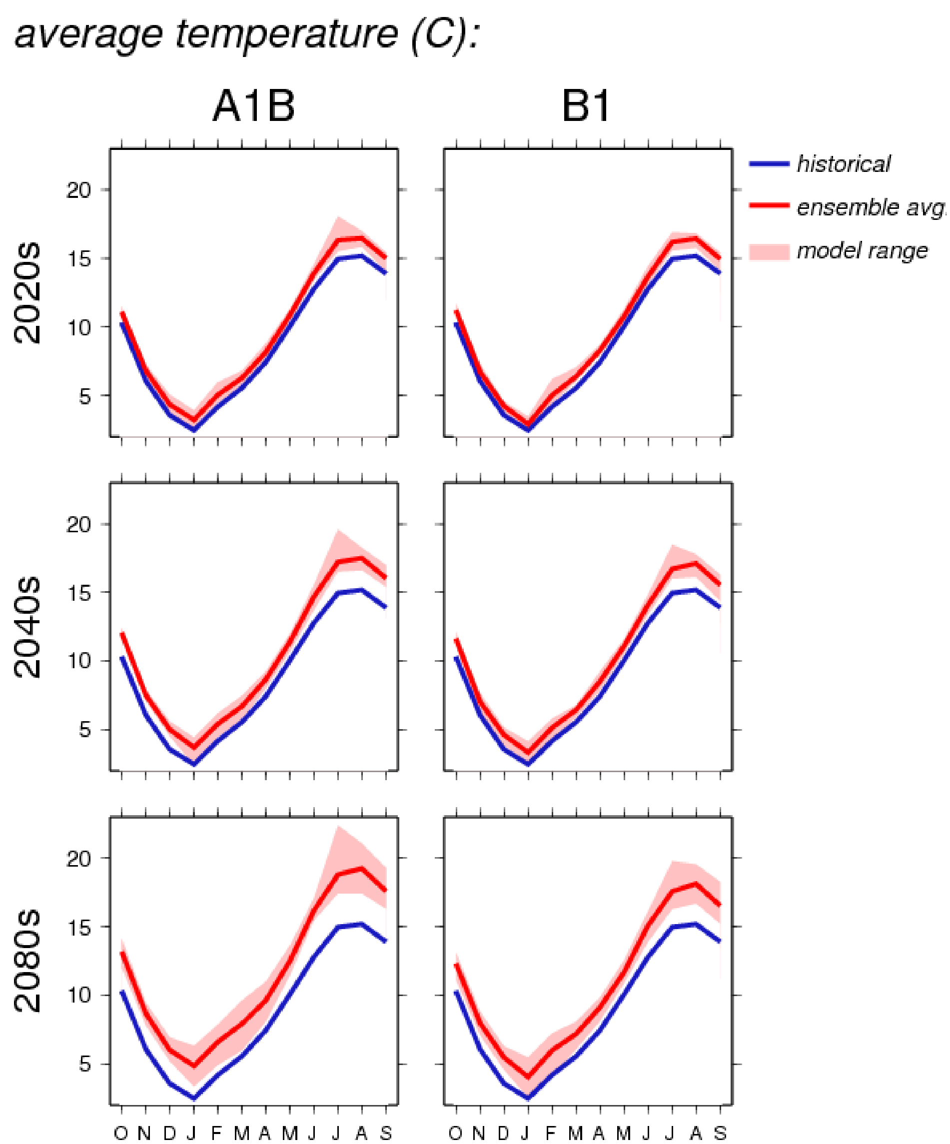


Future Trends

Scientists use a variety of climate models, which include consideration of natural processes and variability, as well as various scenarios of potential levels and timing of GHG emissions, to evaluate the causes of changes already observed and to project future changes in temperature and other climate conditions (e.g., Meehl et al. 2007, Ganguly et al. 2009, Prinn et al. 2011). All combinations of models and emissions scenarios yield very similar projections of increases in the most common measure of climate change, average global surface temperature (commonly known as global warming), until about 2030. Although projections of the magnitude and rate of warming differ after about 2030, the overall trajectory of all the projections is one of increased global warming through the end of this century, even for the projections based on scenarios that assume that GHG emissions will stabilize or decline. Thus, there is strong scientific support for projections that warming will continue through the 21st century, and that the magnitude and rate of change will be influenced substantially by the extent of GHG emissions (IPCC 2007c, Meehl et al. 2007, Ganguly et al. 2009, Prinn et al. 2011).

Statistical downscaling methods first derive empirically-based relationships between coarse-scale (e.g., the altitude of the 700 hPa pressure level) and observed local (e.g., precipitation or temperature) climate variables. Predicted values of the coarse-scale variables obtained from global climate models are then used to drive the statistical relationships in order to estimate the regional and/or local scale details of future climate (see Mote and Salathé 2010 for more on downscaling methods). The statistical downscaling of 20 global climate models (Mote and Salathé, 2009 and 2010) projects average annual temperature to increase 2.0°F by the decade of the 2020s for the Pacific Northwest, 3.2°F by the decade of the 2040s, and 5.3°F by the decade of the 2080s, relative to the 1970-1999 average temperature. The projected changes in average annual temperature are substantially greater than the 1.5°F increase in average annual temperature observed in the Pacific Northwest during the 20th century. Seasonally, summer temperatures are projected to increase the most. Actual global emissions of greenhouse gases in the past decade have so far exceeded the emissions scenarios used in projections of Mote and Salathé. Consequently, if these emissions trends continue, the climate projections referenced herein likely represent a conservative estimate of future climatic changes. Figure 3-3 shows these modeled, downscaled temperature projections for the Siletz-Yaquina watershed (Hydrologic Unit Code 17100204) (Hamlet et al. 2010).

Figure 3-3. Projected temperature changes for the Siletz-Yaquina Watershed under two emission scenarios. A1B is a higher emission scenario than B1. Current rates are higher than both A1B and B1 (Hamlet et al. 2010).



3.1.3 Precipitation

The discussion below includes data from the two climate stations closest to Siletz Bay NWR, located in Otis and Newport. Roughly 57 to 58 percent of the annual precipitation at these stations occurs during late fall and winter, in the months of November, December, January, and February. By comparison, the summer months of June, July, and August receive a scant 7 percent of the annual precipitation. On average, 47-69 days per year experience more than 0.50 inch of precipitation and 16-29 days greater than 1.00 inch (WRCC 2011d, 2011e). Snow events are infrequent. Fog (water vapor condensing into tiny liquid water droplets in the air) is a common phenomenon along the Oregon coast because of contrasting differences between air, land, and ocean temperatures and humidity. The average number of days per year with dense fog (visibility of 0.25 mile or less) in

Astoria is 41. June averaged the fewest days (1) with dense fog and October with the most days (7) (WRCC 2011f). Fog records for central coastal locations were unavailable. Precipitation data for Otis and Newport are summarized in Table 3-3.

Table 3-3. Precipitation Summaries near Siletz Bay NWR (WRCC 2011d, WRCC 2011e)

Precipitation (inches)	Otis July 1948 – Sept. 2010	Newport Jan. 1893 – Sept. 2010
Average Annual Precipitation	97.35	67.77
Average Annual Snowfall	2.9	1.1
Average Monthly Snowfall Range (winter)	0.2 to 1.4	0.2 to 0.5
Highest Annual Snowfall	24.0 (1969)	11.0 (1943, 1972)
Highest Monthly Snowfall	20.0 (January 1950)	11.0 (Jan. 1943, Dec. 1972)
Wettest Year on Record	135.18 (1996)	111.03 (1968)
Driest Year on Record	71.21 (1976)	38.45 (1929)
Wettest Season on Record	67.47 (winter 1999)	49.89 (winter 1918)
Driest Season on Record	1.37 (summer 1967)	0.00 (summer 1931)

Longer-term precipitation trends in the Pacific Northwest are more variable than temperature and vary with the period of record analyzed (Mote et al. 2005). The Pacific Northwest experiences wide precipitation variability based on geography and seasonal and year-to-year variability (Salathé et al. 2010). Looking at the period 1920 to 2000, total annual precipitation has increased almost everywhere in the region, though not in a uniform fashion. Most of that increase occurred during the first part of the record with decreases more recently (Mote et al. 2005).

Precipitation trends from the Newport USHCN observation station shows the average yearly precipitation change has decreased more than 15.9% over the past 30 years, with more striking decreases in the summer and fall (Table 3-4 and Figures 3-4 to 3-6).

Table 3-4. Seasonal Precipitation Trends, 1981-2010 (USHCN 2012) Tillamook, Oregon, United States Historical Climatology Network Observation Station

Monthly Precipitation	30-yr Change % from 1981 Value
Winter (Dec-Feb)	-3.9%
Spring (March-May)	-14.9%
Summer (Jun-Aug)	-47.6%
Fall (Sept-Nov)	-25.9%

Figure 3-4. Water year total precipitation 1925-2010 at Newport, Oregon (USHCN 2012).

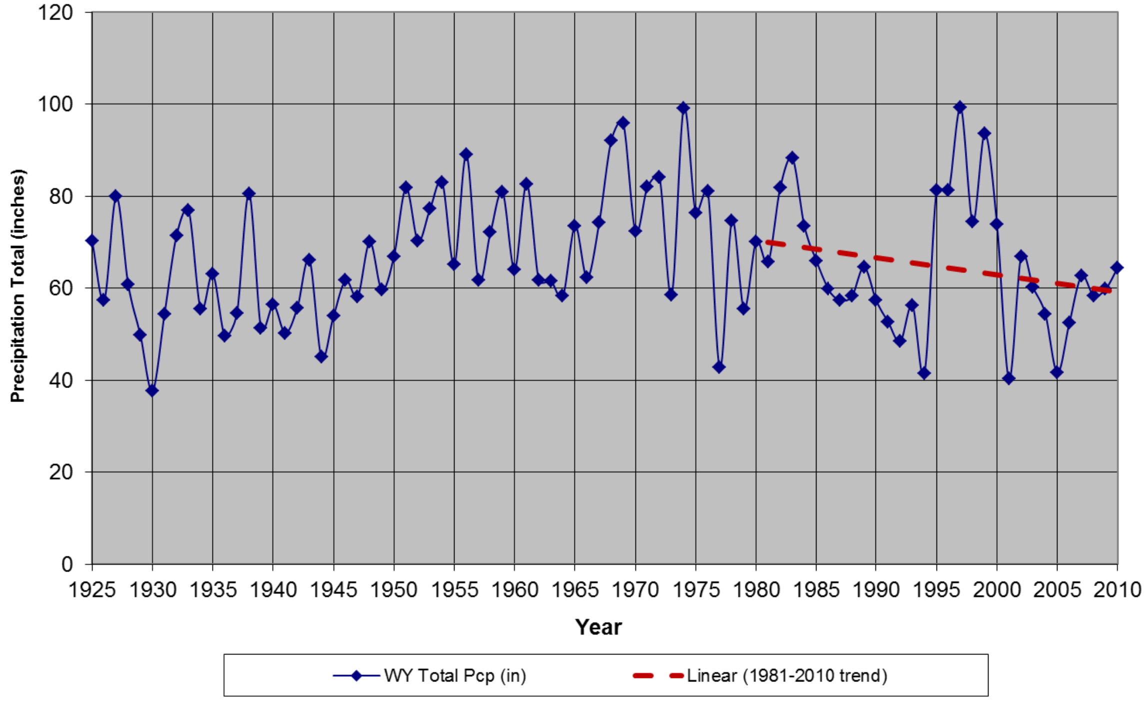


Figure 3-5. Summer (Jun-Aug) total precipitation 1925-2010 at Newport, Oregon (USHCN 2012).

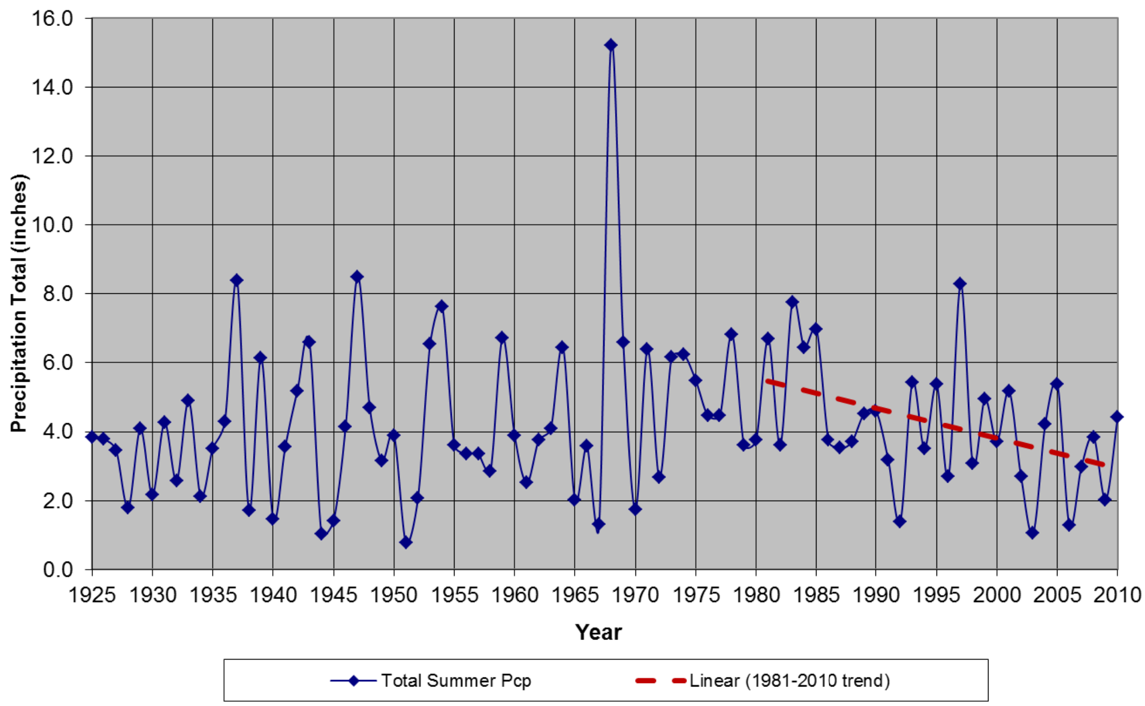
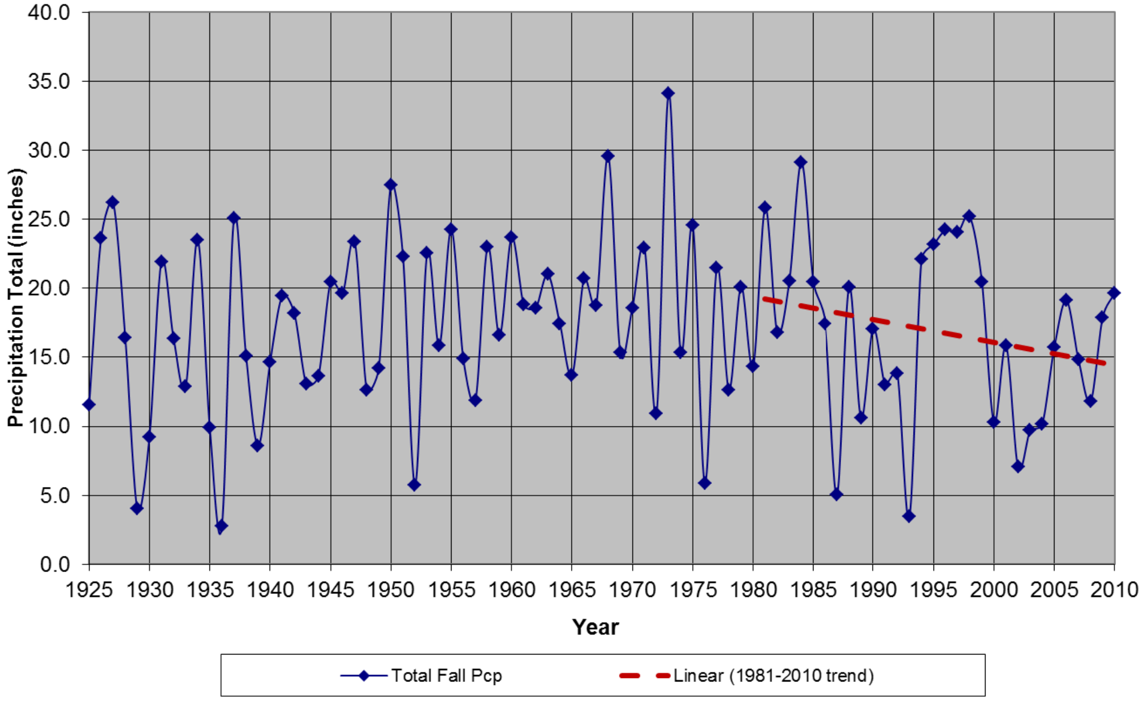


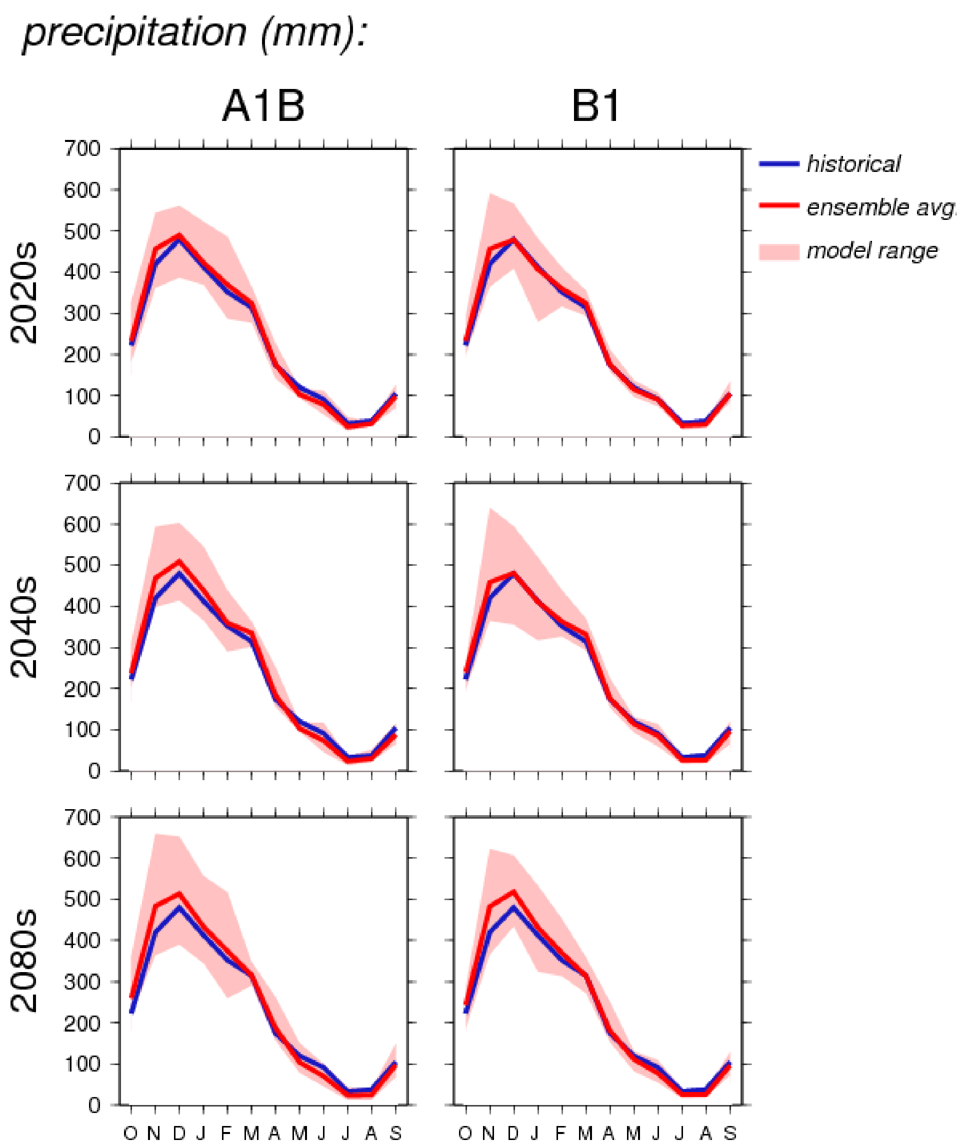
Figure 3-6. Fall (Sept-Nov) total precipitation 1925-2010 at Newport, Oregon (USHCN 2012).



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). Using data derived from the statistical downscaling of 20 global climate models, projected changes in annual precipitation within the Pacific Northwest throughout the twenty-first century, averaged over all models, are small (+1% to +2%) though individual models produce changes of as much as -10% or +20% by the 2080s. Some models project an enhanced seasonal cycle with changes toward wetter autumns and winters and drier summers (Mote and Salathé 2010). However, even small changes in seasonal precipitation could have impacts on streamflow flooding, summer water demand, drought stress, and forest fire frequency. Additionally, researchers have consistently found that regional climate model simulations yield an increase in the measures of extreme precipitation. This finding suggests that extreme precipitation changes are more related to increased moisture availability in a warmer climate than to increases in climate-mean precipitation (Leung et al. 2004, Salathé et al. 2010). 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, Salathé et al. 2010). Figure 3-7 shows these modeled, downscaled precipitation projections for the Siletz-Yaquina watershed (Hydrologic Unit Code 17100204) (Hamlet et al. 2010).

Figure 3-7. Projected precipitation changes for the Siletz-Yaquina Watershed under two emission scenarios. A1B is a higher emission scenario than B1. Current rates are higher than both A1B and B1 (Hamlet et al. 2010).



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 2011g).

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 (WRCC 2011g). It reaches its maximum intensity in midwinter. Wind direction switches to primarily southeasterly or easterly prevailing winds. 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 by the end of October (Taylor and Hannan 1999).

Wind data collected hourly from automated stations at reporting airports on the Oregon coast have been used to draw generalizations about wind activity in/on Siletz Bay Refuge (Table 3-5). Average wind speeds have been calculated on hourly data collected from 1996 to 2006. The highest average wind speeds at Astoria and Newport occurred during the winter months of December, January, and February. At North Bend, the highest average wind speeds occurred during the summer months of June, July, and August. The calmest months at Astoria and Newport were during the late-summer/early-fall months of August, September, and October. At North Bend, the calmest months were October, November, and February.

Prevailing wind direction, defined as the direction with the highest percent of frequency, was calculated from hourly data during 1992 to 2002. In Astoria, easterly winds occur from October through March, switching to southerly winds in April, and then to west and northwest winds from May through September. In Newport, winds from the east occur in December through February, from the south during fall and spring, and north-northwest during the summer months. In North Bend, winds blow from the south-southeast from November to April before becoming northerly for the remainder of the year.

Table 3-5. Wind Data Summaries for Three Locations along the Oregon Coast (WRCC 2011h, WRCC 2011i)

	Astoria	Newport	North Bend
Prevailing Wind Direction	E	S	N
Average Annual Wind Speed	7.7 mph	8.8 mph	8.9 mph
Average Monthly Wind Speed Range	6.7 (Sept.) – 8.7 (Dec.) mph	6.5 (Sept.) – 11.2 (Dec.) mph	7.3 (Oct.) – 11.2 (Jul.) mph

Several times each year, very strong winds hit the Oregon coast (Taylor and Hannan 1999). Wantz and Sinclair (1981) published estimates of extreme winds in the Northwest. They estimate that speeds along the coast sustained for an average of one minute and recurring on average every two years are as high as 56 miles per hour, while fifty-year events would produce winds of approximately 74 miles per hour. Peak gusts would be about 40% higher.

As a rule, Oregon does not experience hurricanes, and tornadoes are infrequent and generally small in the northwestern part of the United States. However, the National Weather Service issued a hurricane warning for the first time for the Oregon coast during an extremely powerful storm that slammed into the Pacific Northwest during December 2-4, 2007, during which winds topped out at 130 miles per hour (209 kilometers per hour) along coastal Oregon (Read 2008). The National Climatic Data Center maintains a database that provides information on the incidence of tornadoes reported in each county in the United States. This database reports that 100 tornadoes were reported in Oregon from 1950 to 2010. In Lincoln County, only three tornadoes have been recorded. All three tornadoes had maximum wind speeds estimated in the range of 40 to 72 miles per hour (64-116 kilometers per hour, or F0) (NCDC 2011).

3.1.5 Climate Cycles in the Pacific Northwest

Two climate cycles have major influences on the climate and hydrologic cycles in the Pacific Northwest: the El Niño/Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO). In El Niño years, average sea surface temperatures in the central and eastern equatorial Pacific Ocean are warmer than average and easterly trade winds in the tropical Pacific are weakened. A La Niña is characterized by the opposite – cooler than average sea surface temperatures and stronger than normal easterly trade winds. These changes in the wind and ocean circulation can have global impacts to weather events. The ENSO influence on Pacific Northwest climate is strongest from October to March. During an El Niño event, the winters tend to be warmer and drier than average. La Niña winters tend to be cooler and wetter than average. Each ENSO phase typically lasts 6 to 18 months and the shift between the two conditions takes about four years (CIG 2011, Conlan and Service 2000).

Like ENSO, the PDO is characterized by changes in sea surface temperature, sea level pressure, and wind patterns. The PDO is described as being in one of two phases: warm and cool. During a warm phase, sea surface temperatures near the equator and along the coast of North America are warmer while in the central north Pacific they are cooler. During a cool phase, the patterns are opposite. Within the Pacific Northwest, warm phase PDO winters tend to be warmer and drier than average while cool phase PDO winters tend to be cooler and wetter than average. A single warm or cool PDO phase lasts 20-30 years. The triggering cause of the PDO phase shift is not understood.

The potential for temperature and precipitation extremes increases when ENSO and PDO are in the same phases and thereby reinforce each other. When ENSO and PDO are in opposite phases, their opposite effects on temperature and precipitation can cancel each other out, but not in all cases and not always in the same direction (CIG 2011).

Future Trends

Based on the evidence of the history of ENSO and PDO events, it is likely that these cycles will continue to occur far into the future. However, the potential influence of anthropogenic climate change on ENSO and PDO is unknown because more information is needed by the experts.

3.2 Hydrology

3.2.1 Refuge Hydrology

Siletz Bay NWR is located within the Siletz Bay estuary, which covers approximately 1,862 acres, including diked and filled lands, and has a watershed of about 373 square miles (Good 2000, Adamus et al. 2005). Estuarine influence extends inland about 23 miles but fluctuates considerably due to the geomorphology of this watershed (Oregon DSL 1989). Currently, the estuary contains a total of 623 acres of tidal and formerly tidal marshes and swamps (Brophy 2001). A comparison of 1850s historic vegetation with recent vegetation mapping by Brophy (2011) using Scranton (2004) and Hawes et al. (2008) indicates a 47% loss of tidal marsh and 84% loss of tidal swamp within the estuary.

The majority of the Refuge is composed of either intertidal, muted tidal, or diked tidal marshes draining into the Siletz River, Millport Slough, Drift Creek, or directly into Siletz Bay. Several diked freshwater wetland tracts within this Refuge have already gone through a restoration process to restore tidal flow to the lands. Other tracts experience varying degrees of muted tidal action mostly due to deterioration or abandonment of tidegates and other control/drainage structures. Excluding the Schooner Creek Tract, and parts of the Watson Tract above Drift Creek, the upland portions of Millport Slough South, and the Erickson/Schaffer Easement, most of the Refuge is within the boundary of the 100-year floodplain (FEMA 2009a, 2009b, 2009c).

Wetlands west of U.S. Highway 101 are largely intact, with natural tidal hydrology. However, old dikes located on the Siletz Keys parcel affect tidal exchange. A small tidal marsh restoration project on the Schnuelle Tract, located north of the mouth of Drift Creek and west of the highway, was completed in November 2000, returning tidal action to the site.

East of Highway 101 and on the south bank of the Siletz River, the 10-acre Schoen Tract contains a perimeter dike that prevents tidal flows except during extreme high tides. The Millport Slough marshes contain both natural and restored tidal marsh areas. The marsh to the north of Millport Slough is a relatively undisturbed tidal prairie with intact tidal hydrology (i.e., with highly sinuous, dendritic, deep, and steep-sided tidal channels). Millport Slough South is a tidal wetland that was diked and managed as pasture for many decades until dike failures occurred in the 1980s and 1990s. A restoration project was completed in late 2003 through a partnership with Ducks Unlimited and the Confederated Tribes of Siletz Indians. The restoration involved breaching 220 feet of dike, removing two dikes totaling 9,300 feet and filling 1,200 feet of artificial ditches. The western half had been subjected to muted tidal influence since water control structure failure in 1981.

Refuge lands in the Drift Creek area located on the east side of the highway are primarily muted tidal wetlands. Historically, this area was comprised of tidal marsh, and floodplain overflow areas. This and other adjoining parcels were diked and drained and converted to pastureland for grazing of livestock. A severe flood event in the late 1990s resulted in the complete loss of the water control structure on private land located adjacent to the southeast corner of the Shaffer Tract. Loss of the water control structure and subsequent breaches in the dikes adjacent to Drift Slough and along Drift Creek now allow significant but muted tidal flows on the property. The portion of the Watson Tract located south of the Drift Slough tidal channel and east of the refuge residence is also a diked tidal marsh with muted tidal flow. A tidegated culvert formerly existed at the northwest corner of the site. Upon failure, limited tidal flow restricted by to beaver dams now enters the site.

The Kangas Tract is located east of Highway 101, south of SE 64th Street, and west of South Drift Creek Road. Historically, this entire lowland area was tidally-influenced wetland; however, the area is now diked, ditched, and drained and until the mid-1990s was heavily grazed and hayed for cattle forage. The ditches on the property receive extremely muted tidal flows through a culvert under the highway and a failed tidegate located on private property. Beaver dams in the ditches and plugging of the Highway 101 culvert have caused water inundation on some parts of the property and flooding of private lands on the east side. In 2012, the Oregon Department of Transportation is planning to replace the culvert under Highway 101 with a much larger 12-foot-diameter box culvert. This size culvert will allow for future tidal restoration of the Kangas Tract.

The wetland within the Erickson/Schaffer Easement is a former tidal marsh that has been altered by construction of the Siletz River Highway (Highway 229) and placement of a tidegate in the culvert under the highway. In fall 2000, the tidegate was only partly functional (i.e., it did not close completely) and as a result, a brackish-water-tolerant Lyngby sedge community has become established in the west end of the wetland near the culvert. A strong pattern of remnant tidal channels exists on this wetland, particularly in the southeast third of the site (Brophy 2002). The major tidegate affecting this area is located on the adjoining private property on the north boundary.

Future Trends

While the refuge lands themselves currently receive the vast majority of their annual precipitation as rainfall, the watershed feeding the Siletz River currently receives substantial quantities of its annual precipitation as snow. One of the most important responses to warmer winter temperatures in the Pacific Northwest has been the loss of spring snowpack (Mote et al. 2005). Climate impacts on snow hydrology in the Pacific Northwest are particularly sensitive because total annual precipitation is highly concentrated in the winter months and the region includes a large amount of snow cover that accumulates at temperatures near 0°C; areas at greater risk to climate warming than cold climate snowpacks because temperature affects both precipitation phase (snow versus rain) and the rate of snowpack ablation (Nolin and Daly 2006). As temperatures rise, the likelihood of winter precipitation falling as rain rather than snow increases. Small increases in average winter temperatures can lead to increased rains, reduced snowpack, and earlier snowmelt.

Also, the changes in precipitation described in Section 3.1.3, above, foretell lower freshwater flows to the Refuge especially in the summer and fall months.

3.2.2 Tides and Salinity

The nearest National Ocean Survey tidal benchmark to Siletz Bay NWR is located in Depoe Bay, approximately 7 miles south. However, subordinate tidal stations with available predictions closer to the Refuge are available in Kernville and Taft. Additionally, tide gages placed at Millport Slough and Siletz Keys during 2007 to 2008 also provide local tidal datums. Tidal benchmark information for Depoe Bay for the 1983-2001 period and tidal datums calculated at Millport Slough and Siletz Keys are summarized in Table 3-6. Historic records of tides and water levels from the Depoe Bay, Kernville, and Taft tide stations are summarized in Table 3-7. Data for each station includes mean ranges, diurnal ranges, and the minimum and maximum water levels on record where available. 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.

Tide water is brackish: more salty during the growing season, and more fresh during high winter river flows. Mean salinities recorded for the Siletz Bay estuary at the location nearest to the Refuge for January-March, April-June, July-September, and October-December are 1, 8, 22, and 22 parts per thousand (ppt) (Hamilton 1984). These measurements indicate that during winter and spring, the freshwater flow into the bay strongly limits the intrusion of marine water. Freshwater flow, measured at Siletz, is usually lowest in August and September and highest during December and January (USGS 2011).

Table 3-6. Tidal Benchmark Summary for Depoe Bay, Oregon, and Tidal Datum Summary for Millport Slough and Siletz Keys (NOAA 2011a, Brophy et al. 2011)

Station Information	Depoe Bay Sta. ID 9435827	Millport Slough (10/25/07-7/27/08)	Siletz Keys (07/2007-10/2007)	Siletz Keys (10/2007-06/2008)
Mean Higher High Water (MHHW) (ft)	8.24	7.68	7.23	7.90
Mean High Water (MHW) (ft)	7.53	7.00	N/A	7.23
Mean Tide Level (MTL) (ft)	4.45	N/A	N/A	N/A
Mean Sea Level (MSL) (ft)	4.42	N/A	N/A	N/A
Mean Low Water (MLW) (ft)	1.37	N/A	N/A	N/A
North American Vertical Datum 1988 (NAVD88)	0.63	0.00	0.00	0.00
Mean Lower Low Water (MLLW)	0.00	N/A	N/A	N/A

Table 3-7. Historic Tidal Data Summary for Depoe Bay, Kernville, and Taft, Oregon (NOAA 2011b, NOAA 2011c)

Station Information	Depoe Bay Sta. ID 9435827	Kernville Sta. ID 9436031	Taft Sta. ID 9436101
Mean Range (ft)	6.16	4.6	5.0
Diurnal Range (ft)	8.24	6.1	6.6
Mean Tide Level (MTL) (ft)	4.45	3.1	3.4
Minimum Water Level (ft below MLLW)	-3.33 (05/24/1982)	N/A	N/A
Maximum Water Level (ft above MLLW)	12.22 (01/26/1983)	N/A	N/A

Future Trends

It is anticipated that the warming of Oregon's temperate climate will contribute to fundamental changes along the coast, including but not limited to shifts in the timing and intensity of coastal storms, changes in precipitation and the delivery of freshwater inputs, sea level rise, and increased inundation of the shallow tidal basins. Regional coastal climate change may also result in changes in the intensity and timing of coastal upwelling, shifts in temperatures and dissolved oxygen concentrations, and alteration of the carbonate chemistry of nearshore waters. The combination of these changes will alter chemical concentrations in estuaries (Ruggiero et al. 2010). As a moderately river-dominated drowned river mouth estuary (Lee and Brown 2009), the Siletz Bay estuary may experience changes in the salinity regime in response to changes in precipitation and snow melt in the watershed (resulting in changes in freshwater inflows) and increased intrusion of seawater associated with rising sea levels. However, the effect of climate change on estuarine salinity will vary with location inside the estuary and the magnitude of the relative sea level rise rate in the vicinity of the estuary.

3.2.3 Sea Level Rise

Sea level rise on the Oregon coast is the result of three major forces: global mean sea level rise driven by the melting of land-based ice, local dynamical sea level rise driven by changes in wind which pushes coastal waters toward or away from shore, and localized vertical land movements driven primarily by tectonic forces (Mote et al. 2008, McKay et al. 2011). Mean sea level is defined as the average sea level over a 19-year period, above which other fluctuations (e.g., tides, storm surges, etc.) occur (Smerling et al. 2005). Global mean sea level rise has been in the range of 1.3 to 2.3 millimeters (0.05 to 0.09 inch) per year between 1961 and 2003 (IPCC 2007a). But since 1993 the rate has increased about 50% above the 20th century rise rate to 3 millimeters (0.12 inch) per year (Bromirski et al. 2011) and the latest global satellite sea level observations measure a rate of 3.19 millimeters (0.13 inch) per year (NASA 2012). This acceleration is primarily the result of ice field and glacier melt-off (McKay et al. 2011). For example, the total global ice mass lost from Greenland, Antarctica, and Earth's glaciers and ice caps between 2003 and 2010 was about 4.3 trillion tons (1,000 cubic miles), adding about 0.5 inch (12 millimeters) to global sea level in a seven-year period (Jacob et al. 2012).

Based on monthly mean sea level data from 1967 to 2006, the mean sea level trend at South Beach, Oregon, located approximately 19 miles south of the Refuge, is 2.72 millimeters/year with a 95% confidence interval of ±1.03 millimeters/year. This is equivalent to a change of approximately +0.89 feet per century (NOAA 2011d).

Future Trends

The IPCC Special Report on Emissions Scenarios (SRES) forecasts that global sea level will increase by approximately 12 inches (30 centimeters) to 39 inches (100 centimeters) by 2100 (IPCC 2001). However, more recent analyses (Chen et al. 2006, Monaghan et al. 2006) indicate that the eustatic rise in sea levels is progressing more rapidly than was previously assumed, perhaps due to the dynamic changes in ice flow omitted within the IPCC report's calculations. Vermeer and Rahmstorf (2009) suggest that, taking into account possible model error, a feasible range by 2100 might be 30 inches (75 centimeters) to 75 inches (190 centimeters) (Vermeer and Rahmstorf 2009).

Tebaldi et al. (2012) show that even seemingly low increases in sea level will have significant impacts in the short term when storm surges are taken into account. An analysis of historic data combined with future projections of sea level rise is used to estimate future return periods for what today are considered 50-year and 100-year events. This magnifies sea level rise by a factor of five, on average, and dramatically increases the occurrence, or return periods, of storm surge events. The closest area to the Refuge that was analyzed is the South Beach tide gauge in Newport. The return period for storm surges currently qualifying as 100-year events is projected to change to every 5 years at this site by 2050. The analysis shows that 50-year storm surges events are projected to increase by approximately 52 inches at the tide gauge, and 100-year storm surges events are projected to increase approximately 54 inches.

Rising sea levels may result in tidal marsh submergence (Moorhead and Brinson 1995) and habitat migration as salt marshes transgress landward and replace tidal freshwater and brackish marsh (Park et al. 1991). Changes in tidal marsh area and habitat type in response to sea level rise were modeled using the Sea Level Affecting Marshes Model (SLAMM 6), which accounts for the dominant processes involved in wetland conversion and shoreline modifications during long-term sea level rise (Park et al. 1989, Clough et al. 2010, Clough and Larson 2010). Within SLAMM, there are five primary processes that affect wetland fate under different scenarios of sea level rise: inundation, erosion, overwash, saturation, and accretion. There are currently several active projects involving the use of SLAMM 6 to estimate the impacts of sea level rise on the coasts of the Pacific Northwest (e.g., Glick et al. 2007).

For Siletz Bay NWR, SLAMM 6 was run using mean and maximum estimates from scenario A1B from the SRES. Under the A1B scenario, the IPCC AR4 (IPCC 2007a) suggests a likely range of 0.21 to 0.48 meters of sea level rise by 2090-2099 “excluding future rapid dynamical changes in ice flow.” The A1B-mean scenario that was run as a part of this project falls near the middle of this estimated range, predicting 0.40 meters of global sea level rise by 2100. The A1B-maximum scenario predicts 0.69 meters of sea level rise by 2100. To allow for flexibility when interpreting the results, SLAMM was also run assuming 1 meter (3.28 feet), 1.5 meters (4.92 feet), and 2 meters (6.56 feet) of eustatic sea level rise by the year 2100. Pfeffer et al. (2008) suggests that 2 meters (6.56 feet) by 2100 is at the upper end of plausible scenarios due to physical limitations on glaciological conditions. Model results through 2025 for Siletz Bay NWR under several sea level rise scenarios where the dikes would not continue to be maintained or raised and thus subjected to inundation, are presented in Table 3-8 (Clough and Larson 2010, So et al. 2011). All model results are subject to uncertainty due to limitations in input data, incomplete knowledge about factors that control the behavior of the system being modeled, and simplifications of the system.

Table 3-8. Predicted Change in Acreage of Land Categories at Siletz Bay NWR by 2025 Given SLAMM Modeled Scenarios of Sea Level Rise (Clough and Larson 2010, So et al. 2011)

		Sea Level Rise Scenarios				
	Initial Condition	**A1B Mean (.39 meter [1.28 feet] by 2100)**	**A1B Maximum (.69 meter [2.3 feet] by 2100)**	**1 meter (3.28 feet) by 2100**	**1.5 meters (4.92 feet) by 2100**	**2 meters (6.56 feet) by 2100**
Tidal Flat	715.8	716.1	716.2	716.3	716.5	716.8
Undeveloped Dry Land	395.6	355.6	352.1	348.1	342.0	335.4
Regularly Flooded Marsh	280.6	296.1	298.2	301.7	309.9	322.8
Estuarine Open Water	261.3	260.4	260.4	260.5	260.5	260.5
Irregularly Flooded Marsh	234.6	235.3	236.1	237.0	237.9	238.2
Inland Fresh Marsh	62.4	41.6	38.0	33.0	25.6	21.5
Tidal Swamp	18.1	15.9	14.8	13.6	12.1	11.1
Developed Dry Land	15.3	14.3	14.2	14.2	14.1	14.0
Ocean Beach	10.3	10.3	10.4	10.4	6.6	2.4
Transitional Salt Marsh	5.1	50.1	55.3	61.0	66.5	64.9
Estuarine Beach	1.1	3.7	3.7	3.8	3.8	3.9
Inland Open Water	1.1	0.6	0.6	0.6	0.6	0.6
Swamp	0.7	0.7	0.7	0.7	0.7	0.7
Inland Shore	0.2	0.2	0.2	0.2	0.2	0.2
Open Ocean	0.0	1.4	1.4	1.5	5.4	9.6

For example, mineral sedimentation rates and organic matter (vegetative) accretion rates need to be taken into account for inland marine influenced ecosystems such as the Refuge’s marshes. Nyman et al. (2006) find that the vegetative component is the more significant of the two factors (i.e., accretion varied with organic accumulation rather than mineral sedimentation). Salt-marsh accretion rate was investigated by Thom (1992) at six sites that spanned a gradient in relative rate of sea level rise in Washington and Oregon. Mean accretion rate over all sites was found to be 3.6 millimeters (0.14 inch) per year (95% confidence interval = 2.4 to 4.8 millimeters [0.09 to 0.19 inch] per year). However, marsh accretion rates specific to Siletz Bay taking in both mineral and organic sources have not yet been measured.

3.3 Ocean Chemistry

The ocean will eventually absorb most carbon dioxide released into the atmosphere as a result of the burning of fossil fuels and other sources. Current rates of carbon dioxide emissions are causing and an increase in the acidity of ocean surface waters and a decrease the saturation of calcium carbonate ($CaCO_3$), a compound necessary for most marine organisms' development of shells and skeletons (Hönisch et al. 2012). Oceanic absorption of CO_2 from fossil fuels may result in larger acidification changes over the next several centuries than any inferred from the geological record of the past 300 million years (with the possible exception of those resulting from rare, extreme events such as meteor impacts). In the past 300 million years, three analogous ocean acidification events have been identified and these events coincided with mass extinctions of marine organisms, however it should be noted that warming and corresponding oxygen depletion co-occurred during these events and contributed to the extinctions (Hönisch et al. 2012).

Virtually every major biological function of marine organisms has been shown to respond to acidification changes in seawater, including photosynthesis, respiration rate, growth rates, calcification rates, reproduction, and recruitment. Much of the attention has focused on carbonate-based animals and plants which form the foundation of our marine ecosystems. An increase in ocean acidity has been shown to impact shell-forming marine organisms from plankton to benthic mollusks, echinoderms, and corals (Doney et al. 2009). Many calcifying species exhibit reduced calcification and growth rates in laboratory experiments under high-CO_2 conditions. Ocean acidification also causes an increase in carbon fixation rates in some photosynthetic organisms (both calcifying and noncalcifying) (Doney et al. 2009, Smith and Baker 2008, and Ocean Carbon and Biogeochemistry Program 2008). These potential impacts to the marine food web may obviously negatively affect refuge resources such as seabirds, shorebirds and salmonids. Localized acidification rates within Siletz Bay have not been evaluated.

3.4 Topography and Bathymetry

With the exceptions of the Schooner Creek Tract, and parts of the Watson Tract above Drift Creek and Erickson/Schaffer Easement, the topography of the Siletz Bay NWR does not vary significantly and is largely flat, with most areas below 12.0 feet North American Vertical Datum 1988 (NAVD88) in elevation (OLC 2010). The majority of the Refuge is composed of either intertidal, muted tidal, or diked tidal marshes draining into Siletz Bay, the Siletz River, Millport Slough, or Drift Creek. Elevations of the marsh surfaces typically range between 8.0 to 9.0 feet NAVD88; however the diked or formerly diked areas of the Millport Slough, Drift Creek, and Kangas Tract areas, as well as the Erickson/Schaffer Easement likely experienced variable amounts of subsidence. The highest elevations within the Refuge occur within the Schooner Creek Tract at around 250.66 feet NAVD88. The forested areas within the Watson Tract and the Erickson/Schaffer Easement also reach over 200 feet NAVD88.

3.5 Geology and Geomorphology

3.5.1 Tectonic Context

The Oregon coast is located on the western margin of the North American continental plate near its junction with the Juan de Fuca plate, a section of denser oceanic crust. Where the latter plate moves eastward and collides with the North American plate, it slides underneath and descends into the earth's mantle in an area known as the Cascadia Subduction Zone (Orr et al. 1992, Nelson et al. 1995). Although the subduction process is very gradual, proceeding at a relative velocity of 4 centimeters (1.12 inches) per year, the massive forces that drive the converging plates cause strain to accumulate at the edge of the North American plate (Douglas 1991). Over time, the accumulation of strain causes the edge of the continental plate to bend and rise in elevation in a process known as uplift. Periodically, this strain is released during an earthquake and the edge of the North American plate rapidly drops downwards, suddenly lowering the coastline, and correspondingly raising the relative sea level. The elevation drop which occurs during an earthquake is termed subsidence. These processes of regional plate tectonics have had substantial influence in shaping the physical features and geographic characteristics of the Oregon coast.

3.5.2 Geologic and Geomorphologic Overview

Siletz Bay NWR is within the Coastal Range physiographic province described by Orr et al. (1992). The Coast Range, a long narrow belt of moderately high mountains and coastal headlands, extends southward from the Columbia River to approximately the middle fork of the Coquille River, and inland from the continental shelf and slope to the western edge of the Willamette Valley. Over 200 miles long, and 30 to 60 miles wide, the province averages 1,500 feet in altitude with a maximum elevation of 4,097 feet at Mary's Peak.

The Coast Range has its origins in accreted oceanic sediments born from volcanic activity approximately 64 million years ago. These Roseburg volcanics in the southern portions of the range were followed by the Siletz River and Tillamook volcanics in the northern portions of the range, formed mostly during the Paleocene to middle Eocene (about 60 to 45 million years ago). Deposited with these volcanics but also overlying them and intruded by them is a regionally extensive marine sandstone and siltstone commonly referred to as the Tyee Formation. Successively younger deposits of sediments and volcanics are found to the east of the Coast Range and along the coast. During the Oligocene (-25 million years ago), uplift of sedimentary basins in Oregon resulted in the westward migration of the coastline from as far east as Idaho towards the present position. As the western edge of the North American plate was uplifted by pressure from the subducting Juan de Fuca plate, a series of basalt flows from fissures in eastern Oregon began to reach the coast. During the Miocene, Columbia River lavas invaded the northern coastal area. By the Pliocene, the current coastline was approximately in place and rivers continued to cut deep valleys through igneous and sedimentary rocks.

Subduction of the Juan de Fuca plate under North America is continuing to push the Coast Range upwards, albeit at varying rates along the coast. For example, Cape Blanco is being uplifted at a rate of 1 inch every 3 years while Astoria is only being uplifted at a rate of 1 inch every 36 years (Orr et al. 1992). The last great (moment magnitude >8) Cascadia Subduction Zone earthquake occurred on January 26, 1700 (Atwater et al. 2005). Hazard estimates, based on the magnitude-9 earthquakes, had set the recurrence interval at about 500 years, with a 10-15% chance of another in the next 50 years.

However, Goldfinger et al. (2010) determined an average recurrence interval of about 240 years, leading to a 37% probability of a great earthquake occurring somewhere along the Cascadia fault in the next 50 years.

The Alsea Formation, a marine siltstone and very fine-grained sandstone stratum uplifted during the Oligocene, underlies the Schooner Creek Tract and the upland areas of the Watson Tract and Erickson/Schaffer Easement. Excluding the upland areas of the Refuge overlaying Oligocene sedimentary rock, the remainder was formed during the Holocene (12,000 years ago to present) following series of sea level rise, subsidence, and uplift events.

Considered a “drowned river” estuary, the Siletz Bay estuary formed when melting glaciers at the end of the most recent ice age caused global and regional sea level rise. The remnant river mouth was then submerged and over time infilled with sediment. Infilling of the estuary and marsh development occurs as runoff from precipitation washes sediments from slopes into streams or their flood plains. These sediments are then transported downstream to the estuary where they settle and become influenced by tides (Simenstad 1983). Most of the present-day Refuge is located on this alluvium, which is predominantly composed of mixtures of sand, silt, clay, and organic matter (Schlicker et al. 1973, Snavely et al. 1976). Much of the coarser sediment settles out near the banks of the river, forming natural levees. The finer materials such as fine sands and clayey silts remain suspended longer and settle throughout the intertidal zone and flooded lowlands. Additionally, sediments are moved into the lower estuary from the ocean shore by tsunamis, storm surges, and dune building.

3.6 Soils

With the exception of some soils formed from the weathering of Oligocene age sedimentary rock in the forested upland areas near Schooner Creek, Drift Creek, and the Erickson/Schaffer Easement, the majority of the Refuge is primarily overlain with alluvium deposited after the last glacial period (Snavely et al. 1976, USDA 1997).

The principal soil type in both the diked and undiked tidal marsh areas of the Refuge is Coquille silt loam (0 to 1 percent slopes). Coquille silt loam is a deep, poorly drained soil formed in silty recent alluvium derived from mixed sources with slow permeability and water capacity of about 11 to 13 inches. The effective rooting depth is more than 60 inches but is limited by a seasonal high water table 2 feet above to 2 feet below the surface throughout the year. This soil is frequently flooded for brief periods throughout the year.

The soil types underlying the forested uplands of the Schooner Creek, Drift Creek, and Millport Slough South areas, and the Erickson/Schaffer Easement are primarily Fendall-Templeton silt loams (45 percent Fendall soil, 35 percent Templeton soil, 35 to 60 percent slopes) and Templeton-Fendall silt loams (55 percent Templeton soil, 30 percent Fendall soil, 5 to 35 percent slopes). The Fendall-Templeton silt loam is found on the side slopes while the Templeton-Fendall silt loam is found on the broad top. Both Fendall and Templeton soils are formed in colluviums weathered from sedimentary rock. The Fendall soil is moderately deep and well drained. Permeability is moderately slow and available water capacity is 4 to 10 inches. The Templeton soil is deep and well drained. Permeability is moderate and available water capacity is 8 to 16 inches. The native vegetation on both of these soil types is mainly western hemlock, Sitka spruce, Douglas-fir, red alder, salal, salmonberry, thimbleberry, red huckleberry, evergreen huckleberry, and western swordfern.

The northeastern-most section of the Schooner Creek Tract adjacent to SE 54th Drive is underlain with Gleneden silty clay loam (2 to 12 percent slopes). This soil type is deep, somewhat poorly drained, and formed on marine terraces in clayey alluvium derived from mixed sources. Permeability is slow and available water capacity is 8 to 10 inches.

3.7 Fire

3.7.1 Pre-settlement Fire History

There is little published information available describing the specific historic role of fire on lands that are now within Siletz Bay NWR. Wildland fires on the Oregon coast have always been infrequent and do not exhibit any predictable cycle. The forested Refuge areas are dominated by Sitka spruce and located in the “near coastal zone” where climatic conditions limit the frequency and intensity of naturally occurring fires. The limited data available indicate that fires in this zone were very infrequent and tended to burn wide areas but only under very rare, extremely dry and windy conditions in late summer and fall. In the tidal and freshwater marsh ecosystems that comprise much of the Refuge, fire was likely very infrequent. However, Native Americans in the Siletz Bay area are thought to have set fires to create habitat for game animals and to promote the growth of weaving materials and food.

3.7.2 Post-settlement Fire History

The only recorded large fires in post-settlement times were the Siletz Fire (800,000 acres) and the Yaquina Fire (estimated 500,000 acres), both in the mid to late 1800s. Both of these catastrophic fires were thought to have been set by settlers to clear land for other purposes.

The normal fire season recognized by the U.S. Forest Service and the Oregon Department of Forestry (ODF) Toledo District is June 1 to September 30. There have been no recorded fires on or near Siletz Bay refuge lands in the past 10 years.

Under the current refuge fire management plan, guidelines for appropriate wildland fire suppression, hazard fuel reduction, and pile burning are detailed. Mechanical treatment may be used as a fire management strategy for hazard fuels reduction. Pile burning as a limited prescribed fire technique may be used to reduce hazard fuels; however, no prescribed burning has been conducted on the Refuge. Typical “prescribed fire season” is fall and spring and is weather-dependent. Pile burning can occur year-round depending on weather conditions and restrictions placed by the Oregon Smoke Management Plan. There is no formally established “prescribed burning season” as any domestic pile or barrel burning is allowed all year contingent on weather conditions. Larger scale burning such as forestry slash burning requires a permit and a pre-burn inspection by ODF. Lincoln City has permanently banned all outdoor burning within the Lincoln City Fire District.

3.8 Environmental Contaminants

3.8.1 Air Quality

The Oregon Department of Environmental Quality (ODEQ) does not have any ambient air quality monitoring stations located on the Oregon Coast. The majority of ODEQ’s air quality monitoring stations are located within the interior valleys between the Coast and Cascade Mountain Ranges where the majority of Oregon's population resides. The lack of ambient air quality monitoring on the Oregon Coast makes it difficult to assess baseline air quality conditions.

Siletz Bay NWR is located within the Oregon Coast Airshed, which is generally well mixed year-round due to the influence of the Pacific Ocean. Low pressure systems move through the airshed throughout the year and usually bring wind, clouds, and rain. The intensity and frequency of these low pressure systems increases during the fall through winter resulting in sometimes very rainy and windy conditions. In between these low pressure systems high pressure systems move in resulting in drying trends. High pressure systems generally dominant the airshed during late spring, summer, and early fall. Coastal fog due to inland heating is common during the summer months. In general, the Oregon Coast Airshed remains relatively unstable resulting in a well-mixed airshed with suspected good air quality.

Locally, air quality may be affected by various activities on and adjacent to the Refuge including: marine vessels, automobiles, and other human caused activities such as outdoor burning, wood stoves, and operation of various vehicles and machines (e.g., gasoline/diesel powered equipment, motorboats). The refuge staff uses various types of equipment and transportation methods to achieve the refuge habitat conservation projects, monitoring and research. Habitat improvement projects and daily monitoring activities may include the use of tractors, heavy equipment and/or the operation of trucks, boats, or other vehicles.

3.8.2 Water Quality and Contaminants

No areas within the Refuge are currently considered contaminated and there are few existing contaminant threats. However, the Refuge is in an estuary, which could be exposed to upriver, as well as ocean contaminant sources. The watershed contains large areas of private commercial forest land where chemical herbicides are heavily used and could be transported to the Refuge via surface water. If a large coastal oil spill occurred in the vicinity of the Refuge, the estuary could be contaminated with material carried in with the tide. In addition, U.S. Highway 101 runs through the Refuge and could be a source for a spill or pollution resulting from an auto accident. Lincoln City, north of the Refuge, could be a source for pollutant entering into the Bay.

A state is required to identify waters that do not meet that state's water quality standards under Section 303(d) of the Clean Water Act (CWA). These waters are considered "water quality limited" and placed on the state's 303(d) impaired waters list. Section 303(d) requires the state to develop Total Maximum Daily Loads (TMDLs) for impaired waterbodies. TMDLs are the amount of each pollutant a waterbody can receive and not exceed water quality standards. Water quality standards for Oregon include beneficial uses, narrative and numeric criteria, and antidegradation policies. The Oregon Department of Environmental Quality (ODEQ) lists impaired water segments by designated fish uses; therefore, entire tributaries can be listed after one assessment event. Parameters included in the assessment are aquatic weeds or algae, bacteria (E. coli), bacteria (fecal coliform), biological criteria, chlorophyll a, dissolved oxygen, pH, sedimentation, temperature, total dissolved gas, toxic substances, and turbidity.

No waters within the Siletz Bay NWR boundary were listed as impaired because these waters have not been assessed under the CWA. However, temperature was reported as significantly impaired on Siletz River and Drift Creek adjacent to the Refuge in the 2002 and 2004/2006 303(d) reporting cycles. This impairment affects the beneficial uses of anadromous fish passage, and salmonid fish rearing (ODEQ 2011). Turbidity was added as a significant impairment to Siletz River in Oregon's

2010 Section 303(d) List of Category 5 Water Quality Limited Waters Needing a TMDL submitted by ODEQ to EPA for review and approval in January 2011. Turbidity affects the beneficial uses of drinking water and water supply (ODEQ 2011). Additionally, municipal sources discharge into streams eventually draining into the Siletz Bay NWR. These discharges operate under NPDES permits containing effluent limitations which reflect State water quality standards and monitoring requirements. ODEQ has initiated (initial scoping and data collection phase) a TMDL in the Siletz-Yaquina subbasin.

Climate change has the potential to cause water quality impairments including possible effects on estuarine water temperature, salinity, dissolved oxygen, nutrients, chlorophyll a, bacterial contamination, and carbonate chemistry (Ruggiero et al. 2010).

3.9 Surrounding Land Use

The Refuge is bordered by Lincoln City to the north and is located within Lincoln County, Oregon. Most of the Refuge, with the exception of the Schooner Creek Tract, falls outside of City limits. Urban zoning around the Refuge is limited to the Taft, Cutler City, and south Lincoln City area. Rural residential areas are scattered along the Siletz River near the town of Siletz, and along lower Drift and Schooner Creeks. Residences also line Salishan Spit and are adjacent to the Refuge at the Siletz Keys. The Schooner Creek Tract is located immediately north of a small group of residences, and the road comprising its north and west boundary leads to the city sewage treatment plant. Immonen Road, which leads into the Millport Slough area, has several structures located at the beginning of the road, as well as a pottery shop and glass blowing studio on the bayside of the road. The Schaffer easement is located along the Kernville Highway, and has several privately-owned structures located just outside of the southern tip of the easement. There is also an inholding with a cluster of residences and outbuildings located downhill from the east boundary of the easement, surrounded by mixed Douglas-fir woodland. The Salishan Spa and Golf Resort is located south of the Refuge.

The vast majority of the County is zoned for Forestry use. About 60 percent of the commercial forest is privately owned. The rest is publicly owned and is administered mainly by the U.S. Forest Service, Bureau of Land Management, and Bureau of Indian Affairs and by the State of Oregon. Agriculture use areas are primarily located along the mainstem Siletz River from Moonshine Park downstream to the estuary, and along lower Drift Creek and Schooner Creek. Farming primarily consists of livestock grazing and forage production.

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Roy W. Lowe/USFWS

Chapter 4
Biological Environment

Chapter 1 Introduction and Background
Chapter 2 Management Direction
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Chapter 4. Biological Environment

This chapter addresses the biological resources and habitats on the Siletz Bay National Wildlife Refuge (NWR or Refuge); however, it is not an exhaustive overview of all species and habitats. The chapter begins with a discussion of biological integrity (historic conditions and ecosystem function), as required by the Refuge Administration Act. 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 (ROCs) designated under this CCP. Background information includes description, location, condition, trends, key ecological attributes, and threats (stresses and sources of stress) associated with each ROC. The information presented herein was used to develop goals and objectives for the CCP (see Chapter 2).

4.1 Biological Integrity, Diversity, and Environmental Health

The National Wildlife Refuge System Administration Act, as amended, 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. The BIDEH policy (601 FW 3) defines *biological integrity* as "the biotic composition, structure, and functioning at genetic, organism, and community levels comparable with historic conditions, including the natural biological processes that shape genomes, organisms, and communities." *Biological diversity* is defined as "the variety of life and its processes, including the variety of living organisms, the genetic differences among them, and communities and ecosystems in which they occur." *Environmental health* is defined as the "composition, structure, and functioning of soil, water, air, and other abiotic features comparable with historic conditions, including the natural abiotic processes that shape the environment." 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.

The Refuge System policy on BIDEH (601 FW 3) also provides guidance on consideration and protection of the broad spectrum of fish, wildlife, and habitat resources found on the Refuge and in associated ecosystems that represents BIDEH.

4.1.1 Historic Conditions and Habitat Alterations

The biological integrity, diversity, and environmental health (BIDEH) of the ecosystems including and surrounding Siletz Bay NWR have undergone dramatic alterations since pre-settlement times. The most discernible changes include: (1) the conversion and development of large portions of coastal areas into agriculture, housing, and commercial lands; (2) logging; (3) the alteration of fire regimes; (4) introduction of contaminants into the aquatic environment; (5) the loss of native species accompanied by a large influx of non-native and invasive plants and animals into the system; and (6) climate change. This section discusses the connection between some of these main landscape level changes with the current vegetation and wildlife on the lands and waters occupied by the Refuge. This summary is not a complete analysis of all factors related to changes in native vegetation, fish, and wildlife.

Historically, native people settled small communities around Siletz Bay and subsisted by harvest of berries, tubers, plants, shellfish, fish, and animals. Native Americans burned portions of the forest to clear land of thick vegetation and create open areas. After 1850, permanent Euro-American settlements became established. Trees were cleared and patches of plowed farmland began to appear. The only recorded large fires in post-settlement times were the Siletz Fire (800,000 acres) and the Yaquina Fire (estimated 500,000 acres), both in the mid to late 1800s. Both of these catastrophic fires were thought to have been set by settlers to clear land for other purposes (USFWS 2004). There have been no recorded fires on or near Siletz Bay refuge lands in the past 20 years.

Post-settlement, native populations declined precipitously due to lack of immunity to European diseases. As the non-native population steadily grew adjacent to the bay, most of the lowlands were homesteaded for farms. Some of the bay tidal marshes were diked off from tidal action and converted to pastures for hay production, cattle grazing, and dairy operations. Many straight ditches were dug throughout the area; however, major tidal channels were left in place but deepened through dredging. All salt marshes in the Pacific Northwest have been altered to some extent, and most have been degraded or eliminated altogether. As much as 90 percent of these losses have been for agricultural development and consist of diking and draining of salt marshes to convert them to pastures and crop-growing fields (Oberrecht 1997). Native plant species were replaced and often invasive or exotic species were introduced. Most of Oregon's tidal prairie has been diked and converted into pasture, and much has been filled including portions of the original Millport Slough marsh (Brophy 2002). Also, all activities in the estuary reduced tidal marsh habitat by 47% and spruce swamp habitat by 84% (Brophy 2011 using data from Scranton 2004 and Hawes et al. 2008).

The key economic activities in the late 1880s were salmon fishing, commercial clam fishery, native oyster collection, and timber harvest. Docks and groins extended into the water and seawalls were constructed as the fishing industry flourished. Close to 800,000 lbs. of anadromous fish were landed in 1924 (Cleaver 1951). Commercial clam diggers collected 240-320 lbs/person per tide (Snow 1973). Between 1925 and 1939, log rafts totaling 1.25 billion board feet of lumber crossed the bar (Rea 1975). The estuary is now devoid of industry and large vessel traffic. The commercial salmon fishery was declining when the estuary was closed to gill net fishing in 1957. Clam populations are too small to support a commercial fishery, and log rafts are no longer towed across the bar. Although reasons for the decline of the salmon populations are too complex to attribute to only a few factors, the decline of the clam fishery and log export industry can be attributed to major hydrographic changes caused by a rapid increase in the sedimentation rate in the estuary (ODFW 1979).

Expansion of the logging industry and associated road building increased sedimentation of the bay. Extensive diking of marshland prior to 1928 altered water courses, which also contributed to the increased sedimentation rate (Zinn 1973). Sediment, once deposited in the marsh, was carried into the bay during winter floods (Dicken et al. 1961). The causeway for the U.S. Highway 101 bridge built in 1926 and the diking of Millport Slough in 1951 prevented high velocity flood waters from reaching the south bay. Consequently, scouring no longer occurred, and the south bay rapidly filled with sediment. This sedimentation covered clam beds, clogged the estuary, and caused the fishing industry to gradually disappear. Since the late 1800s, the surface area of the bay has become two-thirds filled with sediment and once productive softshell clam beds have been smothered. Small clam beds are still found in the mudflat areas between Snag Alley at the mouth of Drift Creek to the mouth of the Siletz River (USFWS 1990, ODFW unpublished data). Introduced varnish clams became established and are now harvested at Schooner Creek.

After World War II, the shoreline of the bay became further altered through numerous dredge and fill operations such as the U.S. Highway 101 realignment and establishment of the Siletz Keys residential development. Commercial and residential encroachments onto coastal wetlands increased resulting in lost habitat, increased pollution and human activity, and lower water quality. The lumber and fishing industries were gradually replaced by tourism and recreation as the most important economic industry. Demand for construction of recreation and tourist associated facilities continues today (USFWS 1990). The estuary has been partially filled for housing developments and used for sewage disposal. Since 1939, 35 to 40 acres of land have been filled (Rea 1975). Three sewage treatment plants discharge into the estuary, which may affect water quality. The specific effects of these recent alterations are not easily discernible, however, because baseline data are absent (ODFW 1979).

4.1.2 Early Refuge Management

The Siletz Bay NWR was established in 1991 with the donation of 40 acres of muted tidal marsh. The objective of the Refuge is to protect the remaining wetlands and uplands adjacent to Siletz Bay from rapidly encroaching development, and to enhance and restore wetlands habitats for a variety of estuarine dependent fish and wildlife species. Since acquisition, managers have implemented strategies to accomplish these objectives and have utilized the “hands-off” management approach. The Refuge has been closed to the public to protect the ecosystem. However, limited reconnaissance biological studies have been conducted to gather baseline data and assess current environmental status. Also, a small 4-acre tidal marsh restoration project was completed in November 2000 at the mouth of Drift Creek.

An additional portion of the Refuge was restored to tidal wetlands in 2003. The Millport Slough Tidal Marsh Project was completed through a partnership between the USFWS, Ducks Unlimited, and the Confederated Tribes of the Siletz Indians. The project enhanced and restored 100 acres to tidal marsh and involved breaching 220 feet of dike, removing two dikes totaling 9,300 feet and filling 1,200 feet of artificial ditches. Large woody debris was placed in the marsh to improve habitat for anadromous fish. The project benefits juvenile salmonids, including spring and fall Chinook, chum, and coho salmon, winter and summer steelhead, coastal cutthroat trout, and Pacific lamprey by providing rearing habitat.

Prior to restoration activities, a contractor conducted baseline monitoring and mapping of emergent wetland plant communities at the restoration site and a matched reference site (Brophy 2002). The information provided by this study provided a snapshot of initial conditions on the proposed restoration site. The baseline data helped resource managers design the restoration project, and helped evaluate the success after restoration was completed. In addition, these data will guide managers in future restoration projects and monitoring efforts.

Management of invasive plant species has been part of the habitat management plan since Siletz Bay NWR was established. Several non-native invasive plants have been found on refuge lands, and extensive efforts to control and stop the spread of Himalayan blackberry, English ivy, and Scotch broom have been initiated. Mechanical, physical, biological, and chemical means have been utilized to combat invasive plants throughout the Refuge in accordance with 7 RM 14 (Pest Control Policy). Plans to remove, control, and prevent establishment of non-native plant species and treat infestations with Integrated Pest Management (IPM) techniques are implemented on an as needed basis.

4.2 Selection of Priority Resources of Concern

4.2.1 Analysis of Priority Resources of Concern

Refuge management priorities are derived from the National Wildlife Refuge System (NWRS) Mission, individual refuge purpose(s), NWRS policy that identifies NWRS Resources of Concern, and the mandate to maintain the BIDEH of the refuge. These mandates are consistent with the National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997. The management direction of Siletz Bay NWR is driven by Refuge purposes and statutory mandates, coupled with species and habitat priorities. The latter are identified in various USFWS conservation plans, as well as those developed by our state, federal, and private partners (USFWS 2008b). The step-by-step process to prioritize Resources of Concern and management priorities for a refuge is displayed in Figure 4-1.

Wildlife and habitat goals and objectives were designed directly around the habitat requirements of species designated as Priority Resources of Concern (ROCs). Resources of concern are called conservation targets in conservation planning methodologies used by other agencies and non-governmental organizations. In developing objectives, the team followed the process outlined in the Service's draft Identifying Resources of Concern and Management Priorities for a Refuge: A Handbook (USFWS 2008b). As defined in the Service's Policy on Habitat Management Plans (620 FW 1), resources of concern are:

> all plant and/or animal species, species groups, or communities specifically identified in refuge purpose(s), System mission, or international, national, regional, state, or ecosystem conservation plans or acts. For example, waterfowl and shorebirds are a resource of concern on a refuge whose purpose is to protect 'migrating waterfowl and shorebirds.' Federal or State threatened and endangered species on that same refuge are also a resource of concern under terms of the respective endangered species acts (620 FW 1.4G)…
>
> Habitats or plant communities are resources of concern when they are specifically identified in refuge purposes, when they support species or species groups identified in refuge purposes, when they support NWRS resources of concern, and/or when they are important in the maintenance or restoration of biological integrity, diversity, and environmental health.

Therefore, resources of concern for a refuge may be a species or species group, or the habitat/plant community that supports a priority species/species group.

In developing its listing of Priority ROCs, the planning team selected not only species mentioned in establishing documents for the Refuge, but also species that captured the ecological attributes of habitats required by larger suites of species. The ecological attributes of habitats should be analyzed to meet the life history requirements of ROCs, and are therefore critical to sustain the long-term viability of the ROC and other benefitting species. Ecological attributes of habitats include vegetation structure, species composition, age class, patch size and/or contiguity with other habitats; hydrologic regime; and disturbance events (e.g., flooding, fire). These provide measurable indicators that strongly correlate with the ability of a habitat to support a given species. Tables listing the desired conditions for habitat types found on the Refuge incorporate "Desired" conditions that were based on scientific literature review and team members' professional judgment. These desired conditions for specific ecological attributes were then used to help design habitat objectives, as presented in Chapter 2. However, not all ecological attributes or indicators were deemed ultimately feasible or necessary to design an objective around. Other factors, such as feasibility and the Refuge's ability to reasonably influence or measure certain indicators, played a role in determining the ultimate parameters chosen for each habitat objective. Thus, ecological attributes should be viewed as a step in the planning process. The ultimate design of objectives was subject to further discussion and consideration.

Limiting factors were also considered in developing objectives. A limiting factor is a threat to, or an impairment or degradation of, the natural processes responsible for creating and maintaining plant and animal communities. In developing objectives and strategies, the team gave priority to mitigating or abating limiting factors that presented high risk to ROCs. In many cases, limiting factors occur on a regional or landscape scale and are beyond the control of individual refuges. Therefore, objectives and strategies may seek to mimic, rather than restore, natural processes. The structure of plant communities utilized by ROCs can be created, rather than restoring the original native species composition. For example, mowing and/or grazing may be used to maintain a desirable vegetation structure, when restoring native grassland communities may be impractical. Through the consideration of BIDEH, the Refuge will provide for or maintain all appropriate native habitats and species. Refuge management priorities may change over time, and because the CCP is designed to be a living, flexible document, changes will be made at appropriate times.

Early in the planning process, the planning team cooperatively identified priority species for the Refuge, as recommended under the Service's Habitat Management Planning policy (620 FW 1). These ROCs frame the development of goals and objectives for wildlife and habitat. ROCs may be species, species groups, or features that the Refuge will actively manage to conserve and restore over the life of the CCP, or species that are indicators of habitat quality for a larger suite of species. Negative features of the landscape, such as invasive plants, may demand a large part of the refuge management effort, but are not designated as ROCs.

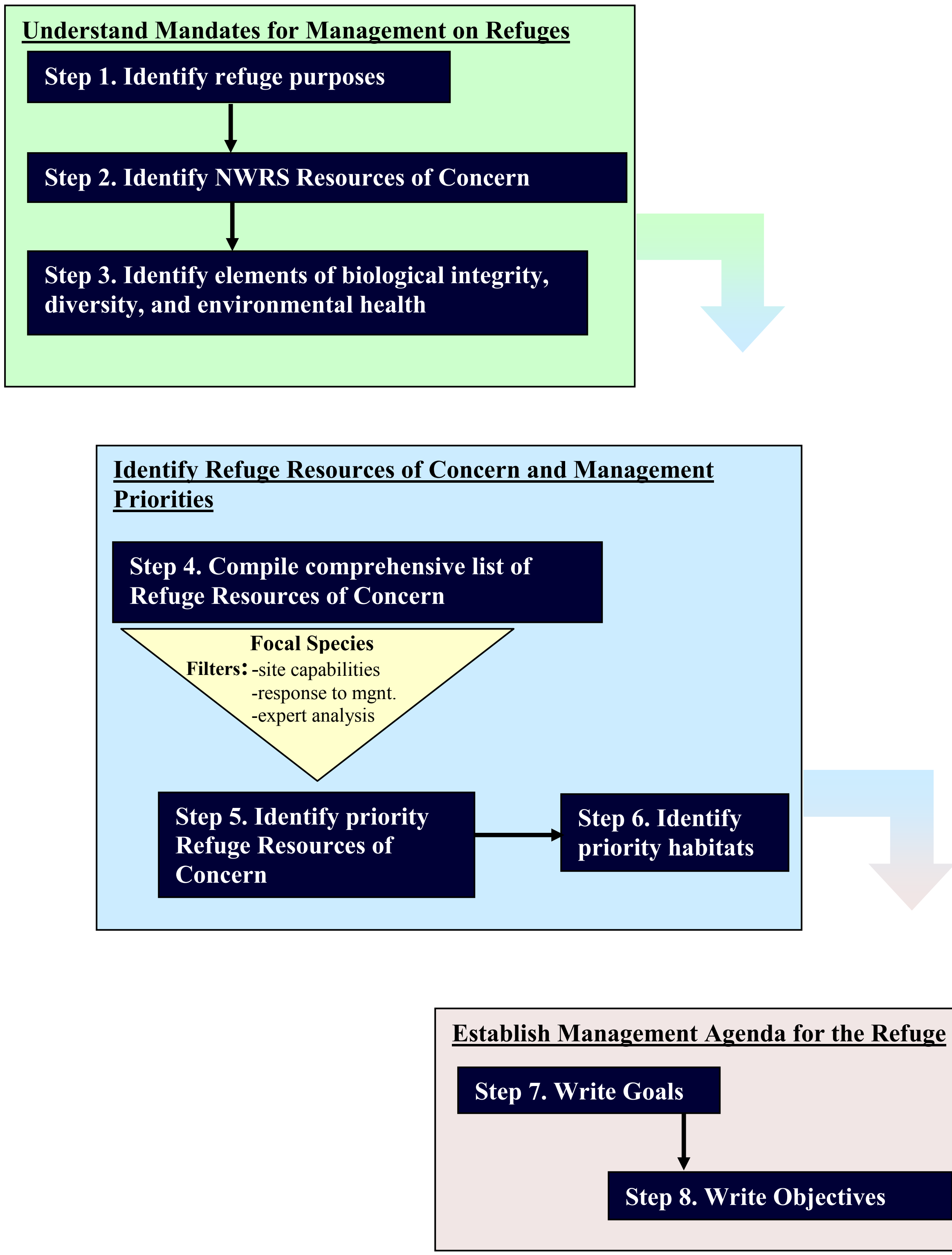
The main criteria for selecting priority ROCs included the following requirements:

- The resource must be reflective of the refuge's establishing purposes and the Refuge System mission;
- The resource must include the main natural habitat types found at the refuge;
- The resource must be recommended as a conservation priority in the Wildlife and Habitat Management Review; or
- The resource must be federally or state listed as a candidate for listing, or a species of concern.

Other criteria that were considered in the selection of the resources of concern included the following:

- Species groups and/or refuge features of special management concern;
- Species contributing to the biological diversity, integrity, and environmental health of the ecosystem;
- Species where it is feasible to estimate abundance (needed for future monitoring and adaptive management).

Figure 4-1. Overview of the process to prioritize resources of concern and management priorities for a refuge (USFWS 2008b).



4.2.2 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 Siletz Bay NWR (see Chapter 1). The Service also sought input from Oregon State conservation agencies, non-governmental organizations, and the general public. The refuge purposes, as stated in the enabling legislation for each refuge (see Chapter 1), were carefully reviewed as was the Refuge's contribution to maintenance of BIDEH (Appendix E) within the ecoregion. As a result of this information gathering and review process, a comprehensive list of potential ROCs was developed. From this list, those species and habitats that are most representative of refuge purposes and priority habitats, BIDEH, as well as other FWS and ecosystem priorities, were chosen as ROCs (habitat types) and focal resources (plant and animal species). Habitats selected as ROCs include: (1) Upland Forests (North Pacific Hypermaritime Sitka Spruce Forest), (2) Estuarine Habitats (Temperate Pacific Tidal Salt and Brackish Marsh, Temperate Pacific Intertidal Mudflat, and North Pacific Intertidal Freshwater Wetland), and (3) Forested Wetland and Stream-Riparian Habitat (North Pacific Hardwood-Conifer Swamp, North Pacific Intertidal Freshwater Wetland, North Pacific Lowland Riparian Forest and Shrubland). Vegetation type descriptions according to the International Terrestrial Ecological System Classification under development by NatureServe and its natural heritage program members (Comer et al. 2003, NatureServe 2012) are listed in parentheses.

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 Refuge will also benefit. They are referred to here as other benefiting species. See Appendix E for a completed list of priority resources of concern, focal resources, and other benefiting species.

4.3 Upland Forests

4.3.1 Description of Sitka Spruce–Western Hemlock Forest

Sitka spruce and western hemlock are the principal components of the Pacific Northwest coastal fog belt type or the Sitka spruce zone found along the Oregon and Washington coasts. The tremendous potential for rapid growth and high yield of the Sitka spruce-western hemlock type ranks it among the most productive coniferous types in the world (Smith et al. 1984).

This large-patch coniferous forest community is present on rich, fresh sites overlaying nutrient-rich bedrock types from coastal British Columbia, south to the central Oregon coast. These forests occur at elevations from 0 to 650 meters. Soils are usually loamy to sandy and are most commonly classified as Ferro-Humic Podzols but are quite variable and range from Dystric Brunisols to Gleysols. Soils are usually derived from fluvial or colluvial materials but may also be morainal or organic materials. Soil nutrient regimes are usually mesic or subhygric (but range from submesic to hydric), and soil nutrient regimes are usually rich to very rich (NatureServe 2010).

The forest community has a moderately closed canopy, poorly developed shrub layer dominated by regenerating western hemlock, well-developed forb layer, and moderately well-developed moss layer with variable species composition. The moderately closed canopy is dominated by high cover of Sitka spruce and western hemlock, often with low to moderate cover of western red cedar, the latter more common in the north. The poorly developed shrub layer is dominated by moderate cover of regenerating western hemlock and low cover of red huckleberry and salmon berry. Low to moderate cover of false huckleberry, blueberry, or salal sometimes occurs in the shrub layer. The well-developed forb layer is typically dominated by western sword fern. The composition of the moderately developed moss layer varies with the moisture regimes with more feathermosses on drier sites and more leafy mosses on wetter sites (NatureServe 2010). The desired attributes of this forested habitat include:

- 30-95% (73% average) canopy cover of Sitka spruce and western hemlock with DBH >24-36"
- 25-95% (83% average) cover of a mosaic of native shrubs (e.g., salmonberry, huckleberry, salal), ferns, and herbaceous species in understory. Shrub height averages 3 meters (9.84 feet).
- 600 square foot/acre density of nurse logs
- 6/acre density of snags
- <5% cover of invasive plants (e.g., blackberry, Scotch broom)
- <1% cover English ivy

4.3.2 Historic and Current Distribution

Sitka spruce-western hemlock forests occur in the mountains of the Queen Charlotte Islands, in the mountains and lowlands of western and northern Vancouver Island and along the outer coast and windward slopes of the Coast Mountains and Kitimat Ranges of British Columbia, at low elevations on the western Olympic Peninsula and western Willapa Hills of Washington, along a narrow outer coastal strip in northern and central Oregon, and just barely into the northwestern Cascade Range of Washington. It occurs on all slope positions on gentle to steep slopes on all aspects. At the south end of its range, it tends to occur more commonly on middle slopes (NatureServe 2010). Forests dominated by western hemlock and Sitka spruce hug the fog belt along the Oregon coast, seldom reaching more than a few miles inland or a few hundred feet above sea level. Both species are shade tolerant, but Sitka spruce is more resistant to salt spray. Sitka spruce sometimes grows in pure stands but is more commonly mixed with western hemlock, western red cedar, Douglas-fir, red alder, and lodgepole pine (commonly called shore pine along the coast).

4.3.3 Refuge-specific Sites

A forested buffer of Sitka spruce, western hemlock, red alder, and salal occurs along the north, east, and south edges of Millport Slough. Approximately 22 acres of tidal marsh at the north end was filled during the construction of Siletz Keys and is now primarily comprised of upland red alder, an early successional stage which will eventually transition toward Sitka spruce-western hemlock forest. Sitka spruce-western hemlock forest also occurs as a block near Drift Creek, on the upslope (eastern) part of the Erickson/Schaffer Easement, and within the Schooner Creek Tract. A total of 122 acres of Sitka spruce-western hemlock forest are within the Siletz Bay NWR (Figure 2-1).

4.3.4 Condition, Trends, and Threats

Sitka spruce-western hemlock forests are among the most productive in the world and have been extensively managed for timber production. Harvest of old-growth and mature forests for commercial timber and paper production has resulted in loss of species diversity and forest complexity on most of the landscape due to planting of even-aged, monotypic stands, and short harvest rotations.

Threats facing this habitat type include climate change, invasive species, and insect or disease infestation. Response to climate change will vary according to regional and local topography, forest type, soil moisture, productivity rates, species distribution and competition, and disturbance regimes.

Both Sitka spruce and western hemlock are species with shallow roots highly susceptible to windthrow. Natural disturbance is primarily windthrow resulting in small gaps and an all-aged stand structure. Forest regeneration is usually rapid and forest openings can quickly develop a dense canopy of young trees with sparse understory vegetation. Other small gaps may result from insect-caused mortality or root-rot.

Historically fire was a very rare occurrence, occurring approximately every 4,000 years on average (Lertzman et al. 2002). Human-induced wildfire is a potential catastrophic threat to forested habitats as well as fire suppression. Conversion of habitat to residential and non-forest uses has accelerated forest fragmentation. Introduced invasive plants (e.g., English ivy and holly) pose a significant threat to forested habitats on the Refuge. Potential insects or diseases that could affect the Refuge's forests include aphids, scale and bark beetles, root rot, leaf cast, and other fungi.

4.3.5 Key Species Supported

In late-successional or old-growth state, Sitka spruce-western hemlock forests provide both food and nesting habitat for a large variety of bird species. Many species of birds, such as great horned owl, northern saw-whet owl, northern flicker, pileated woodpecker, hairy woodpecker, Hammond's flycatcher, Steller's jay, common raven, chestnut-backed chickadee, red-breasted nuthatch, Pacific wren, and varied thrush, use the conifer forests because of the presence of other birds and rodents, bark and wood-boring insects, and conifer seeds. The large trees south of Schooner Creek which overlook the north end of the bay are the nesting site of a pair of resident bald eagles (USFWS 2004). In addition, the litterfall of arboreal lichens and needles provides winter forage for black-tailed deer. Many species of amphibians occur because of the damp litter on the floor of mature forests. These include the northwestern salamander, western red-backed salamander, ensatina salamander, clouded salamander, and western toad. The Pacific giant salamander and tailed frog both prefer steep cold mountain streams in old growth forests as breeding habitat, and damp litter on the forest floor to survive as metamorphosed adults.

4.4 Estuarine Habitats

One goal of the Refuge System is to conserve and restore, where appropriate, critical ecosystems and ecological processes characteristic of those ecosystems. One such critical ecosystem in the Pacific Northwest and elsewhere includes estuaries and the associated tidal wetlands. Tidal wetlands are of high ecological importance and are considered essential habitat for many marine and anadromous fish and migratory birds (Seliskar and Gallagher 1983). In Oregon's seventeen largest estuaries, tidal wetland acreage has declined considerably based on pre-European-settlement (pre-1850s) estimates. Fourteen of these estuaries have experienced tidal wetland decreases of 40 percent or more and Siletz Bay has lost 59% of the historic tidal marsh and swamp that was present (Good 2000). Consequently, federal, state, and local jurisdictions consider tidal wetlands a high priority for protection, enhancement and restoration, and many have established programs to conserve or restore this critical resource (e.g., ODFW 2006).

4.4.1 Description of Salt Marsh, Intertidal Mudflats, and Muted Tidal Marsh

Salt marshes are vegetated lands flooded and exposed by estuary waters. Acting as a transition zone between aquatic and terrestrial sites, salt marshes are extremely valuable habitats. These marshes provide shoreline stability against wave and wind erosion, reduce flood peaks, trap nutrients, sediment, and pollutants. As one of the most productive ecosystems on earth, salt marshes are highly important to fish, wildlife, and society. Salt marshes provide food and nursery areas for numerous young fish, crabs, shrimp, clams, and other invertebrates when flooded (USFWS 1990). Plant communities indicative of a salt marsh or tidal wetland include Lyngby's sedge, seashore saltgrass, pickleweed, Pacific silverweed, and tufted hairgrass. These plant communities are often associated with unaltered estuarine tidal wetlands in Oregon (USFWS 2006). Desired conditions of salt marsh are characterized by the following attributes:

- Diverse elevations ranging from about 3 feet below MLLW to 9 feet above MLLW for tidal flats and tidal marshes. Hydrological flows are affected by high flows in the rivers and tidal cycles
- Low elevation areas are a mosaic of species including salt grass and pickleweed
- Upper elevation includes Lyngby's and slough sedge, tufted hairgrass, Pacific silverweed, and Henderson's checkermallow
- Interspersed tidal channels of different orders with large woody debris component
- Completely submerged during high seasonal tidal cycles
- No *Spartina*

Intertidal mudflats are substrates flooded and exposed by tidal action and comprise the most extensive intertidal habitat within Siletz Bay. Desired conditions of intertidal mudflats are characterized by the following attributes:

- Diverse elevations ranging from about 3 feet below MLLW to about 4 feet MLLW that is completely inundated during two daily tidal cycles
- Sandy/muddy substrate that is sparsely vegetated by widgeon grass and seasonal algae blooms
- Presence of large woody debris
- Presence of bio-film on muddy substrate
- No Japanese eelgrass
- No *Spartina*

Muted tidal marsh are areas of diked tidal marsh that receive partial or restricted tidal water flows and are only partially inundated with salt water. Breached dikes and restrictive culverts or tidegates reduce tidal inflow and limit water circulation. Even though tidal influence and action is limited, these areas support a diverse plant community characteristic of tidal marsh and have slightly more freshwater-influenced vegetation (Brophy 2002). Muted tidal marsh is characterized by the following attributes:

- Presence of native plant species such as slough sedge and Pacific silverweed
- Lower salinity or freshwater dominated

- <5% cover of invasive/undesirable plants (blackberry, reed canarygrass, Scotch broom)
- No *Spartina* species

4.4.2 Historic and Current Distribution

All coastal states contain salt marshes, which flourish near river mouths, in estuaries, and around lagoons in areas protected from battering ocean waves and storms. Along the Atlantic and Gulf coasts, salt marshes are widely dispersed and often sprawl over large areas. On the Pacific Coast however, they are relatively small and sparsely distributed, accounting for only three percent of the nation's total acreage, and making them all the more valuable for their scarcity. In Oregon's seventeen largest estuaries, tidal wetland acreage has declined considerably based on pre-settlement estimates. Fourteen of these estuaries have experienced tidal wetland decreases of 40 percent or more (Good 2000). Brophy (2011) using Scranton (2004) and Hawes et al. (2008) estimated 16,173 acres of tidal marsh within the state in the 1850s and by 2005 80% of those acres were no longer tidal marsh.

Since the pre-settlement period, approximately 47% of the tidal marsh habitat within Siletz Bay has been lost (Brophy 2011 using Scranton 2004 and Hawes et al. 2008). Many of the diked areas around the bay are former salt marshes which have been cut off from tidal action by the construction of levees and drainage systems but then continue to function as freshwater seasonal wetlands.

4.4.3 Refuge-specific Sites

Siletz Bay NWR contains 314 acres of salt marsh, 0.8 acre of intertidal mudflats, and 111 acres of muted (restricted) tidal marsh. Salt marsh occurs at Millport Slough (north and south) and sections within Siletz Bay adjacent to U.S. Highway 101. Intertidal mudflats occur along the edge of the salt marsh within the bay and are exposed at low tide. Areas of muted tidal marsh are found adjacent to the Siletz River on the north side and at the east end of Millport Slough. Muted tidal marsh is also located along Drift Creek and on the east side of Highway 101 near Cutler City (Figure 2-1).

4.4.4 Condition, Trends, and Threats

Diking, channeling, and filling of salt marshes have damaged and displaced many hundreds of thousands of acres throughout coastal America. Wetlands were once extensive throughout much of the nation and were viewed as impediments to settlement, development, and progress. Even federal lawmakers saw them as wastelands of no apparent value. The Swamplands Acts of 1849, 1859, and 1860 promoted the diking and draining of wetlands by offering free land to those willing to transform them into valuable dry land for agriculture and other purposes. All salt marshes in the Pacific Northwest have been altered to some extent, and most have been degraded or eliminated altogether. As much as 90 percent of these losses have been for agricultural development and consist of diking and draining of salt marshes to convert them to pastures and crop-growing fields. Since the 19th century, the natural functions of Oregon's salt marshes have been overshadowed by their obvious value as dry land. Compared to other coastal states, Oregon had relatively small salt marshes to begin with, but even those have been drastically reduced or obliterated, not only for agricultural purposes, but also for urban, industrial, and port development. In Coos Bay and Tillamook Bay, for example, only about 15 percent of the original marshlands remain and at Siletz Bay 53% remains. Early logging and lumber operations also directly and indirectly took their toll on Oregon's coastal wetlands. With marshes fringing the shallow estuary shoreline areas, earliest port and industrial facilities included long piers extending over the marshes, well into the estuaries where water was deep enough to moor ships. Eventually, those marshes were filled with dry ballast from the ships, sawdust from the mills, and spoils from the dredges used to keep navigation channels open. Coastal wetlands were also turned into fields for raising hay and oats to feed the livestock used in nearby logging camps (Oberrecht 1997).

Millport Slough North is a relatively undisturbed tidal wetland with plant communities dominated by tufted hairgrass, Baltic rush, Pacific silverweed, seashore saltgrass, and Lyngby’s sedge. The only major non-native component is creeping bent grass, which is common even in Oregon’s most pristine high marsh communities (Brophy 2002). Millport Slough South is a tidal wetland that was diked since the early 1900s until completion of a tidal marsh enhancement and restoration project in late 2003. The restored area now receives full tidal influence. The western half of the restoration site had been subjected to muted tidal influence since a water control structure failed in 1981 and is occupied by monotypic stands of Lyngby’s sedge, reflecting the low surface elevation and brackish water influence in this area. On the east side of Millport Slough South, a large tidal channel is present and natural high marsh vegetation has returned, including species like tufted hairgrass, Pacific silverweed, and sea-watch angelica (Brophy 2002). Refuge lands in the Drift Creek area are primarily muted tidal wetlands dominated by Lyngby’s sedge and slough sedge (USFWS 2004).

The Millport Slough North marsh is in relatively good condition and experiences good tidal circulation. A portion of the marsh on the east end was filled to create Millport Slough Road and the eastern tip was diked. Approximately 22 acres of tidal marsh at the north end was filled during the construction of Siletz Keys and is now an upland red alder forest. Millport Slough was dammed at the current location of the Millport Slough Road bridge and part of the marsh was filled to create the causeway for U.S. Highway 101. All of these actions impacted the hydrology of the marsh. Evidence of intact tidal hydrology within the Millport Slough North marsh is provided by the condition of tidal channels on the site. The tidal channels that permeate Millport Slough North correspond to the characteristics of undisturbed tidal channels: highly sinuous, extensively branched (dendritic), deep, and steep-sided. Small channels are particularly steep-sided (often nearly vertical in profile), and overhung with drooping leaves and stems of grasses, sedges, and forbs (Brophy 2002).

Remnant tidal channels on Drift Creek North form a low-order system with little branching. When sites are diked and grazed, breakdown of the originally complex tidal channel system into a simpler, lower-order system is common. However, the site has not been ditched, so remnant channels remain. Vegetation patterns follow these remnant channels and the general topography of the site. The Drift Creek South wetland is also a diked tidal marsh with muted tidal flow. Tidal flow enters the Drift Creek South wetland both through a dike breach at the northwest corner of the site, and through some small breaches in the dike along the north edge of the site. Some of these holes were created or expanded by nutria (Brophy 2002).

Plant communities at Millport Slough North are typical of undisturbed high marsh, and are very diverse, particularly to the east and in the center of the site. The plant communities within this wetland show a broad diversity that reflects the range of tidewater salinities within this area, from sedge-dominated salt marsh on low benches near the bay to the forb-dominated communities found in the low-salinity marsh at the upper end of the slough. Species diversity on Millport Slough South is noticeably lower than at Millport Slough North. Reduced species diversity is typical of many diked tidal wetlands and muted tidal wetlands, which are often dominated by monotypic stands of rhizomatous species (Brophy 2002). However since restoration work was completed in Millport Slough South, species diversity has increased and the area is experiencing gradual plant composition changes due to increased salt water presence. Non salt-tolerant species will eventually die-off and be replaced with typical salt marsh plants. Due to subsidence, vegetation cover on the Millport Slough South site will differ from Millport Slough North.

The Millport Slough restoration project restored and enhanced approximately 100 acres of former tidal salt marsh and will contribute to ecosystem restoration in several ways. Wetland types which have declined significantly in Oregon and which were historically found at the site became reestablished. Wetland functional attributes, such as fish and wildlife habitat and floodplain function, were restored or enhanced through the project. These restoration benefits and purposes are consistent with the management goals of the Siletz Bay National Wildlife Refuge and the Oregon Department of State Lands General Authorization for Wetland Restoration and Enhancement (ODFW 2006, USFWS 2006).

Even under natural conditions (i.e., no human intervention), plant communities change gradually or suddenly due to factors like sediment accretion, changing stream and river courses, beaver activities, and succession (in the shorter term), and sea level rise and climate change in the longer term. Compared to these factors, human activities on the landscape cause even more rapid plant community change. Major human activities within the Siletz estuary that have affected plant communities include filling of marsh for development; construction of Highway 101; diking and ditching of large marsh areas like Millport Slough and the Drift Creek estuary; and channelization and impoundment of drainage-ways.

Plant communities in some portions of Siletz Bay NWR (e.g., the north part of Millport Slough, which is undiked; the islands in Siletz Bay) have probably been relatively stable over several decades and will probably continue to be slow to change, barring direct major human disturbance in the future. However, indirect impacts of past and future human activities will continue to change even these areas. For example, the construction of Highway 101 decades ago altered sediment movement and sediment accretion patterns, and marsh development in the bay has been and will continue to be affected by these altered patterns. In contrast to the slower-changing plant communities of the less-disturbed marsh areas, some portions of Siletz Bay are currently quite dynamic due to direct human alteration. For example, parts of the Drift Creek estuary were diked decades ago, but the dikes are now deteriorating or being breached. This allows re-introduction of tidal flow, and the changing salinities and hydrologic patterns are currently causing rapid change in plant communities. Other factors causing rapid plant community change include beaver dams, and grazing, which results in reduction in percent cover of palatable plant species. For example, Lyngby's sedge was heavily grazed in the Drift Creek estuary, and since grazing was discontinued, Lyngby's sedge communities have become more extensive. Another example of a dynamic plant community is the lower portion of the Erickson/Schaffer Easement wetland, where a deteriorating tidegate is allowing increased tidal influence (Brophy 2001). In addition, future sea level rise due to global climate changes will likely have a great impact and perhaps eventual loss of tidal marsh habitat at Siletz Bay.

4.4.5 Key Species Supported

The estuarine marshland supports thousands of migratory waterfowl and shorebirds, which in turn provide an important prey base for the recently delisted bald eagle and the peregrine falcon. Both birds breed locally and are found year-round in the area. Waterfowl species such as mallard, northern pintail, American wigeon, green-winged teal, bufflehead, and western Canada goose feed and rest on the marshes. Great blue heron and other waders; gulls; shorebirds including whimbrel, sandpipers, and dowitchers; and open meadow species such as sparrows and swallows are seen here. Marshes at the mouth of Drift Creek are used by band-tailed pigeons for obtaining minerals. Raptors such as northern harrier and red-tailed hawk are commonly seen foraging the marshes for prey. Aquatic mammals such as marsh shrews, Oregon voles, muskrat, river otter, and raccoon are common. Black-tailed deer and Roosevelt elk use the evaporated salt accumulations as “licks” and graze the marsh grasses (USFWS 2004).

The intertidal mudflats support numerous invertebrate species including clams, shrimp, and crabs. Shorebirds including sandpipers, dunlin, sanderling, and black-bellied plover use the area for feeding and resting. Gulls and California brown pelicans roost here, and the area of Snag Alley in particular serves as a regular loafing area for harbor seals.

The Siletz Bay and river system supports large runs of anadromous fish including spring and fall Chinook, threatened coho salmon (Oregon Coast ESU), chum salmon, winter and summer steelhead, coastal cutthroat trout, and Pacific lamprey (USFWS 2004, van de Wetering, personal communication). Common marine fish species include Pacific staghorn and buffalo sculpin, shiner perch, and English sole (USFWS 2006).

4.5 Forested Wetland and Stream-Riparian Habitat

4.5.1 Description of Wet-Mesic Sitka Spruce-Western Hemlock

For the purposes of this CCP, wet-mesic Sitka spruce-western hemlock forests are defined as woody habitats that consist of valley forested wetlands and riparian forest along rivers, salt marsh, or mudflats (e.g., National Vegetation Classification Standard *Tsuga heterophylla* - *Picea sitchensis*/*Lysichiton americanus* Hardwood-Conifer Rich Swamp Group, NatureServe 2012). Periodic freshwater tidal and/or seasonal riparian flooding are the major natural processes that drive this system. The disturbance regime is mostly small-scale windthrow or other gap mortality processes (though there are occasional widespread intense windstorms) and very few fires. Soils are perennially wet, usually with high organic content.

Historically, many of the areas located in the lower brackish (mesohaline to oligohaline) and freshwater tidal zones of Oregon’s estuaries were likely Sitka spruce and/or shrub tidal swamp. Tidal swamps were also found on the margins of the marine salinity zone where freshwater dilutes ocean water, such as along tributary streams, on high natural levees, and in hillslope seepage zones. On higher quality, least-disturbed remnant tidal Sitka spruce swamp sites, this community has scattered to abundant Sitka spruce, often growing on islands such as downed timber and natural levees along deep well-defined tidal channels, and a mixed herbaceous-woody understory. The vegetation between forested islands or along waters’ edges consists of typical high marsh or tidal freshwater wetland species like tufted hairgrass, creeping bentgrass, Pacific silverweed, Baltic rush, slough sedge, and western skunk cabbage as well as brackish-tolerant wetland shrubs such as red-osier dogwood, Nootka rose, dewberry, salmonberry, black twinberry, Pacific crabapple, and Hooker willow (Brophy 2002, NatureServe 2012). Non-wetland species such as salal and huckleberry can also be fairly abundant, growing on fallen logs or spruce root platforms elevated well over the hydric soil surface. Riparian red alder is also present and is important for its role in improvement of soil nutrient cycling and soil microbiology. Tree roots stabilize river banks and help prevent erosion. Alder also adds organic matter and nutrients to the river and keeps waters cool through shading. Cool water temperatures and cover are essential for fish spawning and survival (USFWS 1990).

The desired attributes of wet-mesic Sitka spruce-western hemlock forest (i.e., forested wetland and stream-riparian habitats) are the following (based on Brophy 2009, Brophy et al. 2011, Brophy and van de Wetering 2012, NatureServe 2012):

- Periodic freshwater tidal and/or seasonal riparian flooding
- Flat topography with local microrelief caused by logs, stumps, and buttressed roots of spruce trees
- High organic content of soils (>20% organic matter)
- Woody vegetation dominated by native trees and shrubs (e.g., Sitka spruce, red alder, Hooker willow, Sitka willow, twinberry, Pacific crabapple). Dominant herbaceous species include slough sedge and skunk cabbage with non-wetland species (e.g., salal, huckleberry) growing on fallen logs or spruce root platforms.
- <5% cover of invasive plants (e.g., blackberry, gorse, Scotch broom)
- No English ivy

4.5.2 Historic and Current Distribution

Sitka spruce is commonly referred to as "tideland spruce" in historical documents due to its prominence in tideland areas of Oregon and Washington (Franklin and Dyrness 1988). Sitka spruce forms the canopy of the only major type of tidal forest in Oregon, the spruce tidal swamp. Tidal swamps were historically located in a narrow elevation band at the upslope margin of emergent tidal marsh. The spruce tidal swamp is now rare in Oregon, but it was once extensive in the Columbia and Tillamook estuaries, and probably other estuaries as well (Jefferson 1975). Estimates by Brophy (2011) using Scranton (2004) and Hawes et al. (2008) indicate a 90% loss of tidal swamp within Oregon's estuaries. It is likely that large portions of the Siletz Bay area were once spruce tidal swamp, but like most of Oregon's tidal forest lands, these areas have probably been filled, diked, or cleared of trees (Brophy 2002). Only an estimated 16% of historic spruce tidal swamp remains in Siletz Bay (Brophy 2011).

4.5.3 Refuge-specific Sites

Siletz Bay NWR contains 18 acres of wet-mesic Sitka spruce-western hemlock forest (Figure 2-1). Currently, these woody habitats are located along the Siletz River, Siletz Bay salt marsh and mudflats, and Millport Slough South and consist of a small narrow band of tree stands. These stands are not remnants of historic tidal Sitka spruce swamp. However, they are present within the low-elevation, alluvial floodplain and thus are considered riparian forest. A small remnant spruce tidal swamp is located at the east end of Drift Slough (the tidal slough which flows into Drift Creek just east of the Highway 101 bridge).

4.5.4 Condition, Trends, and Threats

In Oregon, the tidal wetland type that has been the most severely impacted by human alterations is tidal spruce swamp or "spruce tideland forest." This plant community is now very rare on the Oregon coast; in the Columbia estuary, over 90% of the former spruce tidal swamp is gone (Brophy 2002) and Siletz Bay has experienced an 84% loss (Brophy 2011).

Sitka spruce and western hemlocks have shallow root systems, and poor anchorage of trees results from this characteristic. This may be due to shallow soil underlain by bedrock, an impermeable layer near the soil surface, or a high water table, the latter being most common in spruce-hemlock forests. It is not known what amount or duration of excess soil moisture damages the roots, but it is clear that prolonged saturation will restrict rooting to the soil above the saturated layer. Under severe conditions, rooting will be restricted to the familiar flat plates seen on uprooted trees (Fraser and Gardiner 1967).

4.5.5 Key Species Supported

The riparian forest patches and the forested wetlands support elk and deer and small mammals such as beavers, mink, river otters, muskrats, raccoons, deer mice, and vagrant shrews. Many amphibians and reptiles such as long-toed salamander, rough-skinned newt, Pacific tree frog, western toad, lizards, and garter snake are also dependent upon these habitats. The forest areas are also home to typical forest passerine species in addition to those birds dependent on water edges such as green and great blue herons, belted kingfisher, wood duck, Pacific wren, and varied thrush (USFWS 2004).

4.6 Salmonids

The Siletz River watershed is a productive fishery resource for the state of Oregon (Good et al. 2005) and the open water environments are critical to the important fisheries of Siletz Bay. The mixing of fresh and salt waters within the estuary permits anadromous fish to adjust to the change in salinity and temperatures as they pass to and from the ocean environment. Anadromous fish common in the Siletz system include spring and fall Chinook salmon, coho salmon, winter steelhead, coastal cutthroat trout, and Pacific lamprey. Once abundant chum salmon may only occur in small numbers now. Seasonal migrations of anadromous fish result in year-round use of the Siletz River watershed by adult salmon. In addition, resident coastal cutthroat trout are found throughout the watershed.

Conserving and restoring salmonid populations is an important goal, not only for their own sake, but also because of their cultural, historical, and ecological value. Salmonids are an important food source for numerous other wildlife species. Sixty-seven wildlife species of the Pacific Northwest, including many known to inhabit the Refuge, have been known to have a “strong” or “recurrent” relationship with salmon (Cederholm et al. 2000). Salmon play an important ecological role in the transport of energy and nutrients between the ocean, estuary, and freshwater streams, supporting overall ecosystem health. All life stages provide nutrients and energy needed for healthy stream ecosystems. Today, only three percent of the marine-derived biomass once delivered by anadromous fish is currently reaching those watersheds. Research on the consumption of salmon by vertebrate wildlife has documented 137 species of birds, mammals, amphibians, and reptiles are predators or scavengers of salmon. In coastal streams, marine derived nutrients from salmon carcasses increase the overall productivity of the system (Cederholm et al. 2000).

4.6.1 Description of Coho Salmon and Coastal Cutthroat Trout

The Oregon Coast Coho salmon evolutionarily significant unit (ESU) found in the Siletz River system is listed as a threatened species under the Endangered Species Act (NOAA 2008). The size of an adult coho may measure more than 2 feet (61 centimeters) in length and can weigh up to 36 pounds (16 kilograms). However, the average weight of adult coho is 8 pounds (3.6 kilograms). Coho salmon have dark metallic blue or greenish backs with silver sides and a light belly and there are small black spots on the back and upper lobe of the tail while in the ocean. The gumline in the lower jaw is white while in Chinook salmon it is black. Spawning fish in inland rivers are dark with reddish-maroon coloration on the sides. Coho salmon adults migrate from a marine environment into freshwater streams and rivers of their birth in order to mate (called anadromy; i.e., anadromous). They spawn only once and then die. Adults return to their stream of origin to spawn and die, usually at around three years old. Some precocious males known as “jacks” return as two-year-old spawners. Spawning males develop a strongly hooked snout and large teeth. Females prepare several redds (nests) where the eggs remain for six to seven weeks until they hatch. As the time for migration to the sea approaches after spending a year in freshwater, juvenile coho salmon lose their parr marks, a pattern of vertical bars and spots useful for camouflage, and gain the dark back and light belly coloration used by fish living in open water. Their gills and kidneys also begin to change at this time so that they can process salt water. In their freshwater stages, coho feed on plankton and insects, and switch to a diet of small fishes as adults in the ocean (NOAA 2010). Parr have 8-12 narrow parr marks centered along the lateral line. The marks are narrow and widely spaced. The adipose fin is finely speckled, imparting to it a gray color, but the other fins lack spots and are tinted orange. They have 9-12 dorsal fin rays, 12-17 anal fin rays, and 9-11 pelvic fin rays. Lateral line scales number from 121-148 and the scales are pored. There are 11-15 branchiostegal rays on either side of the jaw. Gill rakers are rough and widely spaced, with 12-16 in the lower half of the first arch (Moyle 1976).

Throughout their native and introduced range, coastal cutthroat trout vary widely in size, coloration, and habitat selection. Though their coloration can range from golden to gray to green on the back, depending on strain and habitat, all populations universally feature distinctive red, pink, or orange marks on the underside of the lower jaw or below the gill plates; usually the easiest diagnostic of the species for the casual observer. These markings are responsible for the formation of the typical name “cutthroat.” At maturity, different populations of cutthroat can range from 6–40 inches in length, depending on habitat and food availability, making size an ineffective indicator as to species identity. Anadromous cutthroat may reach weights of 20 pounds but those fish which remain permanently in fresh water may only reach a weight of 2 pounds (Eddy and Underhill 1978). Cutthroat readily interbreed with the closely related rainbow trout, producing fertile hybrids commonly called “cutbow.” As this species generally bears similar coloration and overall appearance to the cutthroat, retaining the characteristic orange-red slash, these hybrids often pose a taxonomical difficulty (Connolly et al. 2008).

Coastal cutthroat trout exhibit anadromous, stream-dwelling, lake-dwelling, and headwater stream-resident life history forms. Anadromous fish spawn in small tributaries from late winter through spring, depending on the locality. Juveniles remain in streams for two or more years and congregate during their early months in habitats along stream edges. Later, they move to pools unless coho salmon are present, in which case they are driven to riffles. Most anadromous coastal cutthroat trout juveniles smolt are typically age 3 or 4 when they migrate to sheltered saltwater areas. Seaward migration peaks in May, and the fish remain close inshore while in salt water. The fish seldom overwinter at sea but return to rivers in the fall or winter of the year they go to sea. In some instances, these are overwintering migrations only, because anadromous female coastal cutthroat trout seldom spawn before age 4. Stream-dwelling forms migrate to mainstem rivers or to lakes; otherwise, their life history characteristics are much like those of the anadromous form. Headwater stream-resident coastal cutthroat trout become sexually mature as early as age 2, but seldom live beyond age 4 or 5. These fish exhibit only limited instream movements and generally live out their lives within 200 meters (656 feet) of their birthplace (Trotter 1989).

4.6.2 Historic and Current Distribution

Coho salmon are a widespread species of Pacific salmon, occurring in most major river basins around the Pacific Rim from central California to Korea and northern Hokkaido, Japan. In the United States distribution is from Point Hope, Alaska to the San Lorenzo River in Santa Cruz County. The historic range of the coho in the lower 48 states included coastal streams of California, Oregon and Washington, plus the much larger Sacramento and Columbia river systems, reaching as far inland as Idaho. It also occurs in rivers throughout coastal British Columbia and western Alaska. Published investigations have reported that a number of local populations of coho salmon in Washington, Oregon, Idaho, and California have become extinct and that abundance and productivity of many others is depressed (Brown and Moyle 1991, Frissell 1993, Nehlsen et al. 1991, Good et al. 2005, NOAA 2008).

We have very limited direct information about the spatial structure of the Oregon Coast coho salmon populations. Previous analyses (Nickelson and Lawson 1998, Nickelson 2001) assumed that spawners from major river basins are largely isolated, and that each basin comprises at least one population. The Umpqua River is large and diverse enough to hold several populations, but for analysis purposes it was considered as one. Three coastal lakes, Siltcoos, Tahkenitch, and Tenmile, are considered to be a single population, but may actually be separate. Genetic analyses are being conducted to resolve these questions, but results were not available at the time of this review (Good et al. 2005). This is a change from the status review update in 1997 (Schiewe 1997), when the Oregon coast was considered to consist of four populations, called gene conservation groups. Three of these groups (north/mid coast, mid/south coast, and Umpqua) were in the Oregon Coast coho salmon ESU and the fourth (south coast) was in the Southern Oregon/Northern California Coast coho salmon ESU (Good et al. 2005).

The following ESUs are “likely to become endangered in the foreseeable future:” Snake River fall-run Chinook, Snake River spring/summer-run Chinook, Puget Sound Chinook, Lower Columbia River Chinook, Upper Willamette River Chinook, California Coastal Chinook, Central Valley spring-run Chinook, Snake River steelhead, Lower Columbia River steelhead, Upper Willamette River steelhead, Northern California steelhead, Central California Coast steelhead, South-Central California Coast steelhead, Oregon Coast coho, Southern Oregon/Northern California Coasts coho, Ozette Lake sockeye, Hood Canal summer-run chum, and Lower Columbia River chum (Good et al. 2005).

Cutthroat trout are native to western North America. The species has evolved through geographic isolation into many subspecies, each native to a different major region or specific drainage basin. Native cutthroat species are found along the Pacific Northwest coast, in the Cascade Range, the Great Basin, and throughout the Rocky Mountains. For the coastal cutthroat trout subspecies, some populations have anadromous individuals, living for periods in the Pacific Ocean as adults and returning to freshwater from fall through early spring to feed on insects and spawn (Trotter 1989). Most populations, however, stay in fresh water throughout their lives and are known as non-migratory, stream-resident or riverine populations.

The coastal cutthroat trout occurs over the broadest geographical range of any of the recognized cutthroat trout subspecies (Behnke 1979, Johnston 1981). The subspecies is distributed along the Pacific coast from the Humboldt Bay area of California to Prince William Sound, Alaska, a distance of about 3,025 kilometers (1,880 miles). It occurs inland to the crest of the Cascade Mountain Range in Oregon and Washington and to the Coast Range crest in British Columbia and southeast Alaska, an average distance of 160 kilometer (99 miles) (Trotter 1989). Its native range coincides quite closely with the coastal rain forest belt defined by Waring and Franklin (1979).

4.6.3 Condition, Trends, and Threats

The status of most anadromous fish within the Oregon Coast ESU has been in decline for decades. Currently, coho salmon on the Oregon Coast (Oregon Coast ESU) are listed as threatened on the federal Threatened and Endangered Species List. Oregon Coast Coho ESU was originally listed threatened in 1998, set aside due to Alsea case and commitment to conduct status review; proposed threatened in 2004, found not warranted in 2006, contested and listed in 2008 (73 FR 7816); contested and new status review conducted; threatened finding published in Federal Register in 2011 (superseded 2008 finding) and kept critical habitat and protective regulations from 2008 in place. The State of Oregon lists coho salmon as a threatened species for the entire state. Oregon Coast steelhead was found not warranted for listing in 1998 and considered a “species of concern” by NOAA in 2004 due to specific risk factors. Oregon Coast Chinook ESU found not warranted for listing in 1998 because populations appear healthy and stable in some areas of the coast and declining in others. There are very little data available for sea run and native coastal cutthroat trout, and their population status is unclear.

In 2003 the Oregon Workgroup of the Oregon Northern California Coast Technical Recovery Team convened to review and analyze information that could shed light on historical populations of Oregon Coast coho salmon. Documentation of life history traits, distribution, or abundance of Oregon Coast coho salmon prior to 1940 is limited. Considerable biological information has been gathered during the past 30 years, and particularly the past 12 years; however, it is difficult to relate the biological characteristics of modern populations to those that existed historically in the same basin. Human activities over the past 200 years have altered every aspect of salmon habitat on the coast, harvest has changed abundance patterns, and hatcheries may have blurred the distinctions among stocks. Coho salmon have adapted their behavior to many of these changes and, as a result, present-day Oregon Coast coho salmon populations function differently than they did historically (Lawson et al. 2007).

The abundance and productivity of Oregon Coast coho since the status review completed in 1997 (NMFS 1997a) represented some of the best and worst years on record (NOAA 2008). Yearly adult returns for the Oregon Coast coho ESU were in excess of 160,000 natural spawners in 2001 and 2002, far exceeding the abundance observed for the past several decades. These encouraging increases in spawner abundance in 2000–2002 were preceded, however, by three consecutive brood years (the 1994–1996 brood years returning in 1997–1999, respectively) exhibiting recruitment failure (recruitment failure is when a given year class of natural spawners fails to replace itself when its offspring return to the spawning grounds 3 years later). These 3 years of recruitment failure were the only such instances observed thus far in the entire 55+ year abundance time series for Oregon Coast coho salmon (although comprehensive population-level survey data have only been available since 1980). The encouraging 2000–2002 increases in natural spawner abundance occurred in many populations in the northern portion of the ESU, populations that were the most depressed at the time of the 1997 review (NMFS 1997a). Although encouraged by the increase in spawner abundance in 2000–2002, the long-term trends in ESU productivity were still negative due to the low abundances observed during the 1990s (NOAA 2008).

The Oregon Coast coho salmon ESU total natural spawner abundance was estimated based on stratified random survey (SRS) techniques, broken down by ODFW’s monitoring areas (MAs), for 11 major river basins and for the coastal lakes system. These data are for the return years 1990–2002 and are expressed in terms of naturally produced fish, rather than the standard of naturally spawning fish used in other status review updates. Total recent average (3-year geometric mean) spawner abundance for this ESU is estimated at about 140,600, up from the 5-year geometric mean of 52,000 in the 1997 update and higher than the estimate at the time of the most recent status review (Good et al. 2005). In 2001, the ocean run size was estimated to be about 178,000; this corresponds to one-tenth of ocean run sizes estimated in the late 1800s and early 1900s, and only about one-third of those in the 1950s (ODFW 1995). In 2002, the ocean run size increased to 304,500, fourth highest since 1970 and perhaps 25% of historical abundance. Present abundance is more evenly distributed within the ESU than it was in 1997. Escapement in the relatively small mid/south coast monitoring area was the strongest in the ESU until 2001. In 2002, escapements in the mid/south were down about 25%, while the north and mid-coast monitoring areas showed strong gains. The Umpqua monitoring area is up by a factor of 4 since 1996 (Good et al. 2005).

The population of coho salmon in the Siletz River is one of the smaller populations in central coast Oregon. Population estimates ranged from 441 natural-origin spawning adults in 1990 to 2,369 spawning adults in 2002 (Good et al. 2005). The number of adults returning to spawn is a direct result of the number of juveniles that migrate into the ocean. Historical abundance of coho for the Oregon Coast Coho ESU is estimated at approximately 2 to 3.3 million fish depending upon the methodology and data used to derive the estimate (Lawson 2007).

Threats currently facing the Oregon Coast coho ESU include the present or threatened destruction, modification, or curtailment of its habitat or range. In many Oregon coastal streams, past human activities (e.g., logging, agriculture, gravel mining, urbanization) have resulted in impediments to fish passage, degradation of stream complexity, increased sedimentation, reduced water quality and quantity, loss and degradation of riparian habitats, and loss and degradation of lowland, estuarine, and wetland coho rearing habitats. The relevant issues are whether current habitat conditions are adequate to support the ESU’s persistence and whether habitat conditions are likely to worsen in the future. There is uncertainty about the adequacy of current habitat conditions, and this uncertainty contributed to the finding that the ESU was likely to become an endangered species within the foreseeable future. Also, if the long-term decline in productivity of the Oregon Coast coho ESU reflects deteriorating conditions in freshwater habitat, this ESU could face very serious risks of local extinction during the next cycle of poor ocean conditions. With respect to population growth and urbanization, approximately 3.4 percent of “high intrinsic potential” habitat areas for coho (e.g., lowland stream reaches particularly important to juvenile coho rearing and overwintering survival) are within currently designated urban growth areas, suggesting that future human population growth may not represent a significant threat to the ESU (NOAA 2008). With respect to lowland and upland habitat areas under various types of land use and ownership, NOAA found that some areas are likely to improve, some are likely to decline, and others are likely to remain in their current condition. Overall, there is a high level of uncertainty associated with projections of future habitat conditions due to underlying economic and sociopolitical factors influencing forest harvest and restoration rates, urban conversion of agricultural and forest lands, and the enforcement and implementation of land-use plans and regulations. Based on their analysis, NMFS found that there is insufficient evidence to conclude that the Oregon Coast coho ESU was more likely than not to become an endangered species because of the “threatened destruction, modification, or curtailment of its habitat or range.” It remains uncertain whether future freshwater habitat conditions will be adequate to support a viable coho ESU, particularly during periods of unfavorable ocean conditions and poor marine survival.

Another identified threat is overutilization for commercial, recreational, scientific, or educational purposes. Harvest rates on Oregon Coast coho populations ranged between 60 and 90 percent between the 1960s and 1980s (Good et al. 2005). Modest harvest restrictions were imposed in the late 1980s, but harvest rates remained high until most directed coho salmon harvest was prohibited in 1994. These restrictive harvest regulations, developed concurrently with the Oregon Plan and subsequently revised, have imposed conservative restrictions on directed and incidental fishery mortality, and appropriately consider marine survival conditions and the biological status of naturally produced coho populations. Under these revised regulations, harvest rates are stipulated to be between 0 and 8 percent during critically low spawner abundance, and may increase to a maximum exploitation rate of 45 percent under high survival and abundance conditions. Empirical data over the last 10 years show that harvest mortality for Oregon Coast coho has been maintained below 15 percent since the adoption of the revised regulations (NOAA 2008).

Disease, predation, past species introductions, and habitat modifications have resulted in increased non-native predator populations, notably in coastal lake habitats. Predation by increased populations of marine mammals (principally sea lions) may influence salmon abundance in some local populations when other prey species are absent and where physical conditions lead to the concentration of adults and juveniles (Cooper and Johnson 1992). However, the extent to which marine mammal predation threatens the persistence of Oregon coast coho populations is unknown. Infectious disease is one of many factors that can influence adult and juvenile salmon survival. Salmonids are exposed to numerous bacterial, protozoan, viral, and parasitic organisms in spawning and rearing areas, hatcheries, migratory routes, and the marine environment. Specific diseases such as bacterial kidney disease, ceratomyxosis, columnaris, furunculosis, infectious hematopoietic necrosis virus, redmouth and black spot disease, erythrocytic inclusion body syndrome, and whirling disease, among others, are present and known to affect West Coast salmonids (Rucker and Ordall 1953, Wood 1979, Leek 1987, Foott et al. 1994, Gould and Wedemeyer undated). In general, very little current or historical information exists to quantify trends over time in infection levels and disease mortality rates. However, studies have shown that naturally spawned fish tend to be less susceptible to pathogens than hatchery-reared fish (Buchanan et al. 1983, Sanders et al. 1992). Native salmon populations have co-evolved with specific communities of these organisms, but the widespread use of artificial propagation has introduced exotic organisms not historically present in a particular watershed. Habitat conditions such as low water flows and high temperatures can exacerbate susceptibility to infectious diseases. Aggressive hatchery reform efforts implemented by the State of Oregon have reduced the magnitude and distribution of hatchery fish releases in the ESU, and, consequently, the interactions between hatchery- and natural-origin fish and the potential transmission of infectious diseases. Additionally, regulations controlling hatchery effluent discharges into streams have reduced the potential of pathogens being released into coho habitats.

Natural or human-made factors may affect the coho’s continued existence. Natural variability in ocean and freshwater conditions has at different times exacerbated or mitigated the effects on Oregon Coast coho populations of habitat limiting factors. There is considerable uncertainty in predicting ocean-climate conditions into the foreseeable future, as well as their biological impacts on the Oregon Coast coho ESU. Variability in ocean-climate conditions is expected, and coho productivity and abundance are similarly expected to fluctuate in response to this natural environmental variability. It is unknown whether unfavorable ocean conditions will predominate in the foreseeable future.

During the twentieth century, the coho decreased to as little as 1% of its former abundance in its southern range (in California and Oregon). It is extirpated in more than half of its native rivers in that region. The decline of the coho stocks of California and Oregon has been caused by several interacting factors. Much of their freshwater habitat has been degraded by siltation and temperature increases caused by logging and other disturbances in the watersheds of their breeding and rearing habitats in headwater streams. Clear-cut logging in the riparian (or stream-side) zone results in large increases in the summertime water temperature, which can be lethal for these cool-water fish. In addition, the erosion of soil from destabilized stream-banks and at road crossings results in the deposition of silt into the gravel spawning and larval-rearing habitat of salmon, which smothers the eggs and larvae. Moreover, many rivers have had hydroelectric dams constructed on them, and this prevents or impedes the migration of coho to and from the sea. Other threats to coho include erosion associated with overgrazing of livestock, in-river mining of gravel or gold, urban and industrial pollution, agricultural diversions, and urbanization. These factors have affected coho salmon throughout their range on the Pacific coast, but the damages have been most intense for stocks breeding on coastal rivers in California and Oregon. Overall, the coho has become extirpated over about 56% percent of its historic range in the lower 48 states, endangered in about 13%, threatened in about 20%, and of special concern in 5%. The coastal rivers of Oregon produced about 1.4-million coho in 1900, but fewer than 20,000 in the 1990s. In Washington, the 1.2 million coho that once lived in the Columbia basin are virtually extinct (NOAA 2000).

NOAA Fisheries' 1999 review of West Coast coastal cutthroat trout populations identified six ESUs, including the Oregon Coast Coastal Cutthroat Trout ESU that includes the Siletz River watershed. The 1999 analysis by NOAA was evenly divided on whether the Oregon Coast cutthroat trout ESU is likely to become endangered in the foreseeable future. Currently, coastal cutthroat trout of the Oregon Coast ESU is not listed on the state or federal Threatened and Endangered Species List. Current or historical abundance information, especially for adult coastal cutthroat trout, is available for only a very small proportion of the known populations within any ESU. Biologists familiar with coastal cutthroat trout generally believe that, in some areas (e.g., Lower Columbia River Basin, Puget Sound, Northern California), anadromous coastal cutthroat trout populations have experienced significant recent declines relative to historical levels of abundance (NOAA 1999). Coastal cutthroat trout have a very plastic life history and are widespread in coastal areas; however, very little specific data have been collected to assess trends. Coastal cutthroat trout is subject to many of the same factors as coho and other salmon species, in addition to factors affecting isolated resident populations upstream of salmon distribution in watersheds.

The Oregon Coast coastal cutthroat trout Species Management Unit (SMU) includes 24 historical populations of coastal cutthroat trout inhabiting ocean tributary streams from the Necanicum River south to the Sixes River. All four life history types are present with the SMU, and several populations exhibit all four life history types. A status assessment of coastal cutthroat trout within the SMU determined all historical populations were found to be in existence and not at risk of extinction in the near future. An assessment for the Oregon Coast coastal cutthroat trout SMU found all populations passed all of the interim criteria and therefore, the conservation of the SMU was not at risk (Connolly et al. 2008).

4.6.4 Key Habitats Used

Coho salmon spawn in the headwaters of tributaries, rivers, or streams in beds with clean gravel. The freshwater habitat of the headwater is characterized by cool clean water with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development. These features are essential in the environment because without them the species cannot successfully spawn and produce offspring (NOAA 2008). After hatching from eggs, coho salmon fry spend one year in freshwater habitat, specifically in backwater pools and stream edges. As juveniles, coho salmon depend on deep water pools, off-channel alcoves, ponds, beaver dam pools, and complex cover for rearing and Refuge during high winter runoff events (Pollock et al. 2004). Estuarine areas are also important to coho and in some cases smolts spend months in this transition zone, where the salt and fresh water meet. The estuaries need to be free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh and saltwater. Submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels provide natural cover. Juveniles and adults forage on aquatic invertebrates and fishes which supports growth and maturation. These features are essential in the estuary because without them juveniles cannot reach the ocean in a timely manner and use the variety of habitats that allow them to avoid predators, compete successfully, and complete the behavioral and physiological changes needed for life in the ocean. Similarly, these features are essential to adult salmonids because they provide a final source of abundant forage that will provide the energy stores needed to make the physiological transition to fresh water, migrate upstream, avoid predators, and develop to maturity upon reaching spawning areas (NOAA 2008).

Coho migrate from the freshwater to the ocean, where they feed and grow for several years. During the marine phase of their life history, coho live in open-water (or pelagic), cool-temperate regions of the northeastern Pacific Ocean. When they reach sexual maturity, they return to the headwaters of their natal stream, where they breed, and die. Coho salmon migrate from the ocean to freshwater in September-January, and they spawn in October-January.

Resident coastal cutthroat trout grow, mature, and spawn often very close to the location from which they hatched. Fluvial and adfluvial cutthroats migrate to spawning streams in the spring, usually to the streams in which they hatched (natal streams), and spawn in spring or summer in small streams. For successful production, juvenile coastal cutthroat trout that live at the edges of streams or in backwater areas depend on the presence of streambank vegetation and abundant instream structure created by logs and root wads.

Anadromous coastal cutthroat trout migrate into freshwater in late summer to late fall, usually to their natal streams, and spawn from late winter to spring. The adults migrate back to the ocean shortly after spawning. Sea-run cutthroat fry migrate to lower reaches of streams after emerging from the gravel in spring or summer. As early as the following spring, but more often two to four springs later, juvenile coastal cutthroat trout migrate to estuaries and the ocean as seawater-adapted "smolts." In the marine environment, coastal cutthroat trout tend to grow about an inch every month, feeding on a variety of small crustaceans and fish. Their residency in seawater is brief—usually only a few months—and they tend to stay close to the freshwater streams and rivers from which they came. The fish return to freshwater later the same year in autumn to spawn or to spend another year growing and developing before undertaking another seaward migration (Fitzpatrick 1999).

4.6.5 Refuge-specific Sites

Critical habitat was designated for the Oregon Coast coho salmon ESU at the time they were federally listed as a threatened species (73 FR 7816). The definition of critical habitat is that area necessary for the survival and persistence of a species. Critical habitat is categorized by primary constituent elements (PCE) that describe the habitats or biological features required by the species (NOAA 2008). The PCEs for coho salmon include freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, estuarine areas, and near shore marine habitats (73 FR 7816). The Siletz River and its tributaries are considered critical habitat; the PCEs within the Siletz are freshwater rearing areas, freshwater migration corridors, and estuarine areas. Most of the aquatic habitat within Siletz Bay NWR or the lower Siletz River is considered estuarine habitat. The important elements within an estuary for rearing salmonids are salinity and water quality conditions that support both adult and juvenile life stages. These habitats support juvenile coho and Chinook salmon as they undergo the physiological transformation that allows them to survive in salt water.

Salmonids use the Siletz River, Millport Slough, Drift Creek, and other small tributary streams or side-channels throughout the Refuge. These riverine areas are highly important and provide food and nursery areas for young fish. Juveniles and smolts can also be found throughout tidal marsh habitats where they use slough and channel areas.

4.7 Shorebirds

Shorebirds spend the majority of their time near the water, though most species prefer mudflats, some use upland pastures, plowed fields, and even forest habitats (Long and Ralph 2001, O'Brien et al. 2006). They can also be found in intertidal mudflats, estuaries, salt marshes, outer beaches and wet meadows. Most shorebirds forage on a diversity of invertebrates, including mollusks, small crustaceans, worms, and insects (Skagen and Oman 1996). Recent studies have found that dunlin and western sandpipers feed on biofilm; sediment laden with a mixture of broken and unbroken diatoms plus organic detritus (Tomohiro et al. 2008, Mathot et al. 2010). Siletz Bay NWR plays an important role in the life cycle of migrating shorebirds by providing stop-over habitat rich in invertebrates and biofilm.

The migration of many shorebird species to their breeding grounds in the Arctic is constrained to a narrow band of time (Evans and Pienkowski 1984, Farmer and Parent 1997). If the birds arrive too early, there is the risk of dying due to extreme cold weather or lack of emerging insects and if they arrive too late, they run the risk of not acquiring a suitable territory (Evans and Pienkowski 1984). In addition, these migrations often include nonstop flights exceeding thousands of kilometers. To complete these long distance flights, shorebirds accumulate large fuel reserves. In many of the more common Pacific Northwest shorebird species, these fuel reserves are accumulated in the form of fat at food-rich stop-over areas. In some cases, large proportions (>50%) of entire migrating populations of shorebirds (e.g., western sandpiper at Yukon Delta, Alaska) use a single site, indicating that any loss of critical stop-over areas could reduce hemispheric shorebird numbers. Since many stop-over areas are relatively restricted along coasts or within estuaries they are particularly vulnerable to various forms of degradation, development, and industrialization.

Shorebirds make significant use of the open bay, mud flats, and tidal marsh with heaviest use occurring from August through November and again during spring migration. Snag Alley and southern portions of the bay receive the most use. Shorebirds including dunlin, western and least sandpiper, greater and lesser yellowlegs, killdeer, black-bellied plover, red-necked phalarope, long-billed dowitcher, and whimbrel make extensive use of the estuary.

4.7.1 Description of Shorebirds (Western Sandpiper)

Shorebirds include phalaropes, plovers, sandpipers, snipes, and turnstones. In general, they have long thin legs with little to no webbing on their feet. They are usually small bodied with long thin bills. The differences in their bill lengths and shape allow the different shorebird species to forage for food within their habitat either on dry soil, mud, or in shallow water.

The western sandpiper is one of the most common shorebirds in the Pacific Northwest and within the Western Hemisphere. This small shorebird (Length 5.5-6.5", Wingspan 14-15 ", Weight 22-35 grams) breeds in a restricted range of the arctic tundra and winters mainly along the western coast of North and South America. In migration, this species stages in huge, spectacular flocks, particularly along the Pacific Coast from San Francisco Bay to the Copper River Delta in Alaska. Estimates suggest that millions of individuals pass through the critical stop-over habitat of Copper River Delta during just a few weeks each spring. Most western sandpipers migrate along the Pacific Coast, although significant numbers move through interior North America. Relatively little is known of the biology of wintering birds, particularly those in the southeastern United States, the West Indies, Central America, and South America (Wilson 1994).

At the breeding site males build a nest scrape to hold the typical four-egg clutch. Both members of the pair incubate eggs and tend young until they fledge. This species eats a varied diet, although insect larvae comprise the majority of its food on the breeding grounds. Along coastal and estuary stop-over habitat during migration, biofilm, crustaceans and polychaete worms make up the bulk of this species diet.

4.7.2 Historic and Current Distribution

The Siletz estuary is located in the Pacific Flyway and is an important resting stop and wintering area for many migratory shorebirds. The estuary is also important for other types of birds, including bald eagles and band-tailed pigeons. Bird use of the estuary is well documented (Heinz 1971, USACE 1976, Bayer 1977, ODFW 1979); however, bird usage by specific location and habitat is sparsely documented since there have been only limited surveys of specific species. Shorebird migration spans great distances from the Arctic to South America. The migratory paths are influenced by geography, wind, and weather patterns. During the spring, and fall migration, shorebirds rest and feed at stop-over locations including the coast of Oregon.

In the Americas the breeding range of the western sandpiper is mainly in the tundra of Alaska, from the mouth of the Kuskokwim River north to the vicinity of Point Barrow and Camden Bay. The winter range of this small shorebird is primarily along the Pacific coast from California to Peru, with small numbers wintering as far north as Washington. This species is locally common along the Atlantic Coast from south New Jersey south to the Gulf Coast. Also, found locally inland at the Salton Sea, CA, to the interior of northern and central Mexico to elevations of 2,500 meters (8,202 feet). These birds are common locally along the Caribbean coast of Central America, Colombia, Venezuela, Surinam, and the West Indies. The species is rare in Canada except for where abundant during migration in coastal British Columbia. Outside of the Americas a small breeding population is located in eastern Siberia on the Chutotski Peninsula. Accidental observations of the species have been documented in Ireland, Britain, France, Spain, Denmark, Sweden, and the Azores, with one specimen collected at Kultuk, Russia on the southwestern shore of Lake Baikal (Wilson 1994). The combination of a restricted breeding range and a broad non-breeding distribution means that some western sandpipers migrate much farther than others. Western sandpipers are differential migrants; males spend the winter farther north than females, and juveniles are disproportionately represented on the northern and southern edges of the distribution. There is also a life history difference as a function of migratory distance. Western sandpipers spending their juvenile non-breeding season in northern Mexico migrate northward in their first spring, but many juveniles in Panama remain on the non-breeding grounds until their second spring.

Although no races or discrete breeding populations of the species are recognized, genetic differences based on random amplified polymorphic DNA analyses were found between wintering grounds in Humboldt Bay, California, and South Island, South Carolina (Haig et al. 1997). Interestingly, the rather limited breeding distribution of western sandpipers does not suggest that this should occur. The extent of genetic differentiation between the small population on the Chukotski Peninsula of Siberia and the North America population is currently unknown.

The estimated total population of western sandpipers is 3.5 million birds (range = 2.8–4.3 million) (Bishop et al. 2000, Morrison et al. 2001). The data used to derive the population estimate were collected in 1992–1995. Although it is possible that a population decline is occurring (Brown et al. 2001), the magnitude of any change in population size is unknown. During spring migration, high concentrations of western sandpipers have been observed in the San Pablo-San Francisco Bay area of California when 473,963 western sandpipers were counted between 16 and 18 Apr, 1988 (Stenzel and Page 1988). During spring migration, nearly 75,000-100,000 western sandpipers were estimated to have stopped over at Bandon Marsh NWR on a single day in mid-May, 2006 (USFWS unpublished data). It has been estimated that nearly 2.4 million western sandpipers pass through British Columbia annually on fall migration (Butler et al. 1987).

4.7.3 Condition, Trends, and Threats

The Pacific Northwest region extends from Cook Inlet on the south coast of Alaska through coastal Alaska, British Columbia, Washington, and Oregon to northern California. The important shorebird habitats tend to be similar estuarine, riverine, and forested wetland landforms throughout the region. However, the intensity of land use and future threats to shorebird conservation are extremely different between, for example, the wilderness of Alaska and the urbanized Fraser River delta. Strategic plans for this region have been prepared in three sections: Alaska, British Columbia and the Pacific Northwest of the United States.

Threats to shorebirds and associated habitat include: (1) wetland loss due to urban sprawl and human expansion, (2) contamination of the estuarine habitat by industry, (3) aquatic beds destruction or reduction because of shellfish mariculture, (4) wetland drainage and water quality problems, and (5) sea level rise, which may reduce the amount of suitable shallow water habitat.

Pacific coast wetlands have been degraded by urban sprawl and human expansion. Large-scale timber harvest and development of agricultural lands have resulted in direct wetland loss, sedimentation of bays and degradation of water quality and submergent plant beds. Extensive urbanization and industrialization has eliminated entire wetlands and reduced the value of other coastal wetlands to waterbirds. Many of the estuaries along the Pacific coast have been diked and drained, primarily for agricultural development. Losses of 80-95% of intertidal marsh habitat in Oregon's estuaries have resulted from diking for farmland conversion (Thomas 1983a, Brophy 2011). Three national wildlife refuges, including Siletz Bay, Nestucca Bay, and Bandon Marsh, protect essential tidal wetlands on the Oregon coast, but these protected areas are small relative to the historic amount.

Western sandpipers appear to be declining across their range, and it has been suggested that threats at stop-over areas and on the wintering grounds play a significant role in this decline. Anthropogenic impacts may prevent birds from engaging in normal feeding and roosting activities. Marine, estuarine, and upland habitats in western Washington and Oregon provide essential conditions for hundreds of thousands of wintering and migratory western sandpipers and other shorebird species along the Pacific Flyway. The loss of habitat important to shorebirds has been particularly dramatic in the last 100 years (Page and Gill 1994, Dahl 1990). Wetland loss in Oregon has been severe with an 80-95% reduction of intertidal marsh habitats (Brophy 2011). Other potential threats to shorebirds in the Oregon include disease, non-point oil spills, contamination of habitat or food resources caused by agricultural and industrial chemicals, invasion of non-native vegetation and invertebrates in migratory habitat, and direct human disturbance (Buchanan 2005). Catastrophic impact events such as an oil spill (e.g., Exxon Valdez in Prince William Sound, Alaska) would potentially affect the viability of the species, as virtually the entire population of western sandpipers stops in at one migratory location (e.g., Copper River Delta, Alaska) on its way north to breeding grounds.

Potential effects of global warming are serious concerns in many areas and in all seasons. Of concern in the subarctic and Arctic breeding grounds of the western sandpiper is the unknown effect of global warming on breeding success. It is well documented that major breeding areas in Alaska are being affected by reduced snowcover and warmer days. It is not well understood how this warming may affect the reproduction or survival of western sandpipers. An increase in sea level has the potential to reduce available tidal flat foraging areas for shorebirds on their breeding grounds and during migration. The effects of rapid climate change, including potential consequences such as an increase in sea level and increased severe weather events, may affect conditions on breeding, migration, and wintering grounds of the western sandpiper in a manner far beyond present comprehension (Fernández et al. 2006).

4.7.4 Key Habitats Used

The breeding range for the western sandpiper includes subarctic and low-arctic from coast to uplands, occasionally on lower mountain slopes where well-drained, elevated ground occurs amid wet areas (Bent 1927, Holmes 1971). Favored nesting habitat is dominated by dwarf birch, dwarf willow, crowberry, various ericaceous shrubs, tussock grasses, and bryophytes. Proximity of elevated areas for nesting and wetland areas for feeding is a requisite. On arrival in the spring, birds are found in snow-free areas waiting for snow to melt to expose potential nesting sites. During spring and fall migration, from the center of the breeding range east of the Yukon-Kuskokwim Delta, Alaska, post-breeding birds and juveniles stage along the coastal flats of the Delta (Gill and Handel 1990). At coastal stop-over areas (e.g., Siletz Bay NWR), birds frequent intertidal mudflats and river’s edges. At interior stop-over sites, the margins of lakes and ponds are preferred habitat. Winter range habitat generally is within coastal areas with fine sand to muddy substrates (e.g., intertidal mudflats) where the birds generally follow receding and rising tide line for foraging. In the interior of Mexico, western sandpipers are uncommon to common locally along lakeshores, up to 2,500 meters (8,202 feet) in elevation (Wilson 1994).

4.7.5 Refuge-specific Sites

The wetlands and intertidal mudflats within Siletz Bay NWR are protected and allowed to function naturally since they receive intensive use by shorebird species throughout the year. Shorebirds by the thousands utilize the area as a stop-over site to feed and rest during spring and fall migration.

Western sandpipers migrate north through temperate latitudes (Siletz Bay NWR) generally between mid-April and mid-May, and males mostly migrate ahead of females (Butler et al. 1987). Once the spring migration has begun the birds move quickly north with length of stay at migratory stop-over sites typically ranging between 1 and 5 days (Bishop and Warnock 1998, Bishop et al. 2004). In comparison to the northward migration, the southbound movement from the breeding grounds is more prolonged. Western sandpipers migrate south from mid-June to November, arriving at Siletz Bay generally early to mid-July. The length-of-stay during southward migration is about 1–5 days at temperate coastal sites (Butler et al. 1987). At Siletz Bay NWR western sandpipers have been observed in all months of the year, with peak numbers during April/May and August/September during migration (USFWS unpublished data).

Stop-over habitat use by western sandpipers at Siletz Bay NWR is generally restricted to tidal mudflats, edges of the tidally influenced salt marsh channels and the banks of the Siletz River estuary. During stop-over migration western sandpipers feed on a variety of mudflat mollusks, polychaete or marine worms, small invertebrates, and biofilm in mixed shorebird flocks with dunlin, least sandpiper, semipalmated and black-bellied plovers, long and short-billed dowitchers, and greater and lesser yellowlegs. Spring migration of western sandpipers initiates at Siletz Bay NWR with small groups of 15-35 individuals arriving early to mid-April followed by larger groups in late April. Fall migration starts in July and peaks in early to mid-September. The number of individuals observed is variable year-to-year and season-to-season as flight patterns of migrating western sandpipers and other species of shorebirds is highly influenced by the strength of northwest winds in the spring. During periods of high winds birds are driven off the near-shore waters and coastal mountain ridgelines to gather along the coastal strand.

4.8 Waterfowl (Ducks)

Waterfowl include ducks, geese, and swans and are part of the worldwide family *Anatidae*. These are aquatic, web-footed, gregarious birds that mostly feed on water but some also graze on land. Ducks are classified in the tribe Anatini, which contains three genera and 40 species throughout the world. In North America there is but one genus, *Anas*, embracing 10 species of “dabbling or puddle ducks” (Bellrose 1986). Dabbling ducks or puddle ducks are surface-feeders that occur in freshwater shallows or salt marshes. Some of the more commonly found dabbling ducks in the Siletz Bay estuary include mallard, northern pintail, American wigeon, and green-winged teal. Although a dabbling duck in general appearance, the wood duck belongs to the tribe Cairinini. This species belongs to a group called “perching ducks” which are surface feeding woodland ducks that nest in tree cavities or nest boxes. There are nine genera representing 13 species worldwide. Only one species, the wood duck, inhabits North America north of Mexico (Bellrose 1986).

The remaining ducks are placed in three tribes embracing 12 extant genera around the world and are generally referred to as “diving ducks.” The tribe Aythyini is represented by the “pochards or bay ducks” (Bellrose 1986). In North America all belong to one genus, *Aythya*, composed of the canvasback, redhead, ring-necked duck, and the scaups (greater and lesser). Members of the tribe Mergini are termed “sea ducks” and although most of them frequent the ocean during the winter, many also inhabit freshwater areas. This species breeds in the far north and migrate in large compact flocks to and from their coastal wintering grounds. Common sea ducks include the scoters (surf, white-winged, and black), goldeneyes (common and Barrows), bufflehead, and mergansers (common, red-breasted, and hooded). Lastly, the tribe Oxyurini make up the “stiff-tailed duck” group which consists of one genus and two species that frequent North America (Bellrose 1986). The most common species of this group is the ruddy duck. Both dabbling and diving ducks are known to hybridize, and seemingly rare birds sighted outside their normal range may be hybrids.

4.8.1 Description of Waterfowl

Surface-feeding members of the genus *Anas* are termed “dabbling or puddle ducks.” Dabblers feed by tipping tail-up to reach aquatic plants, seeds, and invertebrates. They require no running start to take off but spring directly into flight. Members of this group have their feet set forward underneath their body and their hind toes are smooth without a lobe of skin. Most species show a distinguishing swatch of bright color, or speculum, on the secondary feathers. Many are known to hybridize. “Perching ducks” (wood duck) are equipped with sharp claws for perching in trees, well-developed hind toes, and broad wings.

The “diving ducks” consist of “pochards or bay ducks, sea ducks, and stiff-tailed ducks.” These diving ducks have legs set far back and far apart (a location that facilitates diving), which makes walking awkward. These heavy-bodied birds require a running start on water for takeoff. This group also has a lobe of skin on their hind toes. Sea ducks are stocky and have short necks. Mergansers have long, thin, serrated bills which help to catch fish, crustaceans, and aquatic insects. The ruddy duck is the most distinct species among all ducks and is termed “stiff-tailed duck.” Their feathers are long, stiff, and pointed and their legs are farther back on their bodies than other ducks. Their necks are short and thick. They lay the largest eggs among waterfowl, considering their size. They perform a bizarre courtship display, unique among waterfowl.

4.8.2 Historic and Current Distribution

Migratory waterfowl use four major migratory routes (Pacific, Central, Mississippi, and Atlantic flyways) in North America. The Pacific Flyway includes Alaska, Arizona, California, Idaho, Nevada, Oregon, Utah, Washington, and those portions of Colorado, Montana, New Mexico, and Wyoming west of the Continental Divide. Because of the unique biological characteristics and relative number of hunters in these regions, state and federal wildlife agencies adopted the flyway structure for administering migratory bird resources within the United States. Each flyway has its own council that is an administrative body that forges cooperation among public wildlife agencies for the purpose of protecting and conserving migratory birds in western North America. Flyway councils have responsibilities in the annual process of setting migratory bird policy and regulations within the United States and they conduct and contribute to migratory bird research and management throughout the United States, Canada, and Mexico.

4.8.3 Conditions, Trends, and Threats

Ducks are plentiful in fall through the winter months, utilizing refuge wetlands and flooded lowland areas. Waterfowl numbers vary greatly depending on habitat conditions and yearly variables such as weather and breeding production. Using mid-winter waterfowl survey numbers as an index, the number of wintering ducks in the Siletz area is highly variable and no trends can be inferred. However, tidal salt marsh restoration at Millport Slough has provided additional good quality wetland habitat within the Refuge and can support large numbers of waterfowl. The most abundant duck species identified at Siletz Bay during the 2009 mid-winter waterfowl survey are the bufflehead, scaup, American wigeon, green-winged teal and mallard (USFWS unpublished data). Some of the duck species that can be found wintering in the Siletz area have been documented as breeders on refuge lands.

Waterfowl hunting will be allowed on the Refuge (see Chapter 2) and occurs on adjacent lands, which may influence bird distribution and behavior. Hunting, by its nature, results in the intentional take of individual animals, as well as wounding and disturbance (DeLong 2002). Indirect impacts such as displacement of animals by hunters or disturbance from gunfire also occurs in and adjacent to, areas opened for hunting. It can also alter behavior (e.g., foraging time), population structure (young birds are generally more susceptible), and distribution patterns of wildlife (Owens 1977, Raveling 1979, White-Robinson 1982, Thomas 1983b, Bartlett 1987, Madsen 1985, and Cole and Knight 1990). Prolonged and extensive disturbances may cause large numbers of waterfowl to leave disturbed areas and migrate elsewhere (Madsen 1985).

Every year, the U.S. Fish and Wildlife Service conducts surveys that are used to estimate waterfowl hunting activity, success and harvest by species. Results are used by the Service and State wildlife agencies, in part, to establish season lengths and bag limits designed to maintain healthy, sustainable waterfowl populations. During 2010-11 season, waterfowl hunters in Oregon harvested an estimated 419,100±18% (Raftovich et al. 2011) ducks. On state-owned tidelands of Siletz Bay during 2010-11, hunters harvested very few ducks and the numbers are considered to be below reportable levels (B. Reishus, ODFW, personal observation). Waterfowl harvest data are unavailable because only a small number of hunters pursue waterfowl in the Siletz Bay area and no hunters were surveyed in 2010-11. At any given time there are only 1-2 hunting parties in the Bay because of space and hunting quality is best at only a few spots (e.g., the mouth of the sloughs). Waterfowl hunters tend to self-limit their numbers. Most hunting occurs in October and November and tides influence hunting times. After November the birds disperse further inland and there is almost no hunting occurring in the Bay.

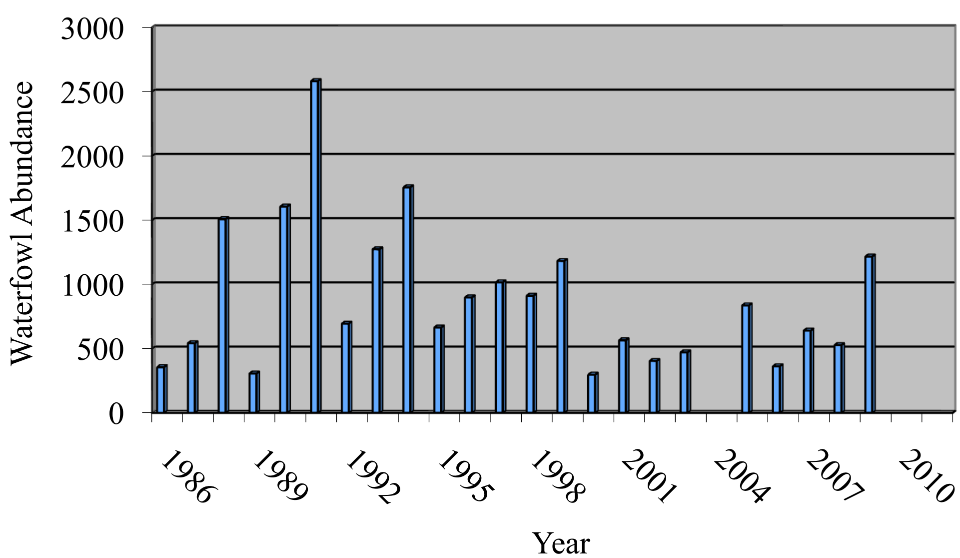
The most heavily harvested duck species in Oregon are mallard, American wigeon, northern pintail, green-winged teal, and northern shoveler (Raftovich et al. 2011). In 2011, continental populations of northern shoveler, green-wing teal, and mallard were all above their long-term averages (USFWS 2011). American wigeon were 20% below their long-term average and northern pintails were similar to the long-term average. Hunters are permitted to harvest coots, but coots are not very common on the Refuge, and they are not popular with Oregon hunters. Given the low harvest rates of these species relative to the State harvest, the refuge hunt program will not significantly contribute to the population changes of these species and the Refuge will continue to conform to State bag limits for ducks.

4.8.4 Waterfowl Population Trends

The Waterfowl Breeding Population and Habitat Survey is the most extensive and most important of North America's waterfowl population surveys. This survey is a cooperative effort of the United States Fish and Wildlife Service, the Canadian Wildlife Service, and state, provincial, and tribal agencies. It currently covers more than 2.1 million square miles of the northern United States and Canada, and includes most of the primary duck nesting areas in North America. Each year, air crews (a pilot biologist and an observer) fly fixed-wing aircraft at low altitude (150 feet) over transect lines through waterfowl habitat areas. Over 55,000 miles of transects are flown every year. Estimates of breeding populations for all waterfowl species observed are derived by taking the aerial counts, adjusting them based on the visibility correction factors, and expanding them over the survey area. Final results from the 2011 Waterfowl Breeding Population and Habitat Survey indicate a total duck population estimate of 45.6 million birds in the traditional survey area, which is an 11% increase over last year's tally of 40.9 million and 35 percent above the long-term average. Continental populations of northern shoveler, green-wing teal, and mallard were all above their long-term averages. American wigeon were 20% below their long-term average and northern pintails were similar to the long-term average (USFWS 2011).

Biologists from state and federal agencies annually conduct the Midwinter Waterfowl Survey to provide a measure of the relative numbers or trends of duck populations. The survey identifies winter waterfowl distribution and habitat use throughout the United States. The survey also provides estimates of the size of goose and swan populations and tracks population trends of duck species that nest outside of breeding survey areas. Midwinter Waterfowl Surveys are conducted during the first two weeks in January along the Oregon coast. Observers count divers, dabblers, geese, swans, and American coots from a fixed-wing aircraft and an overall abundance is estimated (USFWS unpublished data). Data were compiled for all waterfowl observed at Siletz Bay during the midwinter waterfowl surveys from 1986 to 2009 and are displayed in Figure 4-2. The overall mean count was 896 individuals and the lowest count was 297 individual birds recorded in 2000 and the largest was 2,582 in 1991. These data are collected from a fixed-wing aircraft at 200-300 foot altitude and traveling 80-120 miles per hour, which limits ability to survey all areas and all habitats and count every individual present. However, general abundance and population trends can be inferred and obviously Siletz Bay is an important use area for waterfowl. Waterfowl abundance is usually lower during the January mid-winter survey compared to fall months, when birds are concentrated on the bay prior to dispersing throughout the area due to field and seasonal wetland flooding (R. Lowe, personal observation). It should be noted that the mid-winter waterfowl survey serves as an index for comparative purposes and is not necessarily representative of the number of ducks that may be present within the entire geographic area. Refuge counts for ducks have generally ranged between 500 and 1,200 over the past several winters.

Figure 4-2. Waterfowl abundance at Siletz Bay, Oregon from 1986 to 2010 (USFWS unpublished data).



4.8.5 Key Habitats Used and Refuge-specific Sites

Many migratory bird species including black brant, American wigeon, scoters, and canvasback utilize eelgrass beds as a food source. In all, 25 species of ducks, 3 species of geese, tundra swans, and great blue herons use eelgrass beds as food or forage areas. Eelgrass grows in dense stands in shallow areas on mud, gravel, or sand. Due to its rarity along the Oregon coast and its special wildlife values, eelgrass beds provide extremely valuable habitat. At Siletz Bay eelgrass habitat is very limited. The largest concentrations of eelgrass occupy the southern end of Siletz Bay, with small patches occurring at the mouth of the bay, mouth of Schooner Creek, and the southern end of Snag Alley (USFWS 1990).

Bird use of the Siletz Bay marshes is high. Waterfowl species such as mallard, northern pintail, green-winged teal, American wigeon, and white-cheeked geese feed and rest on the marsh and the marsh mudflat interface. Raptors, wading birds, shorebirds, open meadow species such as sparrows and swallows, and gulls can also be found here foraging or resting. Marshes at the mouth of Drift Creek and at Millport Slough are utilized by band-tailed pigeons to obtain minerals for their diet.

4.9 Threatened, Endangered, and Candidate Species

4.9.1 State or Federally Listed Species Known to Occur on the Refuge

One goal of the Refuge System is “To conserve, restore where appropriate, and enhance all species of fish, wildlife, and plants that are endangered or threatened with becoming endangered.” In the policy clarifying the mission of the Refuge System, it is stated, “We protect and manage candidate and proposed species to enhance their status and help preclude the need for listing.” In accordance with this policy, the CCP planning team considered all species with Federal or State status. Tables 4-1 and 4-2 lists state or federal endangered and threatened species that are known to occur on the Refuge. Other listed species may occur but have not been documented. Discussion follows the tables in Section 4.9.2.

Table 4-1. Federal or State Listed Bird Species Known to Occur on the Refuge

Common Name	Federal Status	State Status	Current Occurrence on Refuge
Marbled murrelet	Threatened	Threatened	Potential fly-over

Table 4-2. Federal or State Listed Fish Species Occurring on the Refuge or in Surrounding Waters

Common Name	Federal Status	State Status	Current Occurrence on Refuge
Coho salmon	Threatened		Siletz Bay NWR Units/Siletz River/coastal streams
Pacific smelt (eulachon)	Threatened		Siletz River
Green sturgeon	Threatened		Siletz River

4.9.2 Description and Status of Listed Species Known to Occur on the Refuge

Marbled Murrelet

The marbled murrelet is a small, robin-sized, diving seabird that feeds primarily on fish and invertebrates in near-shore marine waters. It spends the majority of its time on the ocean, roosting and feeding, but comes inland up to 80 kilometers (50 miles) to nest in forest stands with old growth forest characteristics. These dense shady forests are generally characterized by large trees with large branches or deformities for use as nest platforms. Murrelets nest in stands varying in size from several acres to thousands of acres. However, larger, unfragmented stands of old growth appear to be the highest quality habitat for marbled murrelet nesting. Nesting stands are dominated by Douglas-fir in Oregon and Washington and by old-growth redwoods in California (USFWS 2012d).

Salmonids

See Salmonid Section 4.6.

Pacific Smelt (eulachon)

Eulachon (commonly called smelt, candlefish, or hooligan) are a small, anadromous fish from the eastern Pacific Ocean. They are distinguished by the large canine teeth on the "vomer" and 18 to 23 rays in the anal fin. Like Pacific salmon they have an "adipose fin"; it is sickle-shaped. The paired fins are longer in males than in females. All fins have well-developed breeding tubercles (raised tissue "bumps") in ripe males, but these are poorly developed or absent in females. Adult coloration is brown to blue on the back and top of the head, lighter to silvery white on the sides, and white on the ventral surface; speckling is fine, sparse, and restricted to the back. They feed on plankton but only while at sea.

Eulachon typically spend 3 to 5 years in saltwater before returning to freshwater to spawn from late winter through mid-spring. During spawning, males have a distinctly raised ridge along the middle of their bodies. Eggs are fertilized in the water column. After fertilization, the eggs sink and adhere to the river bottom, typically in areas of gravel and coarse sand. Most eulachon adults die after spawning. Eulachon eggs hatch in 20 to 40 days. The larvae are then carried downstream and are dispersed by estuarine and ocean currents shortly after hatching. Juvenile eulachon move from shallow nearshore areas to mid-depth areas. Within the Columbia River Basin, the major and most consistent spawning runs occur in the mainstem of the Columbia River as far upstream as the Bonneville Dam, and in the Cowlitz River.

Eulachon occur in nearshore ocean waters and to 1,000 feet (300 meters) in depth, except for the brief spawning runs into their natal (birth) streams. Spawning grounds are typically in the lower reaches of larger snowmelt-fed rivers with water temperatures ranging from 39 to 50° F (4-10° C). Spawning occurs over sand or coarse gravel substrates (NOAA 2012a).

Green Sturgeon

Green sturgeon are long-lived, slow-growing fish and the most marine-oriented of the sturgeon species. Mature males range from 4.5-6.5 feet (1.4-2 meters) in "fork length" and do not mature until they are at least 15 years old, while mature females range from 5-7 feet (1.6-2.2 meters) fork length and do not mature until they are at least 17 years old. Maximum ages of adult green sturgeon are likely to range from 60-70 years. This species is found along the west coast of Mexico, the United States, and Canada.

Green sturgeon are believed to spend the majority of their lives in nearshore oceanic waters, bays, and estuaries. Early life-history stages reside in fresh water, with adults returning to freshwater to spawn when they are more than 15 years of age and more than 4 feet (1.3 meters) in size. Spawning is believed to occur every 2-5 years. Adults typically migrate into fresh water beginning in late February; spawning occurs from March-July, with peak activity from April-June (Moyle et al. 1995). Females produce 60,000-140,000 eggs. Juvenile green sturgeon spend 1-4 years in fresh and estuarine waters before dispersal to saltwater. They disperse widely in the ocean after their out-migration from freshwater (NOAA 2012b).

4.10 Invasive and Exotic Plant Species

One of the largest threats to wildlife and habitat of the Refuge is invasive plants. Invasive plant species displace native vegetation, altering the composition and structure of vegetation communities, affecting food webs, and modifying ecosystem processes (Olson 1999). Ultimately, plant invasive species can result in considerable impact to native wildlife and the habitat they are dependent upon.

Several non-native invasive plants found on Siletz Bay NWR include reed canarygrass, Himalayan blackberry, English ivy, and Scotch broom. Gorse and *Spartina* spp. are not currently found on the Refuge; however, monitoring for those species is conducted to detect outbreaks or infestation and control efforts would be implemented immediately. Many exotic and invasive plants have been introduced to the Refuge; therefore, this list is not all inclusive and includes only the most problematic species.

4.10.1 Description and Status of Reed Canarygrass

A highly variable species, reed canarygrass is a rhizomatous perennial grass that can reach three to six feet in height. The sturdy, often hollow stems can be up to 1/2 inch in diameter, with some reddish coloration near the top. The leaf blades are flat and hairless, 1/4 to 3/4 of an inch wide. The flowers are borne in panicles on culms high above the leaves. The panicles are generally three to six inches in length. The species flowers in June and July (Weinmann et al. 1984, Hitchcock et al. 1969).

Reed canarygrass is extremely aggressive and often forms dense, highly productive single species stands that pose a major threat to many wetland ecosystems. The species grows so vigorously that it is able to inhibit and eliminate competing native species. In addition, areas that have existed as reed canarygrass monocultures for extended periods may have seed banks that are devoid of native species (Apfelbaum and Sams 1987). Unlike native wetland vegetation, dense stands of reed canarygrass have little value for wildlife. Few species eat the grass, and the stems grow too densely to provide adequate cover for small mammals and waterfowl (Maia 1994). The species is considered a serious weed along irrigation banks and ditches because infestations can increase siltation (Marten and Heath 1973). When in flower, the species produces abundant pollen and chaff, which aggravate hay fever and allergies (Weinmann et al. 1984). Once established, reed canarygrass is difficult to control because it spreads rapidly by rhizomes.

4.10.2 Description and Status of Himalayan Blackberry

Himalayan blackberry is a robust, perennial, sprawling, more or less evergreen, shrub of the Rose family. Leaves are large, round to oblong and toothed, and typically come in sets of three (side shoots) or five (main stems). The most characteristic feature is probably the robust stems supporting large stiff prickles. The shrubs first appear as individual canes, then groups of canes, gradually increasing to become great mounds or banks with individual canes reaching up to 3 meters. Trailing canes spread up to 20-40 feet, frequently taking root at the tips. The white flowers and then the roundish black and shiny 2 centimeter (less than 1 inch) fruit forms on second year (secondary) canes that grow off of first year canes. The fruit ripens from midsummer to autumn; late when compared with native blackberries.

Himalayan blackberry readily invades riparian areas, forest edges, oak woodlands, meadows, roadsides, clear-cuts, and any other relatively open area, including all open forest types. Once it becomes well established, it out competes low stature native vegetation and can prevent establishment of shade intolerant trees (e.g., Douglas-fir), leading to the formation of blackberry thickets with little other vegetation present. The resulting dense thickets can limit movement of large animals from meadow to forest and vice versa, reducing the utility of small openings and meadows as foraging areas. Although the fruit is widely consumed by native animals, it is a poor functional replacement for a diverse native forest understory, meadow, or riparian floodplain. Seeds from the fruit are distributed and spread widely by birds in their feces.

4.10.3 Description and Status of English Ivy

English ivy is an evergreen climbing vine that attaches to the bark of trees, buildings, and other surfaces by way of small root-like structures which exude a sticky substance that helps the vines adhere to various surfaces. Older vines have been reported to reach 1 foot in diameter. Leaves are dark green with white veins, waxy to somewhat leathery, and arranged alternately along the stem. Leaf forms include a 3 to 5-lobed leaf (the most common) and an unlobed rounded leaf often found on mature plants in full sun that are ready to flower. Vines may grow for up to ten years before producing flowers. Under sufficient light conditions, terminal clusters of small, pale yellow-green flowers are produced in the fall. The flowers are attractive to flies and bees in search of late season nectar sources. The black-purple fruits have a thin fleshy outer covering, contain one to three hard stone-like seeds, and may persist through the winter if not eaten first. This feature also helps ensure effective seed dispersal by birds (NPS 2011).

English ivy is a vigorous growing vine that impacts all levels of disturbed and undisturbed forested areas, growing both as a ground cover and a climbing vine. As the ivy climbs in search of increased light, it engulfs and kills branches by blocking light from reaching the host tree's leaves. Branch dieback proceeds from the lower to upper branches, often leaving the tree with just a small green "broccoli head." The host tree eventually succumbs entirely from this insidious and steady weakening. In addition, the added weight of the vines makes infested trees much more susceptible to blow-over during high rain and wind events and heavy snowfalls. Trees heavily draped with ivy can be hazardous if near roads, walkways, homes, and other peopled areas. On the ground, English ivy forms dense and extensive monocultures that exclude native plants (NPS 2011). Ivy will only flower and set fruit on climbing vines; therefore, as a first defense it is advisable to prevent the plants from climbing or removing climbing vines first to prevent fruit production.

4.10.4 Description and Status of Scotch Broom

Scotch broom is a perennial evergreen shrub in the legume family. It reaches heights up to 10 feet and has stiff, angled, more or less erect, dark green, broom-like branches. Many branches are leafless or have few leaves. Upper leaves are simple, but lower leaves are trifoliate (three-parted). The bright yellow flowers are about 3/4 inch long, shaped like pea flowers, and bloom from April to June. The brown or black pods are flat with hairs on the margins only. Each contains several seeds. Seeds are oval, about 1/8 inch long, dark greenish-brown, and have a shiny surface. Seeds can last for 60 years in the soil (Hulting et al. 2008).

Scotch broom was introduced as a garden ornamental by early settlers of the Pacific Coast. It has spread far beyond the bounds of cultivation and now covers many acres west of the Cascades from British Columbia to California. Scotch broom is moving rapidly into forest lands of western Oregon and Washington, where it is interfering increasingly with re-establishment of conifer seedlings on harvested lands. Scotch broom also is being found more frequently in areas east of the Cascades. Wherever it grows, this aggressive plant spreads to form pure stands at the expense of desirable forbs, grasses, and young trees. Because it is a threat to native plant species and indirectly to animals that feed on the displaced plants, Scotch broom is a Class B noxious weed in Washington and Oregon (Hulting et al. 2008).

4.10.5 Description and Status of Gorse

Gorse is not currently found on the Refuge. However, there are infestations at the Heceta Head area and a small number of plants at Otter Rock. Therefore, monitoring for this species is warranted. If gorse is detected in the area, control efforts should be implemented immediately to eliminate the infestation on and adjacent to refuge lands. Gorse is native to western and central Europe where it was cultivated as hedgerows and as a reserve for livestock forage. In southern coastal Oregon, gorse was introduced by early European emigrants and planted as an ornamental shrub. This invasive non-native plant grew in monotypic stands and became an established exotic shrub in most coastal habitats. This species is extremely competitive, displaces native plants, and impoverishes the soil. In addition, it creates an extreme fire hazard due to oily, highly flammable foliage and seeds, and abundant woody material in the plant’s center. The city of Bandon in southwestern Oregon was almost completely destroyed by a fire fueled in part by gorse in 1936. All but 16 buildings out of 500 were completely burned to the ground.

4.10.6 Description and Status of *Spartina*

Smooth cordgrass or saltmarsh cordgrass is a perennial deciduous grass, which is found naturally in intertidal wetlands, especially salt marshes on the East Coast. However on the West Coast, smooth cordgrass is viewed as an aggressive exotic that alters estuarine structure and function, excludes native salt marsh and mudflat vegetation, and eliminates native habitat for shorebirds, waterfowl, and certain shellfish and finfish (USFWS 1997).

This long-lived, warm season perennial typically grows from 1-2.3 meters (3.28-7.55 feet) tall, and has smooth, hollow stems that bear leaves up to 20-60 centimeters (7.87-23.62 inches) long and 1.5 centimeters (0.56 inch) wide at their base, which are sharply tapered and bend down at their tips. The flowers are a yellowish-green, turning brown in the winter, and are wind pollinated. Like its relative saltmeadow cordgrass, it produces flowers and seeds on only one side of the stalk and spreads extensively by long hollow rhizomes. Soft, spongy stems up to ½ inch in diameter emerge from the rhizomes. The rhizoidial roots, when broken off, can result in vegetative asexual growth. In September and October seedheads, which are 10 to 12 inches long, emerge at the end of the stem. Each spike holds from twelve to fifteen 2 or 3 inch long spikelets (USDA 2008). Smooth cordgrass can become an invasive species either by itself or by hybridizing with native species and preventing propagation of the pure native strain.

Smooth cordgrass dynamically alters West Coast physical, hydrological, chemical, and biological estuarine functions and is noted for its capacity to act as an environmental engineer. It grows out into the water at the seaward edge of a salt marsh and can appear on mudflats far from nearby marshes. Sediment accumulates in the cordgrass infested area and enables other habitat-engineering species to settle. This accumulation of sediment and other substrate-building species gradually builds up the level of the mudflats and tidal channels are deepened. This in turn eliminates the gently sloping bare intertidal zone that lies between the salt marsh and the tidal channels (USFWS 1997). As the marsh accretes, smooth cordgrass moves still further out to form a new edge. Smooth cordgrass grows in tallest forms at the outermost edge of a given marsh, displaying shorter morphologies up onto the landward side of the cordgrass belt.

Cordgrass may affect habitat structure for native wetland animals, benthic invertebrate populations, and shorebird and wading bird foraging areas. As a result of Smooth cordgrass growth, benthic invertebrate species composition and abundance in the intertidal zone changes substantially as their habitat is overgrown. In turn, food sources shrink for birds who feed on those invertebrates. Smooth cordgrass also displaces eelgrass on mudflats and native vegetation in saltmarshes (USFWS 1997).

Smooth cordgrass was introduced into Willapa Bay, Washington in 1894 as packing material for oyster shipments from the East Coast. From 1945 to 1988, the plant spread rapidly throughout Willapa Bay. In 1999 it covered 6,000-10,000 ha (15 to 25 thousand acres) of land. Due to extensive control efforts only, approximately 10 acres are considered to be infested at Willapa Bay according to a 2012 estimate. It is also now making inroads into Puget Sound and Grays Harbor in Washington.

4.10.7 Refuge-specific Sites

Reed canarygrass, Himalayan blackberry, English ivy, and Scotch broom occur sporadically on Siletz Bay National Wildlife Refuge, whereas gorse and cordgrass are not currently found on the Refuge. Mechanical, physical, biological, and chemical means have been utilized to combat invasive plants throughout the Refuge in accordance with 7 RM 14 (Pest Control Policy). Plans to remove, control, and prevent establishment of non-native plant species and treat infestations with IPM techniques are implemented on an as needed basis.

Dense stands of reed canarygrass dominated a small area along the Siletz River (north edge of Millport North), where the soil may have been disturbed in the past. Reed canarygrass also lines the wide channel behind the beaver dam at Drift Creek (Brophy 2002), and there is a dense stand in the former Kangas Tract. Himalayan blackberry, English ivy, and Scotch broom are distributed along the roadsides and ditch banks U.S. Highway 101, Millport Slough, and the Siletz River. Control and treatment of Himalayan blackberry at Siletz Bay has been concentrated on refuge uplands and roadsides that are easily accessible by foot. Much of the work has been done by volunteers under the guidance of refuge staff.

Intensive efforts to remove English ivy have been conducted on the Refuge. Volunteers spent hundreds of hours each year since 2007 cutting, chopping, and removing ivy that had infested wooded areas of the Refuge, particularly along Millport Slough and Immonen Roads. On occasion, a chainsaw was needed to remove old growth ivy with a base of up to 8 inches in diameter.

Scotch broom has formed dense thickets along U.S. Highway 101 throughout the Refuge, particularly within the Siletz Keys grassland area, on Alder Island, and along forested borders. Efforts to control Scotch broom have been erratic and only partially successful. Plants re-sprout if roots systems are not removed or killed and quickly reoccupy the sites.

4.11 Invasive and Exotic Animal Species

One of the largest threats to wildlife and habitat of the Refuge is pest animals. 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, animal invasive species can result in considerable impact to native wildlife and the habitat they are dependent upon. For example, introductions of Arctic and red foxes for fur farming purposes resulted in widespread extirpation of breeding Aleutian Canada geese in the Aleutian Islands, Alaska due to predation (USFWS 1993, Bailey and Trapp 1984). The fox decimated goose populations by preying upon vulnerable nesting adults, chicks, and eggs. The Aleutian Canada goose inhabits refuge lands in Alaska during the summer and Oregon during the winter-spring. Because of cooperative recovery efforts that included removing invasive foxes from the breeding islands, the USFWS officially delisted this species from threatened status in 2001 (USFWS 2001). This list is not all inclusive and includes only the most problematic species; many other exotic animals have been introduced. The following list is not all-inclusive and includes only the most problematic species: many other exotic animals have been introduced.

4.11.1 Description and Status of the New Zealand Mudsnail

New Zealand mudsnails are relatively small (average length of 4-5 millimeters [0.16-0.20 inch] in western USA), with a maximum of 11 millimeters (0.43 inch) in native habitats. They reach maturity at 3 millimeters (0.12 inch) in length in rivers in western Montana and Idaho. Their shell usually consists of a right-handed coiling of 5-6 whorls. The shell varies in color (gray, light to dark brown). An operculum (i.e., plate) covers the opening of the shell. New Zealand mudsnails have triploid, parthenogenetic female populations: asexual females are born with developing embryos in their reproductive system. Diploid, sexual male and female populations are extremely rare in western USA. Asexual females generally produce twice the number of daughters as sexual females. The adult New Zealand mudsnail may easily be confused with various native and exotic species which can be similar in appearance, and all newly discovered populations should be verified by experts. The shell of the New Zealand mudsnail is narrower, longer, and has more whorls than most hydrobiid snails native to the United States. New Zealand mudsnails are live bearers (they release embryos and not eggs), and therefore, the presence of newly released young may indicate a possible population. New Zealand mudsnails can inhabit lakes, ponds, streams, rivers, lagoons, estuaries, canals, ditches, water tanks, and reservoirs and occupy a wide variety of substrates including silt, sand, mud, concrete, vegetation, cobble, and gravel. They are capable of tolerating a wide range of temperatures with upper thermal limits of 28°C and lower thermal limits near freezing. They also have a wide salinity tolerance range from saline and brackish to freshwater. Populations in saline conditions produce fewer offspring, grow more slowly, and undergo longer gestation periods. Individuals of this species are able to tolerate turbidity, clear water, and degraded conditions (including sewage) and may pass through the digestive tracts of many fish species (ANS 2011).

The New Zealand mudsnail has a history of becoming a pest species in many parts of the world, and its recent introduction into North American waters is cause for concern. Since the mid-1980s, North American population densities in some infested streams have reached up to 3/4 million individuals per square meter. New Zealand mudsnails could displace native invertebrates. Five species of mollusks (all native to the Snake River) have recently been listed as "endangered" in part due to the establishment of the New Zealand mudsnail and its potential impacts. Establishment is expected to have negative impacts on native fauna (e.g., decrease in densities of herbivorous invertebrates, decrease in attached filter-feeding organisms). There is evidence for a negative correlation between populations of mayflies, stoneflies, caddisflies, and chironomids and New Zealand mudsnail densities of <28,000 per square meter in a spring creek in southwestern Montana. This species may have the potential to impact the food chain of native trout and other fish species and to disrupt the physical characteristics of invaded ecosystems (e.g., reduction in the biomass of periphyton), and the resulting interactions can have wide-ranging effects on stream ecosystem processes. They also have the potential to become a pest species of freshwater supplies: in Australia New Zealand Mudsnails actually emerged from domestic water taps (ANS 2011).

There is great concern about this hitchhiker's ability to spread because of its asexual reproduction and its ability to survive in harsh conditions. Because the mudsnails reproduce asexually, it only takes one individual to become introduced into new water to make an impact. Also, the mudsnails can readily attach themselves to boats, boots, and waders. Preventative measures for anglers must include checking fishing gear and ensuring that it is free of mud and any noticeable snails. People entering areas infested with New Zealand mudsnails must also disinfect boats, boots and other equipment before leaving the area.

This snail has the ability to reproduce quickly and mass in high densities. In some western streams, snails have become as dense as one-half million per meter square, which has raised concern that the mudsnails will impact the food chain of native trout and alter the physical characteristics of the streams themselves. Research is needed to determine the impacts of large populations of mudsnails on the native fauna, such as aquatic insects and native snails, and on any changes in the physical environment.

4.11.2 Description and Status of Nutria

The nutria is a large, dark-colored, semiaquatic rodent that is native to southern South America. At first glance, a casual observer may misidentify nutria as either a beaver or a muskrat, especially when it is swimming. This superficial resemblance ends when a more detailed study of the animal is made. Other names used for the nutria include coypu, nutria-rat, South American beaver, Argentine beaver, and swamp beaver.

Nutria is a member of the family *Myocastoridae*. They have short legs and a robust, highly arched body that is approximately 24 inches (61 centimeters) long. Their round tail is from 13 to 16 inches (33 to 41 centimeters) long and scantily haired. Males are slightly larger than females; the average weight for each is about 12 pounds (5.4 kilograms). Males and females may grow to 20 pounds (9.1 kilograms) and 18 pounds (8.2 kilograms), respectively. The dense grayish underfur is overlaid by long, glossy guard hairs that vary in color from dark brown to yellowish brown. The forepaws have four well-developed and clawed toes and one vestigial toe. Four of the five-clawed toes on the hind foot are interconnected by webbing; the fifth outer toe is free. The hind legs are much larger than the forelegs. When moving on land, nutria may drag its chest and appear to hunch its back. Like beavers, nutria have large incisors that are yellow-orange to orange-red on their outer surfaces. In addition to having webbed hind feet, nutria has several other adaptations to a semiaquatic life. The eyes, ears, and nostrils of nutria are set high on their heads. Additionally, the nostrils and mouth have valves that seal out water while swimming, diving, or feeding underwater. The mammae or teats of the female are located high on the sides, which allows the young to suckle while in the water. When pursued, nutria can swim long distances under water and see well enough to evade capture (ICWDM 2011).

Nutria construct burrows in banks of rivers, sloughs, and ponds, sometimes causing considerable erosion. Burrowing is a commonly reported damage caused by nutria. Burrows can weaken roadbeds, stream banks, dams, and dikes, which may collapse when the soil is saturated by rain or high water. Rain action can wash out and enlarge collapsed burrows and compounds the damage. Nutria depredation on crops is also well documented. Crops that have been damaged include corn, sugar and table beets, alfalfa, wheat, barley, oats, various melons, and a variety of vegetables from home gardens and truck farms. Nutria girdle fruit, nut, deciduous and coniferous forest trees, and ornamental shrubs. They dig up lawns when feeding on the tender roots and shoots of sod grasses. At high densities and under certain adverse environmental conditions, foraging nutria can also significantly impact natural plant communities. Overutilization of emergent marsh plants can damage stands of desirable vegetation used by other wildlife. Nutria are aggressive competitors with the native muskrat which is smaller. Muskrats have been largely eliminated or greatly reduced where nutria have become established (ODFW 2011a).

4.11.3 Description and Status of Feral Cats

A feral cat is a domestic cat that is free roaming, untamed, and un-owned. These cats live and breed entirely in the wild and depend on native wildlife as prey items. Feral cats are often apex predators in local ecosystems feeding on local birds and small mammals.

4.11.4 Refuge-specific Sites

Nutria and feral cats have been observed on the lowland marsh areas of the Refuge. These animals like the ditch banks and use the high vegetation as cover. The New Zealand mudsnail is located in the Millport Slough area and likely occurs in other estuarine areas of the Refuge; however, the extent of infestation is unknown.

William Medlen/USFWS

Chapter 5
Human Environment

Chapter 5. Human Environment

5.1 Cultural Resources

5.1.1 Native American Cultural Landscape

For thousands of years, people living on the Oregon coast relied upon resources obtained from estuaries (Minor and Toepel 1983, Draper 1988, Ross 1990, Lyman 1991 as cited in Byram 2002). Fish, shellfish, terrestrial and marine mammals, avian species, and edible plants all provided the means for sustenance. With its dense food value and predictable runs, salmon in particular were of high value. This is reflected in the ethnographic accounts and archaeological evidence. Major river drainages are known to have been well populated and have many major archaeological sites. However, smaller estuaries without a major stream to support a strong salmon run had smaller populations and fewer major archaeological sites.

The concentration of preferred resources in the productive interface of ocean and land led to numerous stable and distinct groups of Native people on the Oregon coast. These are recorded in early written records and later ethnographic studies. Each estuary and bay was associated with a unique group which broadly shared the same cultural habits, beliefs, and sometimes language with other coastal groups.

Siletz Bay National Wildlife Refuge

The Refuge is located within the traditional territory of the Siletz-dialect speaking people of the Tillamooks or Killmooks. This larger tribe consisted of the Salish-speaking people generally located west of the Coast Range and along the coast from Tillamook Head to 10 or 20 miles south of Siletz Bay. The Tillamooks can be considered the southernmost full expression of the classic Northwest Coast Culture that extended north to British Columbia, Canada. For example, permanent homes, which varied slightly in shape and size through time, were commonly built of cedar logs and split planks. These cedar plank houses could be built totally above ground or partially buried into the terrain. The roof pattern, style of entry, and internal layout were of the Northwest Coast pattern.

The year was divided by procurement and religious ritual recognition of various resources. Along the estuary and on the outer coast, many food resources such as marine fish and shellfish were probably harvested throughout the year, but some of the most valued foods had to be harvested in quantities, processed, and stored when they were available. These included salmon, drift whales, other sea mammals, starchy plants such as camas and fern roots, and elk. Weirs, nets, and other traps were common fish catching techniques; spearing and clubbing also occurred. Many products would be steam cooked in an earth oven or could be brought to a boil with hot stones dipped into a water-filled basket. Some food would be preserved though air drying or smoking on a rack.

In spring, various plants and marine fish became abundant, and the tides were low on the shore for shellfish harvests. Salmonberry sprouts were gathered beginning in April and harvested when ripe during May and June. In late spring and summer, anadromous fish would become available above tidewater, and groups would move to upriver camps to begin their harvests, and to gather and process plant foods such as camas. Salalberry, huckleberry and strawberry were harvested in July and August. When adequate stores were acquired, people had time to travel to inland valleys or north and south along the coast for trade, gaming, and socializing. The Chinook salmon were caught in the runs of August and September, coho in October. During the fall, elk would be taken, and in November, chum salmon could be caught. Winter was a period of less outdoor work activity, when most village residents remained at home and relied largely on stored foods. Stories were told, dances were held, and tools, clothing, basketry, and other crafts and art were produced and maintained. Winter steelhead obtained between December and April brought the cycle back to spring.

Evidence of the above activities and items has been found along the coast. Shell middens or layers of shell, bone, charcoal and fire-cracked rocks that accumulate at occupation sites are common on the coast. Large quantities of fire-cracked rock with charcoal indicate a roasting pit location. Subtle ground depressions may indicate where a plank house stood. Although Siletz Bay and the estuarine reaches of the Siletz River and Drift Creek were prime locations for prehistoric Native American villages, to date no archaeological sites that may represent such villages have been recorded.

5.1.2 Post-settlement Overview

In 1855, the area surrounding Siletz Bay became part of the Coast Reservation and still later, the Siletz Reservation. Homesteaders began arriving soon after Congress passed the Dawes Act in 1887. This act opened up Coast Reservation lands to Euro-American settlement and gave eighty acre "allotments" to reservation Indians. Early settlers homesteaded the land and combined subsistence farming with fishing and hunting in order to survive on the isolated coast (Hall 2011). Much of the tidal marsh habitat was diked, drained, and converted to agricultural lands to produce crops for human and livestock consumption. The key economic activities in the late 19th to early 20th century were salmon fishing, commercial clam fishery, native oyster collection, and timber harvest. By the early 1920s, however, the numbers of fish were diminishing and new regulations in 1935 prohibited drift net fishing altogether. The area then turned to logging for its industry. Between 1925 and 1939 log rafts totaling 1.25 billion board feet of lumber crossed the bar (Rea 1975). With the completion of the Salmon River Cut-Off and the Coast Highway in the late 1920s, a surge in automobile travel brought visitors as well as settlers to the area by the hundreds (Hall 2007). The lumber and fishing industries were gradually replaced by tourism and recreation as the most important economic industry. The commercial salmon fishery was declining when the estuary was closed to gill net fishing in 1957. Clam populations are too small to support a commercial fishery, and log rafts are no longer towed across the bar. The Siletz Bay estuary is now devoid of industry and large vessel traffic (ODFW 1979).

5.1.3 Archaeological Sites and Surveys

Within the approved boundary of the Siletz Bay National Wildlife Refuge there is one recorded archaeological site. There are two known archaeological sites within the vicinity of the Refuge but outside of the approved boundary (Tables 5-1 and 5-2).

Table 5-1. Known Archaeological Sites Within or in the Vicinity of Siletz Bay National Wildlife Refuge

Trinomial	Common Name	Type	Attributes	Within Approved Refuge Boundary
LN00005	Siletz Spit	Prehistoric	House pit	Yes
LN00004	Syote's Farm	Prehistoric	House pits, midden	No
LN00117	None	Prehistoric	House pits, midden	No

Table 5-2. Archaeological Surveys Within or in the Vicinity of Siletz Bay National Wildlife Refuge

SHPO Number	Survey Title	Author	Within Approved Refuge Boundary
245	Sewer Line	J.A. Follansbee	Yes
16819	US 101 at Schooner Creek	H. Gard	Yes
16229	Millport Slough	A. Bourdeau	Yes

5.1.4 Threats to Cultural Resources

A variety of natural and human-caused activities can threaten cultural resources, including:

- Fire, both naturally-occurring and prescribed for habitat restoration, can cause significant damage to historic structures and archaeological sites as can the activities to suppress and manage fire (such as creating fuel breaks, etc.)
- Erosion, whether the byproduct of fire, wind, waves or another natural or manmade agent
- Habitat restoration and other land management activities.
- Vandalism or "pot hunting"

Any activity identified in the CCP's management direction (see Chapter 2), including construction of new facilities or changes in public use could have a potential impact to cultural resources. The greatest threats may be posed by earthmoving, removal of structures, or alteration of the current erosion patterns occurring during habitat restoration, construction, or other land management activities.

The Service is committed to protecting valuable evidence of plant, animal, and human interactions with each other and the landscape over time. These may include previously recorded or yet undocumented historic, cultural, archaeological, and paleontological resources as well as traditional cultural properties and the historic built environment. Protection of cultural resources is legally mandated under numerous Federal laws and regulations. Foremost among these are the National Historic Preservation Act (NHPA) as amended, the Antiquities Act, the Historic Sites Act, the Archaeological Resources Protection Act (ARPA) as amended, and the Native American Graves Protection and Repatriation Act (NAGPRA). The Service's Native American Policy (USFWS 1994) articulates the general principles guiding the Service's relationships with Tribal governments in the conservation of fish and wildlife resources. Additionally, the Refuge seeks to maintain a working relationship and consult on a regular basis with the Tribes that are or were traditionally tied to lands and waters within the Refuge.

5.2 Refuge Facilities

The infrastructure and facilities discussed in this section include boundary signs, public entrances, roads, trails, and administrative buildings. Facilities associated with specific public use programs are discussed in Section 5.5. All public and administrative facilities, with the exception of boundary signs, are depicted on the map located in Chapter 2.

5.2.1 Boundary Signs

Currently, all portions of this Refuge are closed to public use. Approximately 50% of the Refuge is posted with official refuge boundary signs. Boundary signs are located where refuge lands are adjacent to roads and along major waterways including the Siletz River and Millport Slough.

5.2.2 Public Entrances, Roads, Launches, Access Points, and Parking

The Refuge is closed to public use and there are no public entrances. The Refuge is marked with two standard entrance signs; both are located on the east side of U.S. Highway 101 in the SW corner of the Refuge. The Refuge owns two residences and both have manually operated security gates located at the entrance roads to each. A gravel road on the east side of U.S. Highway 101 leads to the former Watson House. The entrance road is gated. There is also a gate at the entrance road that leads to the Siletz Bunkhouse which is occupied year-round by volunteers. There is a small four-car gravel parking lot associated with the Siletz Bunkhouse and a small gravel parking lot associated with the Watson House.

5.2.3 Administrative Buildings and Other Infrastructure

The Oregon Coastal Field Office is located on the campus of the Oregon State University, Hatfield Marine Science Center in Newport, OR, and houses the Refuge Complex and the Newport Ecological Services Field Office. Management of Siletz Bay NWR as well as the other north coast refuges is carried out from this office. The administrative facilities consist of a small interpretive display, a laboratory, an attached shop/garage, and a conference room and office space for 8 permanent, two term, and four temporary employees.

The Refuge owns two residences at Siletz Bay NWR. Both residences are located near the bay in the tsunami hazard zone for Lincoln County. The Watson House is located on the east side of U.S. Highway 101 and the south side of Drift Creek. It has three bedrooms, two bathrooms, and is set up for family living quarters. Over the years, it has been used as a primary residence for staff or as temporary quarters for volunteers. Built in 1969, this residence is located in a dark damp setting and it was not insulated when it was built, making it inefficient and extremely expensive to heat. Over the past decade, some of the windows have been replaced, a pellet stove was added, and the roof was replaced but the house remains very energy-inefficient. The house has an attached two-car garage and there is an old boathouse on the property currently used as a storage facility.

The Siletz Bunkhouse is located on the west side of U.S. Highway 101 and south of Drift Creek. The house has three bedrooms and two bathrooms. It has been retrofitted to serve as a bunkhouse, thus it accommodates multiple occupants. The house is in relatively good condition following major repairs and maintenance over the past decade and is occupied year-round by at least one person, usually a refuge volunteer or intern.

5.3 Wildlife-dependent Public Uses

The National Wildlife Refuge System Improvement Act of 1997 defined six wildlife-dependent recreational uses (hunting, fishing, wildlife observation and photography, environmental education, and interpretation) as “appropriate uses” by definition, and required that these uses receive priority consideration in refuge planning when allowing the use would be compatible with the refuge’s mission.

Siletz Bay NWR has been closed to public use since it was established. However, the navigable waters that flow through the Refuge including Millport Slough, the Siletz River, and Drift Creek are used by the general public.

5.3.1 Hunting

There is currently no hunting program on this Refuge. Since the Refuge was established in 1991 hunting has occurred on the state-owned tidelands of Siletz Bay west of U.S. Highway 101. Refuge land west of U.S. Highway 101 consists of 98 acres of tidal wetlands where the Siletz River empties into the bay near Siletz Keys and approximately 4 acres of uplands surrounding the bunkhouse at the mouth of Drift Creek. The seaward boundary of refuge tidal marsh near Siletz Keys is posted. The tidelands are managed by the Oregon Department of State Lands and are legally open to waterfowl hunting so long as the hunter remains 200 yards or more from the shoreline/road.

5.3.2 Fishing and Clamming

There is currently no fishing program on the Refuge. Fishing occurs on state tidelands and waterways adjacent to refuge lands but is done primarily from boats in the deeper channels of the bay except at the mouth of the bay. The primary clamming area in Siletz Bay, near the Refuge, stretches from the mouth of Drift Creek south across the mudflats in Snag Alley. Clamming is conducted on state-owned tidelands, and clammers occasionally trespass through closed areas of the Refuge to reach this area.

5.3.3 Interpretation, Wildlife Observation, and Photography

Siletz Bay NWR is represented in a Refuge Complex general brochure that is stocked at the headquarters office and other sites along the Oregon coast. The Refuge Complex also maintains a website (www.fws.gov/oregoncoast) where current information regarding the Refuge can be obtained at any time. The Refuge further involves the public through social media and maintains a Facebook account and a Flickr site.

Since 2005, the Refuge has offered seasonal, guided wildlife interpretive trips via canoe/kayak through the non-refuge-owned, navigable waters that flow through Siletz Bay NWR. Refuge staff, interns, and volunteers organize 10-12 trips from late June through late September. On each trip, the guide shares the story of Siletz Bay NWR with visitors and identifies common plants, trees, and wildlife. Visitors register for the trips on a first come first served basis. Visitors provide their own boat and personal flotation device (PFD). The Refuge provides binoculars on loan and extra PFDs in case they are needed. The tour begins at the Siletz Moorage, a privately-owned site located near the intersection of U.S. Highway 101 and the Kernville Highway. This water loop trail takes approximately two hours to complete.

5.3.4 Environmental Education

The Refuge offers environmental education (EE) programs both on and off-site to help promote an understanding of fish and wildlife, their habitats, and the Refuge Complex. Current refuge EE programs have been correlated with the State of Oregon benchmark standards. The largest and most requested EE program is the Shorebird Sister Schools Program (SSSP). Since 2002, the Refuge Complex has expanded and delivered the program to students in grades 4-6. The SSSP has grown to be one the largest of its kind in the National Wildlife Refuge System. Annual enrollment is approximately 700 students participating from schools in three school districts that span half of the Oregon coast.

With the assistance of interns and community volunteers, the program offers interactive lessons that are both fun and educational from January to June to students in the Lincoln County school district. Using activities and lessons from the USFWS endorsed SSSP curriculum, individual lessons stress the importance of quality habitat for shorebirds and other wildlife, and the role the USFWS plays in protecting their habitat. The field component of the program brings students to the Yaquina Bay Estuary where they spend two hours rotating through three field experience stations. It is during this trip when all of the hands-on lessons from the classroom become real as the students are able to use binoculars and field guides to identify birds they have been learning about as they walk the perimeter of the estuary. In another field activity, students are immersed in the diet of shorebirds as they dig on the edge of the estuary for invertebrates in the mud and view prey items in magnified boxes. Finally, they participate in helping the estuary during a cleanup within the high tide line.

More recently the Oregon Coast Community College along with some secondary schools, including Toledo High School, has requested the Refuge provide an educational experience via canoe/kayak. The purpose of these trips is to expose a new audience to the Refuge and to teach them about the importance of estuaries and estuarine restoration to fish and wildlife. They operate in a manner similar to the guided summer tours in that the same route is followed; however, content is focused on the purpose of Siletz Bay NWR, the tidal marsh restoration along Millport Slough, management challenges faced by the Refuge, and wildlife use of the Refuge.

5.4 Other Refuge Uses

5.4.1 Non-recreational Public Uses (easements and right of ways)

A parcel referred to as the Erickson/Schaffer Easement is located along the Kernville Highway. This 57-acre tract of land is included within the Refuge by conservation easement in perpetuity. Since it remains in private ownership, public access to this refuge parcel is not up for consideration; thus, this area is closed to the public. Other right-of-ways and easements on record relate to utilities (phone/electric/water) crossing the Refuge to serve refuge, private, and public facilities.

5.4.2 Illegal/Unauthorized Uses

Currently, the Refuge Complex has one full-time Law Enforcement (LE) Officer. The number of LE hours spent patrolling Siletz Bay is highest during waterfowl season. LE assistance is also provided to the Refuge Complex by the Zone LE officer (who is responsible for western Oregon and Washington). Law enforcement assistance for Siletz Bay is also provided by Oregon State Police and an officer with the Bureau of Land Management. Prior to 2011, the tidal marshes west of Highway

101 had not been surveyed and thus were not boundary posted and the most common violation was trespass by waterfowl hunters. The Refuge also responds to several other law enforcement issues including illegal hunting and fishing, and littering.

5.5 Surrounding Area Outdoor Recreational Opportunities and Trends

5.5.1 Nearby Recreational Opportunities

Lincoln City is the urban area that is nearest to the Refuge. Its population was estimated at 8,066 individuals in 2008. Local, state, and Federal governments have all developed recreational opportunities for both residents and visitors. The Lincoln City Department of Parks and Open Space collectively manages 11 parks with amenities that include picnic tables, boat ramps, walking trails, interpretive signs, beach access, and crabbing docks. They also manage nine open space properties that provide habitat for wildlife and a place for people to walk and enjoy nature. Oregon Parks and Recreation Department (OPRD) manages six state parks within a 15-mile radius of Siletz Bay NWR. The U.S. Forest Service manages the Siuslaw National Forest, which has a popular hiking trail that is a short drive from the Siletz Bay NWR. Other nearby popular recreation locations along the Oregon central coast includes Yaquina Head Outstanding Natural Area, Nestucca Bay National Wildlife Refuge, and Cascade Head Nature Preserve.

There are waterfowl hunting, fishing, and crabbing opportunities in Siletz Bay on state-owned tidelands west of Highway 101 (ODFW 2011b).

5.5.2 Outdoor Recreation Trends

OPRD is responsible for providing guidance, information and recommendations to federal, state, and local units of government, as well as the private sector, in making policy and planning decisions regarding outdoor recreation in Oregon. They do this in the Statewide Comprehensive Outdoor Recreation Plan or SCORP (OPRD 2008). The latest SCORP is a five-year plan covering outdoor recreation in Oregon from 2008 through 2012.

The OPRD began the SCORP planning process in September 2005. The agency took a more proactive approach in addressing a limited number of previously identified and defined issues. Key findings from the 2003-2007 SCORP and the 2005-2014 statewide trails planning efforts identified a number of important demographic and social changes facing outdoor recreation providers in the coming years including: (1) a rapidly aging Oregon population, (2) fewer Oregon youth learning outdoor skills, and (3) an increasingly diverse Oregon population. Key findings for each of these issues are:

Aging Oregon Population

- On average across all activities, respondents expect to spend 28% more days recreating 10 years from now than they currently do.
- The most popular outdoor recreation activities for Oregonians between the ages of 42 and 80 included walking, picnicking, sightseeing, visiting historic sites, and ocean beach activities. A comparison across age categories for top five activities by participation intensity leads to the following conclusions: Walking is the top activity across all age categories (40-79);

jogging is a top activity between the ages of 40-59, but is also popular for those in their 70s; bicycling is a top activity between the ages of 40-64; sightseeing is a top activity between the ages of 45-74; bird watching is a top activity between the ages of 55-79; and RV/trailer camping is a top activity between the ages of 55-74.
- The top five activities in terms of future participation intensity 10 years from now included walking, bicycling, jogging, bird watching, and day hiking.
- Over one-third of Oregon Boomers and Pre-Boomers volunteered in their community, with an average time commitment of 5.3 hours per week. Of those who volunteered, 43% expect future changes in their volunteer activities, with most of the changes involving greater volunteerism: more time, more projects at current volunteer opportunities, and new volunteer opportunities.

Youth Learning Outdoor Skills

- The most popular outdoor activities for parents were walking, viewing natural features, and relaxing/hanging out. For children, the most popular were walking, followed by outdoor sports/games, relaxing/hanging out, and general play at neighborhood parks/playgrounds.
- The more a parent engages in an outdoor recreation activity, the more their child does. Participation varies across child age, with both the number of activities and the number of activity-days peaking amongst 12-14 year olds and decreasing for 15-17 year olds.
- Rural children spend more days, on average, in outdoor activities relative to urban and suburban children.
- Outdoor sports programs and day camps were the most popular types of outdoor recreation programs with respect to past participation. Many parents indicated that it would be very likely for their children to participate in outdoor sports programs (62%), multi-day camps (49%), outdoor adventure trips (45%), and day camps (45%) in the future.

An Increasingly Diverse Oregon population

- Walking for pleasure was the most common favorite activity for both Hispanics and Asians, with fishing and soccer being the next most common for Hispanics and hiking and fishing the next most common for Asians.
- Both Hispanic and Asian respondents most commonly did their favorite activity with members of their immediate family. Asians were more likely than Hispanics to do activities alone, as were older respondents relative to younger respondents.
- The most common location for Hispanic and Asian respondents to do their favorite activity was in a park or other area outside one's town or city. Males were more likely than females to engage in their favorite activity further from home.
- Walking for pleasure was also the activity respondents spent the most days engaged in during the past year. Hispanics engage more intensely than Asians in jogging/running, day hiking, picnicking, fishing, viewing natural features, visiting nature centers, and visiting historic sites.
- The most common activities respondents would like to do more often, or start doing were walking for Asians and walking and camping for Hispanics. The factor that would most help make this happen is availability of partners, followed by more time.
- For the Hispanic population, being in the outdoors, relaxing and having fun were the most important motivators or reasons for participating in outdoor activities. For the Asian population, relaxing, fitness, and having fun were the top motivators.

A summary of management recommendations, that are relevant to the types of outdoor recreation that the Service is engaged in, resulting from the SCORP is as follows:

- Develop a statewide youth outdoor programming framework and funding source to focus youth programming efforts across Oregon to address a specific set of key measurable objectives.
- Create a new Outdoor Recreation Section within OPRD addressing the areas of outdoor recreation and environmental education.
- Develop a strategy to strengthen the role of park and recreation agencies in the state's Safe Routes to Schools grant program.
- Plan and develop regional trail systems in areas having highest relocation intensity in the 40 to 79 age range (Coastal, Southern and Central Oregon communities).
- Provide design assistance for innovative park designs connecting kids with nature.
- Encourage organizational cultural change within public recreation agencies/organizations to effectively address the diversity issue.
- Develop recommendations for addressing language barriers to encourage underrepresented population use of outdoor recreation facilities and programs
- Create a customer service training module related to serving the outdoor recreation needs of an increasingly diverse population.

5.6 Socioeconomics

5.6.1 Population and Area Economy

Oregon’s population of approximately 3,825,700 ranks 27th in the nation. State land area covers 95,997 square miles compared to 3,537,438 square miles in the United States with a population density of 40 persons per square mile compared to 87 nationwide.

Siletz Bay National Wildlife Refuge is located along the northern Oregon Coast. The Refuge is situated just south of Lincoln City, a town with a population of 8,066.

Table 5-3 shows the local population and area economy. The county population increased slightly (3 percent) from 1999 to 2009, compared with an 11 percent increase for the state of Oregon and a 10 percent increase for the U.S. as a whole. County employment increased by 7 percent from 1999 to 2009, slightly behind Oregon and the United States. Per capita income in Lincoln County increased by 9 percent over the 1999-2009 period, while the State of Oregon and the U.S. increased by 4 and 9 percent respectively.

Table 5-3. Siletz Bay NWR: Summary of Area Economy, 2009 (population and employment in thousands; per capita income in 2010 dollars)

	Population		Employment		Per Capita Income	
	2009	Percent Change 1999-2009	2009		2009	Percent Change 1999-2009
Lincoln County, OR	46.3	3%	26.2	7%	$34,365	9%
Oregon	3,825.7	11%	2,202.7	8%	$36,785	4%
United States	307,006.6	10%	173,809.2	8%	$40,285	9%

Source: U.S. Department of Commerce 2011.

The largest industry sectors for Lincoln County are ranked below by employment (Table 5-4). As shown in the Table, tourism is an important sector for the County. The largest source of employment is retail stores (3,820 jobs). Food services and hotels are also important contributors to the economy (3,846 jobs).

Table 5-4. Industry Summary for Lincoln County (dollars in thousands)

Industry	Employment	Output	Employment Income
Retail Stores	3,820	$204,946	$65,619
State and Local Government	3,565	$192,560	$170,011
Food Services	2,689	$150,924	$48,824
Construction	1,543	$193,698	$37,059
Commercial Fishing	1,454	$70,316	$22,702
Hotels and Motels	1,157	$83,822	$25,993
Private Hospitals	775	$95,948	$51,442
Real Estate	735	$92,885	$7,151
Retail Nonstores (electronic sales)	676	$10,145	$427
Employment Services	537	$13,505	$7,236

Source: Minnesota IMPLAN Group, Inc. 2008.

5.6.2 Economic Benefits of Refuge Visitation to Local Communities

From an economic perspective, Siletz Bay National Wildlife Refuge provides a variety of environmental and natural resource goods and services used by people either directly or indirectly. The use of these goods and services may result in economic impacts to both local and state economies. The various services the Refuge provides can be grouped into five broad categories: (1) maintenance and conservation of environmental resources, services and ecological processes; (2) production and protection of natural resources such as fish and wildlife; (3) protection of cultural and historical sites and objects; (4) provision of educational and research opportunities; and (5) outdoor and wildlife-related recreation. People who use these services benefit in the sense that their individual welfare or satisfaction level increases with the use of a particular good or service. One measure of the magnitude of the change in welfare or satisfaction associated with using a particular good or service is economic value. Aside from the effect on the individual, use of the good or service usually entails spending money in some fashion. These expenditures, in turn, create a variety of economic effects collectively known as economic impacts.

A comprehensive economic profile (baseline) of the Refuge would address all applicable economic effects associated with the use of Refuge-produced goods and services. However, for those goods and services having nebulous or non-existent links to the market place, economic effects are more difficult or perhaps even impossible to estimate. Some of the major contributions of the Refuge to the natural environment, such as watershed protection, maintenance and stabilization of ecological processes, and the enhancement of biodiversity would require extensive on-site knowledge of biological, ecological, and physical processes and interrelationships even to begin to formulate economic benefit estimates. This is beyond the scope of this section. Consequently, this section focuses on economic effects, which can be estimated using currently available information. As a result, benefits represent conservative estimates of total social impacts.

The following section focuses on a limited subset of refuge goods and services, primarily refuge budget expenditures that can be directly linked to the marketplace. It should be kept in mind that the emphasis on these particular market-oriented goods and services should not be interpreted to imply that these types of goods and services are somehow more important or of greater value (economic or otherwise) than the non-market goods and services previously discussed.

Recreational Activities

Siletz Bay NWR has been closed to public use since it was established. However, the navigable waters that flow through the Refuge including Millport Slough, the Siletz River, and Drift Creek are used by the general public. The Refuge offers seasonal opportunities to observe wildlife via guided canoe/kayak excursion through these waters. Therefore, actual refuge visitation is extremely low. In 2010, 220 visitors enjoyed boating and 287 people participated in environmental education and interpretation opportunities. Due to the minimal visitation, economic impacts associated with recreational visitation are negligible.

Regional Economic Impacts of the Refuge Budget

Input-output models (Minnesota IMPLAN Group, Inc. 2004, Miller and Blair 1985) were used to determine the economic impact of budget expenditures on the Refuge's local and regional economy. In 2010, the refuge budget totaled about $26,200. Approximately $15,800 (60 percent) is allocated to salaries while the remaining $10,400 is allocated to goods and services supporting the Refuge. Table 5-5 summarizes the Refuge's expenditures in fiscal year 2010.

Table 5-5. Siletz Bay National Wildlife Refuge Annual Expenditures, 2010 (2010 dollars in thousands)

Expenditure:	Annual Expenditures
Salary – Permanent Employees	$15.8
Non-salary	$10.4
Total	**$26.2**

Table 5-6 shows the jobs, job income, and tax revenues generated by refuge expenditures. The Refuge's annual budget generates less than 1 job and $18,600 in job income. Overall, refuge expenditures result in about $46,100 in final demand.

Table 5-6. Local Annual Economic Effects Associated with 2010 Refuge Budget (2010 dollars in thousands)

	Salary	Non-salary	Total
Final Demand	$29.1	$16.9	$46.1
Jobs	$0.2	0.1	0.3
Job Income	$8.8	$9.8	$18.6
Total Tax Revenue	$3.9	$2.8	$6.6

5.6.3 Refuge Revenue Sharing

National wildlife refuges, like other Federal, State, and County-owned lands are not subject to property taxes. However, under provisions of the Refuge Revenue Sharing Act, the Service annually reimburses counties for revenue lost as a result of acquisition of fee title. Payments to the county are based on the highest value as determined by one of the following three equations: three-fourths of 1 percent of the fair market value of the land; 25 percent of net receipts; or $.75 per acre, whichever is greater. Refuge lands are re-appraised every 5 years to ensure that payments are based on current land values. The revenue sharing fund consists of net income from the sale of products or privileges such as timber sales, grazing fees, permit fees, mineral royalties, etc. If this fund has insufficient funds to cover payments to local counties, Congress is authorized to appropriate money to make up the deficit. Should Congress fail to appropriate such funds, payments to counties will be reduced accordingly.

Table 5-7 summarizes Refuge Revenue Sharing payments made to Lincoln County from 2006 to 2010.

Table 5-7. Refuge Revenue Sharing Payments to Lincoln County for Siletz Bay National Wildlife Refuge

Year	Fee Acres	Total Payment
2006	462	$5,396
2007	462	$5,218
2008	512	$3,588
2009	512	$3,371
2010	512	$2,375

5.7 Special Designation Areas

Siletz Bay has been designated as an Important Bird Area (IBA) by the National Audubon Society. Oregon's IBA program recognizes sites of outstanding importance to birds in the state (Audubon Society of Portland 2011). Sites with IBA designation are extremely important to Oregon's birds, though the IBA program by itself does not ensure the continued productivity of selected sites and certainly cannot guarantee continued avian diversity throughout the state. Most species of birds within IBAs are at least partially migratory, and most of the waterfowl, shorebirds, and seabirds of Oregon's IBAs are highly migratory or at least make extensive flights between the recognized IBAs and other areas. In Oregon, this non-regulatory global program is coordinated by The Audubon Society of Portland (2011) with a mission to identify places in Oregon that are important for birds and to promote the restoration and conservation of important bird values at these sites through partnerships, education, observation and hands-on efforts.

Appendices A-J

Roy W. Lowe/USFWS

Appendix A. Appropriate Use Findings

A.1 Introduction

The Appropriate Refuge Uses Policy (603 FW 1 (2006)) outlines the process that the Service uses to determine when general public uses on refuges may be considered. Priority public uses previously defined as wildlife-dependent uses (hunting, fishing, wildlife observation and photography and environmental education and interpretation) under the National Wildlife Refuge System Improvement Act of 1997 are generally exempt from appropriate use review. Other exempt uses include situations where the Service does not have adequate jurisdiction to control the activity and refuge management activities. In essence, the appropriate use policy provides refuge managers with a consistent procedure to first screen and then document decisions concerning a non-priority public use. When a use is determined to be appropriate, a refuge manager must then decide if the use is compatible before allowing it on a refuge. For purposes of this CCP 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.

The policy also requires review of existing non-priority public uses. During the CCP process, the refuge manager evaluated all existing and proposed non-priority refuge uses at Siletz Bay National Wildlife Refuge (NWR or Refuge) using the following guidelines and criteria as outlined in the appropriate use policy:

- Do we have jurisdiction over the use?
- Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?
- Is the use consistent with applicable Executive orders and Department and Service policies?
- Is the use consistent with public safety?
- Is the use consistent with goals and objectives in an approved management plan or other document?
- Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?
- Is the use manageable within available budget and staff?
- Will this be manageable in the future within existing resources?
- 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?
- Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality, compatible, wildlife-dependent recreation into the future?

Using this process and these criteria, and as documented on the following pages, the refuge manager determined the following refuge use is appropriate, and directed that a compatibility determination be completed for the use: Research.

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Finding of Appropriateness of a Refuge Use

Refuge Name: Siletz Bay National Wildlife Refuge

Use: Research, Scientific Collecting, and Survey Activities

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

Decision criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	X	
(b) Does the use comply with applicable laws and regulations (federal, state, tribal, and local)?	X	
(c) Is the use consistent with applicable executive orders and Department and Service policies?	X	
(d) Is the use consistent with public safety?	X	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	X	
(f) Has an earlier documented analysis not denied the use, or is this the first time the use has been proposed?	X	
(g) Is the use manageable within available budget and staff?	X	
(h) Will this be manageable in the future within existing resources?	X	
(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?	X	
(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?	X	

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 _X_

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__X___

Refuge Manager: Rebecca J. Chuck Acting Date: 12/18/12

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: 12/18/12

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

FWS Form 3-2319
02/06

Finding of Appropriateness of a Refuge Use

Supplement to FWS Form 3-2319

Research, Scientific Collecting, and Surveys

Further Explanation of Answers Provided for the Decision Criteria:

Project: Conducting research on refuge lands and waters

Summary: The Refuge receives requests to conduct scientific research on refuge lands and waters. Research applicants must submit a proposal that outlines: (1) objectives of the study; (2) justification for the study; (3) detailed methodology and schedule; (4) potential impacts on refuge wildlife and/or habitat, including disturbance (short and long term), injury, or mortality; (5) personnel required; (6) costs to Refuge, if any; and (7) end products expected (i.e., reports, publications). Research proposals will be reviewed by refuge staff, the Regional Office Branch of Refuge Biology, and others as appropriate prior to the Refuge issuing a special use permit (SUP). Projects will not be open-ended, and at a minimum, will be reviewed annually.

For each of the findings listed on FWS Form 3-2319, a justification has been provided below:

(a) Do we have jurisdiction over the use?

Some or all of the proposed activities will take place within refuge boundaries. The Refuge has jurisdiction over those research projects that are sited within refuge boundaries.

(b) Does the use comply with applicable laws and regulations (federal, state, tribal, and local)?

Any proposed research activities will comply with all applicable laws and regulations and any restrictions or qualifications that are required to comply with laws and regulations will be specified in the SUP.

(c) Is the use consistent with applicable executive orders and Department and Service policies?

Through the review of individual projects, the Refuge will ensure that they are consistent with applicable policies, especially the Research on Service Lands Policy (803 FW 1).

(d) Is the use consistent with public safety?

Through individual project review, the Refuge will ensure that each project is consistent with public safety. If necessary, stipulations to ensure public safety will be included in the project's SUP.

(e) Is the use consistent with goals and objectives in an approved management plan or other document?

The Refuge Administration Act directs the Service to “ensure that the biological integrity, diversity, and environmental health of the National Wildlife Refuge System are maintained for the benefit of present and future generations of Americans…” The Service’s Biological Integrity, Diversity, and Environmental Health Policy (601 FW 3) provides for the consideration and protection of a broad spectrum of native fish, wildlife, and habitat resources found on refuges and associated ecosystems.

When evaluating the appropriate management direction for refuges (e.g., in compatibility determinations), refuge managers are to use sound professional judgment to determine their refuge's contribution to biological integrity, diversity, and environmental health at multiple landscape scales. Sound professional judgment incorporates field experience, knowledge of refuge resources, an understanding of the refuge's role within an ecosystem, applicable laws, and best available science, including consultation with others both inside and outside the Service. Therefore, research is consistent with Service policy.

(f) Is the use manageable within available budget and staff?

The Refuge receives few requests per year for this activity, and it is manageable with available budget and staff.

(g) Will this be manageable in the future within existing resources?

The use at current levels will be manageable in the future with the existing resources.

(h) 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?

The use is beneficial to the Refuge's natural and cultural resources because the types of research projects approved are those that have the distinct likelihood of helping achieve refuge purposes by providing information useful for the management of trust resources and contributing to the public's understanding and appreciation of natural and/or cultural resources.

(i) 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 Service believes that wildlife and habitat conservation and management on the Refuge should be based upon statistically viable scientific research combined with long-term monitoring. The information gained through appropriate, compatible research on refuge lands will be beneficial to the Refuge's natural resources through application of this information into adaptive management strategies. The Refuge Complex will also distribute any information gained to the public, which will allow them to better understand and appreciate the refuge resources and the need for protecting them.

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Appendix B. Compatibility Determinations

B.1 Introduction

The compatibility determinations (CDs) developed during the comprehensive conservation plan (CCP) planning process evaluate uses projected to occur under Alternative C, the preferred alternative, in the draft CCP/environmental assessment (EA) for the Siletz Bay National Wildlife Refuge (NWR or Refuge) (USFWS 2012a), which has carried forward as the management direction for the Refuge in this CCP. The evaluation of funds needed for management and implementation of each use is described in Appendix C, Implementation. Chapter 6 of the draft CCP/EA also contained an analysis of the impacts of refuge uses to wildlife and habitats. That document is incorporated through reference into this set of CDs.

B.1.1 Uses Evaluated At This Time

The following section includes full CDs for all refuge uses that are required to be evaluated at this time. According to Service policy, compatibility determinations will be completed for all uses proposed under a CCP that have been determined to be appropriate. Existing wildlife-dependent recreational uses must also be reevaluated and new CDs prepared during development of a CCP. According to the Service's compatibility policy, uses other than wildlife-dependent recreational uses are not explicitly required to be reevaluated in concert with preparation of a CCP, unless conditions of the use have changed or unless significant new information relative to the use and its effects have become available or the existing CDs are more than 10 years old. However, the Service planning policy recommends preparing CDs for all individual uses, specific use programs, or groups of related uses associated with the proposed action. Accordingly, the following CDs are included in this document for public review.

Table B-1. Summary of Compatibility Determinations

Refuge Use	Compatible	Page
Wildlife Observation, Photography, and Interpretation	Yes	B-5
Waterfowl Hunting	Yes	B-19
Fishing and Clamming	Yes	B-31
Research, Scientific Collecting, and Surveys	Yes	B-45

B.1.2 Compatibility–Legal and Historical Context

Compatibility is a tool refuge managers use to ensure that recreational and other uses do not interfere with wildlife conservation, the primary focus of national wildlife refuges. Compatibility is not new to the Refuge System and dates back to 1918, as a concept. As policy, it has been used since 1962. The Refuge Recreation Act of 1962 directed the Secretary of the Interior to allow only those public uses of refuge lands that were "compatible with the primary purposes for which the area was established."

Legally, national wildlife refuges are closed to all public uses until officially opened through a compatibility determination. Regulations require that adequate funds be available for administration and protection of refuges before opening them to any public uses. However, wildlife-dependent recreational uses (hunting, fishing, wildlife observation and photography, environmental education, and interpretation) are to receive enhanced consideration and cannot be rejected simply for lack of funding resources unless the refuge has made a concerted effort to seek out funds from all potential partners. Once found compatible, wildlife-dependent recreational uses are deemed the priority public uses at the refuge. If a proposed use is found not compatible, the refuge manager is legally precluded from approving it. Economic uses that are conducted by or authorized by the refuge also require compatibility determinations.

Under compatibility policy, uses are defined as recreational, economic/commercial, or management use of a refuge by the public or a non-Refuge System entity. Uses generally providing an economic return (even if conducted for the purposes of habitat management) are also subject to compatibility determinations. The Service does not prepare compatibility determinations for uses when the Service does not have jurisdiction. For example, the Service may have limited jurisdiction over refuge areas where property rights are vested by others; where legally binding agreements exist; or where there are treaty rights held by tribes. In addition, aircraft overflights, emergency actions, some activities on navigable waters, and activities by other Federal agencies on "overlay refuges" are exempt from the compatibility review process.

New compatibility regulations, required by the National Wildlife Refuge System Improvement Act of 1997 (Improvement Act), were adopted by the Service in October 2000 (http://refuges.fws.gov/policymakers/nwrpolicies.html) (USFWS 2000). The regulations require that a use must be compatible with both the mission of the System and the purposes of the individual refuge. This standard helps to ensure consistency in application across the Refuge System. The Act also requires that compatibility determinations be in writing and that the public have an opportunity to comment on most use evaluations.

The Refuge System mission emphasizes that the needs of fish, wildlife, and plants must be of primary consideration. The Improvement Act defined a compatible use as one that "… in the sound professional judgment of the Director, will not materially interfere with or detract from the fulfillment of the mission of the System or the purposes of the Refuge." Sound professional judgment is defined under the Improvement Act as "… a finding, determination, or decision, that is consistent with principles of sound fish and wildlife management and administration, available science and resources …." Compatibility for priority wildlife-dependent uses may depend on the level or extent of a use.

Court interpretations of the compatibility standard have found that compatibility is a biological standard and cannot be used to balance or weigh economic, political, or recreational interests against the primary purpose of the refuge (Defenders of Wildlife v. Andrus [Ruby Lake Refuge]).

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 (House of Representatives Report 105-106). Evaluations of the existing uses on the Siletz Bay National Wildlife Refuge are based on the professional judgment of refuge and planning personnel including observations of refuge uses and reviews of appropriate scientific literature.

In July 2006, the Service published its Appropriate Refuge Uses Policy (603 FW 1). Under this policy, most proposed uses must also undergo a review prior to compatibility. Uses excepted from the policy include priority wildlife-dependent recreational uses, and uses under reserved rights – see policy for more detail. Appropriate use findings for Siletz Bay NWR are included in Appendix A.

B.1.3 References

Defenders of Wildlife v. Andrus (Ruby Lake Refuge I). Case 2098 (D.D.C. 1978). Environmental Reporter 11:873.

House of Representatives. 1997. Report 105-106 on NWRSIA. Available at: http://refuges.fws.gov/policyMakers/mandates/HR1420/part1.html.

USFWS. 2000. Compatibility regulations. Available at: http://Refuges.fws.gov/policymakers/nwrpolicies.html.

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B.2 Compatibility Determination

Use: Wildlife Observation, Photography, and Interpretation

Refuge Name: Siletz Bay National Wildlife Refuge

County and State: Lincoln County, Oregon

Establishing and Acquisition Authorities:

Siletz Bay NWR was established in 1991 under the authority of the Fish and Wildlife Act of 1956 [U.S.C. 742f(a)(4) and 16 U.S.C. 742f(b)(1)]. Additional establishment authorities include the Emergency Wetlands Resources Act of 1986 [16 U.S.C. 39 100 Stat 3583] and the Endangered Species Act of 1973, as amended [16 U.S.C. 1534-1544].

Refuge Purpose(s):

- "for the development, advancement, management, conservation, and protection of fish and wildlife resources" [U.S.C. 742f(a)(4)]…"for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude" [16 U.S.C. 742f (b)(1) (Fish and Wildlife Act of 1956)].
- for "the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to fulfill international obligations contained in various migratory bird treaties and conventions"; [16 U.S.C. 39 100 Stat 3583] (Emergency Wetlands Resources Act of 1986)
- "to conserve (a) fish or wildlife which are listed as endangered species or threatened species…or (b) plants" [16 U.S.C. 1534 (Endangered Species Act of 1973)]

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:

Wildlife observation, photography, and interpretation are defined as priority public uses under the Refuge Improvement Act of 1997 and can enhance visitors' appreciation of the Refuge, the National Wildlife Refuge System, wildlife, their habitats, and the human environment. Under the management direction described in the CCP for Siletz Bay National Wildlife Refuge, the U.S. Fish and Wildlife Service (Service) will allow the following uses to occur: wildlife observation, photography, and interpretation. The Refuge will provide opportunities for these activities on or from Alder Island and on refuge lands west of Highway 101. To facilitate these wildlife-dependent uses on Alder Island, the Service will provide infrastructure including development of a non-motorized boat launch, a parking lot, and a loop trail that is accessible for people of all abilities. A privately owned boat launch is located less than ¼ mile from Alder Island; as such the Service decided not to consider adding facilities for motorized boats. The loop trail (estimated length 0.5 mile) will traverse along the existing dike that surrounds Alder Island. It will provide visitors with a designated route of travel, which will provide protection for sensitive resources through proper routing and construction techniques. The parking lot will be located along the former Highway 101 spur road and will be designed to provide safe access to Alder Island from Highway 101. This location has been selected to be enhanced for wildlife observation, photography, and interpretation based on a variety of factors including the ability for the Refuge to provide safe access from Highway 101 and the topography of the island, which lends itself to designs that minimize wildlife disturbance. The island contains habitat that is used by many bird and mammal species and will provide reliable wildlife observation and photography opportunities for visitors.

The trail will be open to these wildlife-dependent recreational activities year-round during daylight hours only. Camping, overnight use, and fires will be prohibited. Pets and dogs will only be allowed outside of vehicles in parking areas (not on trails) and must be kept on-leash at all times. Wildlife observation, photography, and interpretation will largely be self-guided and will be restricted to the Alder Island Nature Trail and the parking lot. At times, users engaged in these activities will be accompanied by refuge staff and/or trained volunteers (i.e., tours conducted during special events). Interpretive materials will be available to visitors through interpretive panels and an informational kiosk on site, refuge brochures, and through the internet via a refuge website and/or social media site. These interpretive materials will help educate the public on minimizing wildlife and habitat disturbance.

Currently, a private moorage is used to launch both motorized and non-motorized boats to access the Siletz River, the open bay, or Millport Slough for the purpose of fishing, wildlife observation, and boating for pleasure. To provide visitors with a different perspective and/or Refuge-related recreation, the Service will develop a non-motorized boat launch along the old Highway 101 spur road on the east side of U.S. Highway 101. Because much of Siletz Bay NWR is tidally influenced, one of the best ways for visitors to experience refuge resources is via the navigable waters that flow through or adjacent to the Refuge, including Millport Slough, the Siletz River, and No Name Slough. Although these waters are not Refuge-owned and can be accessed by anyone at any time, the Refuge has offered seasonal guided interpretive trips on these waterways via canoe/kayak since 2005. Building a non-motorized boat launch and providing information on paddle routes will allow visitors who do not own a motorized boat access to these waters and provide them with a greater appreciation of wildlife using the area. The boat launch will be open during daylight hours on a year-round basis. Use is expected to be heaviest from May through September when the weather is more conducive to non-motorized boat use (e.g., calmer winds, warmer temperatures, less water chop).

The Service will also open refuge lands west of Highway 101 to self-guided, unstructured wildlife observation and photography year-round. These lands consist of 97 acres of salt marsh where the Siletz River empties into the bay near the development of Siletz Keys and near the mouth of Drift Creek. The Service will not provide infrastructure on these lands to enhance these public uses, and visitors using the area will be advised to use caution since parking facilities on the west side of Highway 101 will not be provided.

Availability of Resources:

Under the CCP's management direction, Alder Island will be open for wildlife observation, photography, and interpretation. The Service has one full-time employee dedicated to the Visitor Service program. Additional refuge staff assists in trail and parking area maintenance, facility and road maintenance, sign posting, construction projects, public outreach, and developing and implementing refuge management programs.

Costs to Administer and Manage Public Use Programs on Alder Island under the CCP's Management Direction

Activity or Project	One-time Expense	Recurring Expense
Build an accessible loop trail	$154,300	
Develop a parking lot	$331,000	
Develop welcoming kiosk	$2,800	
Develop three interpretive panels	$7,000	
Brochures		$500
Develop non-motorized boat launch	$87,300	
Law enforcement patrols		$2,500
Recruit and train volunteers to help manage the program		$16,500 (Vol. coordin. Salary, volunteer expenses, intern cost)
Maintain refuge trails, parking lots, boat launch and water trail		$7,000

Anticipated Impacts of the Use(s):

The Service is committed to providing quality opportunities for wildlife-oriented recreation at Siletz Bay NWR. As part of the Service mission and refuge goals for Siletz Bay, five of the six Refuge System priority wildlife-dependent uses will be offered including hunting, fishing, wildlife observation and photography, and interpretation. Offering wildlife observation, photography, and interpretation will help fulfill refuge purposes and goals and by extension, does not conflict with the mission of the Refuge System.

General Impacts:
A general assessment of impacts resulting from wildlife observation, photography, and interpretation has been compiled from the literature and is briefly summarized below.

Effect of disturbance intensity: Some researchers have attempted to correlate disturbance events in wildlife to the intensity, proximity, or loudness of human disturbance. While studying shorebirds on an eastern coastal refuge, Burger (1986) 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 studied the effect of human proximity on wildlife. 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 at night as the number of people within 100 meters (328 feet) increased. Elk in Yellowstone National Park were disturbed when people were at average distances of 573 meters (1,880 feet) (Cassirer 1990). The 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 two days. Erwin (1989) studied colonial wading and seabirds in Virginia and North Carolina. Mixed colonies of common terns and black skimmers responded at the greatest distances, with respective means of 142 meters (466 feet) and 130 meters (427 feet); mixed wading bird species were more reluctant to flush (30-50 meters [98-164 feet] 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.

Miller et al. (2001) defined an “area of influence” as the area that parallels a trail or line of human movement within which wildlife will flush from a particular activity with a certain probability. In a study analyzing response distance from hiking and mountain biking in sagebrush-grassland habitat in Utah, Taylor and Knight (2003) found that at 100 meters (328 feet) from the line of movement of an off-trail trial, mule deer showed a 96 percent probability of flushing. That probability did not drop to 70 percent until the perpendicular distance increased to 390 meters (1,280 feet).

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 meters (1,562 feet) at the approach of a pedestrian. A multiple regression model including number of previous disturbances, date, and time of day, explained 82 percent of the variability in flush distance and predicted a maximum flush distance at the first disturbance of 503 meters (1,650 feet). Skagen (1980), studying bald eagles in northwest Washington, found a statistically significant decrease in the proportion of eagles feeding when human activity was present within 200 meters (656 feet) 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 (328 feet) in general did not result in a behavioral response (DeLong 2002).

Effects from pedestrian access: Wildlife is frequently more sensitive to disturbance from people on foot than in vehicles (Skagen 1980, Grubb and King 1991, MacArthur et al. 1982). 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 1995). Taylor and Knight (2003), in a logistic regression analyzing mule deer, pronghorn antelope, and bison response to mountain biking and hiking on- and off-trail found that the variables best explaining wildlife response included wildlife species, perpendicular distance of animals to trail (closest distance of animal to trail, regardless of recreationist position), trail position (on-trail or off-trail), and degree of vegetation cover.

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 and found 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 meters (262 feet) 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 percent versus 91 percent) and spent more time running (33 percent versus 2 percent), fighting with other chicks (4 percent versus 0.1 percent), and standing alert (9 percent versus 0.1 percent) when pedestrians or moving vehicles were closer than 100 meters (328 feet) than when they were undisturbed. In addition, plover chicks spent less time out on the feeding flats (8 percent versus 97 percent) and more time up in the grass (66 percent versus 0.1 percent) 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 wildlife-dependent public uses, photographers were the most likely to attempt close contact with birds. He also concluded that even slow approach by photographers was disruptive to waterbirds. Wildlife photographers tend to have larger disturbance impacts than those viewing wildlife since they tend to approach animals more closely (Morton 1995, Dobb 1998).

Predictability of disturbance (habituation): 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, researchers found that nesting cranes seemed to habituate to certain forms of human disturbance and nested within 400 meters (1,312 feet) of highways, railroads, and mines; cranes also were tolerant of helicopter flyovers. Visits to nests and development-induced alterations of surface water drainage were implicated in 24 percent of the nest failures. Taylor and Knight (2003) found that for mule deer, the area of influence around off-trail trials was much greater than that for on-trail trials, suggesting habituation to trails. However, the time it takes for wildlife to habituate, and what wildlife use is like compared to pre-disturbance uses, remains a fertile question. A study by Fairbanks and Tullous (2002) measured the distance of pronghorn from recreational trails on Antelope Island State Park in Utah. The study gathered data the year before the trails were opened for public use, and compared these to data gathered in three consecutive years after recreational use began. Groups of pronghorn were observed significantly farther from trails in years with recreational use than in the year before recreational areas were opened.

Effects from boat proximity: Boating, both motorized and non-motorized, can alter the distribution, reduce use of particular habitats or entire areas by waterfowl and other birds, alter feeding behavior and nutritional status, and cause premature departure from areas (Knight and Cole 1995). More sensitive species may find it difficult to secure adequate food or loafing sites as their preferred habitat becomes fragmented and recreation related disturbance increase (Skagen et al. 1991, Pfister et al. 1992). However, disturbance to birds in general was reduced when boats traveled at or below a five miles per hour speed limit. Motorized boats can generally have more impact on wildlife than non-motorized boats because motorboats produce a combination of movement and noise (Tuite et al. 1983, Knight and Cole 1995). Motorized boats can also cover a larger area in a relatively short time, in comparison to non-motorized boats.

Motorized boats introduce noise and pollution, in the form of gas, oil, and particulates in the air, in estuarine and riverine habitats of the Refuge. Hydrocarbon pollution has been found to bio accumulate with the complex food web, posing a serious threat to the marine environment (Tjarnlund et al. 1993). Hydrocarbons can also be transferred to eggs from the plumage of incubation birds. Extremely small amounts of petroleum hydrocarbons can be toxic to eggs and birds that ingest these contaminants (Hoffman 1989).

Canoes and kayaks can cause significant disturbance effects based on their ability to penetrate into shallower marsh areas (Speight 1973, Knight and Cole 1995). In the Ozark National Scenic Riverway, green heron activity declined on survey routes when canoes and boat use increased on the main river channel (Kaiser and Fritzell 1984). Canoes or slow moving boats have also been observed to disturb nesting great blue herons (Vos et al. 1985). Huffman (1999) found that non-motorized boats within 30 meters of the shoreline in south San Diego Bay caused all wintering waterfowl to flush between the craft and shore. However, compared to motorboats, canoes and kayaks appear to have less disturbance effects on most wildlife species (Jahn and Hunt 1964, Huffman 1999, DeLong 2002).

The total number of boats and people can be an inappropriate measure of recreational intensity because the presence of a single boat might be just as disturbing as that of many (Tuite et al. 1983, Knight and Knight 1984). Even a low level of boating activity affects the duration and pattern of use by wildlife (Bratton 1990).

<u>Refuge-specific Impacts:</u>
People engaging in wildlife observation, photography, or interpretation will access the Refuge by motorized vehicles travelling public roads, and by using the parking lot to be developed by the Refuge. Parking lots and public roads have minimal direct impacts because they occupy a relatively small acreage. The parking lot will be designed to minimize potential runoff from vehicles. Visitors will also be able to access the Refuge via boat from the Siletz River and Drift Creek.

A nature trail will be developed on Alder Island to support wildlife observation, photography, and interpretation. The trail will be located on artificial dredge spoils within riparian habitats. In this habitat, trail construction may require the removal of some trees, snags, or logs and may result in a minor amount of soil compaction and other vegetation removal from trail use and maintenance. The effect of this vegetation removal is expected to have negligible impacts on wildlife or available habitat since the extent of removal is very limited due to the relatively short distance of the trail and the existing sparse understory. In addition, once construction is completed, maintenance will be consistent and will not allow for the development of brushy wildlife habitat that would have to be removed at a time of year that would negatively impact wildlife nesting or other habitat needs.

Bicycle access: A few people access the refuge areas along its boundaries (U.S. Highway 101) by bicycle. Although bicycles on county roads may create additional disturbance, state-managed highways are not under refuge jurisdiction; therefore, effects from activities occurring on these roads are not considered in this compatibility determination. The Service will not allow bicycles on the Alder Island Nature Trail due to the short distance of the trail and the multiple uses already to be allowed, and the resulting potential for user conflicts on this trail. The trail will be limited to pedestrian and disabled-access users engaged in wildlife observation, photography; interpretation and fishing.

Pedestrian access: Pedestrian access to the Refuge creates the highest potential for disturbance or damage to natural resources. Foot travel associated with wildlife observation or photography could potentially result in temporary and minor vegetation trampling. Foot travel may also potentially create disturbance in or near any habitat.

Year-round pedestrian access for wildlife observation and photography will be limited to the planned designated trail on Alder Island. The trail will provide visitors with a designated route of travel, which will provide protection for sensitive resources through proper routing and construction techniques. The remainder of the island will be closed to pedestrian access. This sanctuary area limits pedestrian disturbance during the migratory bird seasons (e.g., spring and fall) and during resident bird breeding season (e.g., spring and summer). As planned, the Alder Island trail will be open to foot travel and will traverse approximately 0.05 mile.

Under the CCP's management direction, people may access the Alder Island trail on foot. Since most wildlife observers and hikers remain on designated trails, direct effects from trampling and disturbance effects will likely be minor. In addition, since research indicates that wildlife habituate best to predictable disturbance, once the trail is established and use becomes regular, direct effects to wildlife should further diminish.

Providing and maintaining access points indirectly impacts wildlife by creating barriers to movement, through vegetation removal and human use of the access point, and abrupt edge creation which may lead to increased predation. Trail edge may concentrate prey species and may be used by predators as travel corridors. Other indirect impacts may include the deposition of litter and erosion caused by the damage to vegetation from trampling. To mitigate for these impacts, refuge staff will monitor the parking area and trail removing litter and replanting if necessary to maintain a clearly delineated access point.

Visitation tends to be concentrated around wetland sites because of superior wildlife viewing opportunities. Therefore, disturbance from non-consumptive recreational activities will increase under the CCP's management direction, but is expected to be minor. The cumulative effect of these disturbances may represent a minor negative impact to salt marsh and intertidal mudflat wildlife.

Boat access: Boat access to the Refuge creates a potential for disturbance to migratory and resident waterfowl and wading birds. Boat use associated with wildlife observation, photography, or interpretation could potentially create disturbance in or near any habitat adjacent to navigable waters. This may cause birds that use the waters of the bay and the forested edges of the island habitat to flush. The disturbance to wildlife is localized and of short duration. Nearby resting and feeding areas will be available for use by any displaced wildlife.

Although refuge lands are not currently open to the public, boats can travel through the Refuge and observe wildlife from the waters of the Siletz River, Millport Slough, and Drift Creek. This access to the Refuge is challenging for boaters during the fall, winter, and spring due to inclement weather; however it is easily accessible during the summer. Since boats are not traveling on refuge waters, the Service cannot directly regulate boating practices but it is possible to reduce impacts through education. To reduce disturbance of migratory and resident wildlife from boaters, the Refuge will install an informational panel at the non-motorized boat launch. Information included on the panel will discuss the potential effects of boating on wildlife, and how visitors can observe ethics and boating practices such as no-wake and slower speeds that will reduce or limit wildlife disturbance.

Most studies cited above have demonstrated immediate, rather than long-term responses to disturbance. Long-term responses are inherently more difficult and expensive to determine. In a review of several studies of the reaction of waterfowl and other wetland birds to people on foot, distances greater than 328 feet (100 meters) generally did not result in a behavioral response (DeLong 2002).

Both refuge visitation and the number of facilities and emphasis devoted to wildlife observation, photography, and interpretation will increase under the CCP's management direction. Although disturbance to wildlife from these activities will be higher than at present, the Service expects that the impacts to refuge wildlife from allowing these uses will be minor.

Impacts to listed species: The listed species utilizing Siletz Bay NWR are the threatened coho salmon, Pacific smelt (eulachon), and green sturgeon. Because wildlife observation, photography, and interpretation will be allowed only from the Alder Island trail and from boats on waters outside refuge lands, and the non-motorized boat access point will be clearly established and delineated, impacts on coho, green sturgeon, and eulachon are expected to be a negligible negative effect.

Impacts to other priority public uses: Wildlife observation, photography, and interpretation generally result in little disturbance to other visitors. Although the Millport Slough area will not be opened for wildlife observation, the Millport Slough waterway itself is open to public travel. The non-motorized boat launch to be constructed by the Service may result in increased boating traffic on Millport Slough, which could flush waterfowl from refuge marsh. If this occurs during waterfowl hunting season, some wildlife observers may inadvertently flush waterfowl being pursued by hunters on the south Millport Slough refuge hunt area. This conflict will be expected to be minimal at the Millport Slough hunt area, because waterfowl hunting will occur only during late fall and winter, a time of year when visitors engaged in wildlife observation and photography at Siletz Bay NWR, especially by boat, are fewer in number.

The Refuge offers interpreter-led paddle trips and a portion of the trip goes along Millport Slough where waterfowl hunting will be offered. These interpreter-led paddle trips will only be offered during the summer and thus will not overlap with the hunt period and no disturbance is expected. It is possible that recreational boaters could flush or displace waterfowl from the Millport Slough area and within refuge lands that are west of Highway 101 if visitors are present in boats during the fall and winter. There is typically very little, if any, recreational non-motorized boating occurring in the bay or within Millport Slough along the river in the winter due to inclement weather, so any impact from people observing or photographing wildlife on hunters during this time is expected to be minor. No impacts are expected to occur to waterfowl hunters on any refuge lands at Siletz Bay NWR from visitors using the Alder Island Nature Trail due to the distance of hunters from Alder Island.

Recreational bank fishing in the Siletz River will be allowed from one or more designated locations along the Alder Island Nature Trail and will be designed to minimize conflicts with other public uses. Thus both anglers and visitors engaged in wildlife observation, photography, and interpretation will be using Alder Island at the same time. No impacts from wildlife observation, photography, and interpretation are expected for anglers.

To ensure safety and minimize conflict between refuge visitors engaged in wildlife observation, photography, and hunting on refuge lands west of Highway 101, the Service will provide information about hunting boundaries and seasons to visitors. Information will be provided at the interpretive kiosks, on the refuge website, and in refuge offices.

Other Impacts:

No significant effects to roads, trails, or other refuge infrastructure from the wildlife observation, photography, and interpretation programs are foreseen. Normal road, trail, and facility maintenance will continue to be necessary. There will be a minor to medium impact on some members of the refuge staff as their workload will increase through the addition of one-time tasks including the construction of the parking lot and trail. Recurring tasks including maintenance and monitoring of the site and law enforcement patrols will also have an impact on staff through increase in workload.

Public Review and Comment:

Wildlife Observation, photography, and interpretation were all discussed at two public meetings held in conjunction with the Comprehensive Conservation Plan process. To initiate the CCP process, a Notice of Intent was published in the Federal Register on November 29, 2010 (Volume 75, Number 228). Written comments were solicited from the public about proposed wildlife-dependent recreational uses. Three CCP planning updates were prepared to summarize the progress of the CCP and to discuss issues related the planning process. This compatibility determination was submitted for public review and comment as an appendix to the Draft Comprehensive Conservation Plan and Environmental Assessment for Siletz Bay NWR. Appendix K of the CCP contains a summary of the comments and Service responses.

Determination:

__________ Use is Not Compatible

____X____ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility:

- Motorized vehicles and bicycles will be limited to designated public roads and parking lots.
- Monitoring and evaluation will be conducted by refuge staff to ensure that high-quality habitat for wildlife feeding, resting, breeding is maintained. Monitor boating activities by periodically assessing and estimating the level of boating activity in refuge waters.
- Camping, overnight use, and fires are prohibited.
- The Alder Island Nature Trail, refuge lands west of Highway 101, parking lots and the non-motorized boat launch will be open year-round to wildlife observation, photography, and interpretation during daylight hours only.
- Wildlife observation, photography, and interpretation will largely be self-guided on both Alder Island and on refuge lands west of Highway 101. Visitors to Alder Island will be restricted to the Alder Island Nature Trail and the parking lot.
- Pets and dogs will only be allowed outside of vehicles in parking areas (not on trails) and must be kept on-leash at all times.
- Law enforcement patrols will be conducted on a regular basis to ensure compliance with refuge regulations.
- The Service will provide signs and brochures to promote appropriate use of the trail and refuge lands to minimize wildlife and habitat disturbance, including boating practices such as no-wake and slower speeds. These materials will clearly state pertinent Refuge-specific regulations.
- The Service will periodically monitor and evaluate the area and programs to determine if objectives are being met and to ensure the resource is not being degraded.

Justification:

As wildlife-dependent recreational uses, wildlife observation, photography, and interpretation receive enhanced consideration in the Comprehensive Conservation Planning process. Given the location of the seasonal sanctuaries, closed areas, and facilities to support wildlife observation, photography, and interpretation, these uses will have a minor direct impact on refuge resources. The associated disturbance to wildlife from these activities, though larger than at present, is also expected to be minor. It is anticipated that wildlife populations will find sufficient food resources and resting places such that their abundance and use of the Refuge will not be measurably lessened from allowing these activities to occur. The relatively limited number of individual animals and plants expected to be adversely affected will not cause wildlife populations to decline, the physiological condition and production of refuge species will not be impaired, their behavior and normal activity patterns will not be altered dramatically, and their overall welfare will not be negatively impacted. Thus, allowing wildlife photography, observation, and interpretation under the stipulations described above will not detract or interfere with the purposes for which the Refuge was established or the Refuge System mission. Wildlife photography, observation, and interpretation provide visitors with the joy of experiencing wildlife on their public lands and help fulfill the mission of the National Wildlife Refuge System.

Mandatory Re-Evaluation Date:

____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

____X____ Environmental Assessment and Finding of No Significant Impact

__________ Environmental Impact Statement and Record of Decision

References:

Boyle, S.A. and F.B. Samson. 1985. Effects of non-consumptive recreation on wildlife: a review. Wildlife Society Bulletin 13:110-116.

Bratton, S.P. 1990. Boat disturbance of ciconiiformes in Georgia estuaries. Colonial Waterbirds 13:124-128.

Burger, J. 1986. The effect of human activity on shorebirds in two coastal bays in northeastern United States. Biological Conservation 13:123-130.

Burger, J. and M. Gochfeld. 1991. Human activity influence and diurnal and nocturnal foraging of sanderlings (Calidris alba). Condor 93:259-265.

Cassirer, E.F. 1990. Responses of elk to disturbance by cross-country skiers in northern Yellowstone National Park. M.S. thesis. University of Idaho, Moscow.

DeLong, A. 2002. Managing visitor use and disturbance of waterbirds. a literature review of impacts and mitigation measures. Appendix L in: Stillwater National Wildlife Refuge Complex final environmental impact statement for the comprehensive conservation plan and boundary revision, Volume 2. U.S. Department of the Interior, Fish and Wildlife Service, Region 1, Portland, OR. 114 pp.

Dobb, E. 1998. Reality check: the debate behind the lens. Audubon 100(1):44-51, 98-99.

Dwyer, N.C. and G.W. Tanner. 1992. Nesting success in Florida sandhill cranes. Wilson Bulletin 104:22-31.

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

Fairbanks, W.S. and R. Tullous. 2002. Distribution of pronghorn (Antilocapra americana Ord) on Antelope Island State Park, USA, before and after establishment of recreational trails. Natural Areas Journal 22:277-282.

Fraser, J.D., L.D. Frenzel, and J.E. Mathisen. 1985. The impact of human activities on breeding bald eagles in north-central Minnesota. Journal of Wildlife Management 49:585-592.

Freddy, D.J. 1986. Responses of adult mule deer to human harassment during winter. Page 286 in: R.D. Comer, T.G. Baumann, P. Davis, J.W. Monarch, J. Todd, S. Van Gytenbeek, D. Wills, and J. Woodling, eds. Proceedings II. Issues and technology in the management of impacted western wildlife: Proceedings of a national symposium. Thorne Ecological Institute. Boulder, CO.

Grubb, T.G. and R.M. King, 1991. Assessing human disturbance of breeding bald eagles with classification tree models. Journal of Wildlife Management 55:500-511.

Hoffman, D.J. 1989. Embryotoxicity and teratogenicity of environmental contaminants to bird eggs. Review of Environmental Contamination and Toxicology 115:41-50.

Huffman, K. 1999. San Diego South Bay survey report-effects of human activity and water craft on wintering birds in South San Diego Bay. USFWS. 45 pp.

Jahn, L.R. and R.A. Hunt. 1964. Duck and coot ecology and management in Wisconsin. Technical Bulletin No. 33. Wisconsin Conservation Department. Madison, WI. 212 pp.

Kaiser, M.S. and E.K. Fritzell. 1984. Effects of river recreationists on green-backed heron behavior. Journal of Wildlife Management 48:561-567.

Klein, M.L. 1989. Effects of high levels of human visitation on foraging waterbirds at J.N. “Ding” Darling National Wildlife Refuge, Sanibel, Florida. Final report to the U.S. Fish and Wildlife Service. Gainesville, FL. 103 pp.

Klein, M.L. 1993. Waterbird behavioral responses to human disturbances. Wildlife Society Bulletin 21:31-39.

Knight, R.L. and D.N. Cole. 1995. Wildlife responses to recreationists. Pages 51-70 in: R.L. Knight and K.J. Gutzwiller, eds. Wildlife and recreationists: coexistence through management and research. Washington, D.C.: Island Press.

Knight, R.L. and S.K. Knight. 1984. Responses of wintering bald eagles to boating activity. Journal of Wildlife Management 48:999-1004.

MacArthur, R.A., V. Geist, and R.H. Johnston. 1982. Cardiac and behavioral responses of mountain sheep to human disturbance. Journal of Wildlife Management 46:351-358.

Miller, S.G., R.L. Knight, and C.K. Miller. 2001. Wildlife responses to pedestrians and dogs. Wildlife Society Bulletin 29:124-132.

Morton, J.M. 1995. Management of human disturbance and its effects on waterfowl. Pages F59- F86 in: W.R. Whitman, T. Strange, L. Widjeskog, R. Whittemore, P. Kehoe, and L. Roberts, eds. Waterfowl habitat restoration, enhancement and management in the Atlantic flyway. 3rd edition. Dover, DE: Environmental Management Committee, Atlantic Flyway Council Technical Section, and the Delaware Division of Fish and Wildlife.

Pfister, C., B.A. Harrington, and M. Lavine. 1992. The impact of human disturbance on shorebirds at a migration staging area. Biological Conservation 60:115-126.

Skagen, S.S. 1980. Behavioral responses of wintering bald eagles to human activity on the Skagit River, Washington. Pages 231-241 in: R.L. Knight, G.T. Allen, M.V. Stalmaster, and C.W. Servheen, eds. Proceedings of the Washington bald eagle symposium. Seattle, WA. 254 pp.

Skagen, S.K., R.L. Knight, and G.H. Orians. 1991. Human disturbances of an avian scavenging guild. Ecological Applications 1:215-225.

Speight, M.C.D. 1973. Outdoor recreation and its ecological effects: a bibliography and review. Discussion Papers in Conservation 4. University College. London, United Kingdom. 35 pp.

Strauss, E.G. 1990. Reproductive success, life history patterns, and behavioral variation in a population of piping plovers subjected to human disturbances. Ph.D. dissertation. Tufts University, Medford, MA.

Taylor, A.R. and R.L. Knight. 2003. Wildlife responses to recreation and associated visitor perceptions. Ecological Applications 13:951-963. doi:10.1890/1051-0761(2003)13[951:WRTRAA]2.0.CO;2.

Tjarnlund, U., G. Ericson, E. Landesjoo, I. Petterson, and L. Balk. 1995. Investigation of the biological effects of two-cycle outboard engines' exhaust on fish. Marine Environmental Research 39:313-316.

Tuite, C.H., M. Owen, and D. Paynther. 1983. Interaction between wildfowl and recreation at Llangorse Lake and Talybont Reservoir, South Wales. Wildfowl 34:48-63.

Vos, D.K., R.A. Ryder, and W.D. Graul. 1985. Response of breeding great blue herons to human disturbance in northcentral Colorado. Colonial Waterbirds 8:13-22.

Refuge Determination:

Prepared by:	Rebecca G. Chuck (Signature)	12/18/12 (Date)
Refuge Manager/ Project Leader Approval:	Rebecca G. Chuck Acting (Signature)	12/18/12 (Date)

Concurrence:

Refuge Supervisor:	(Signature)	12/18/12 (Date)
Regional Chief, National Wildlife Refuge System:	Lori J. West (Signature)	12-19-12 (Date)

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B.3 Compatibility Determination

Use: Waterfowl Hunting

Refuge Name: Siletz Bay National Wildlife Refuge

County and State: Lincoln County, Oregon

Establishing and Acquisition Authorities:

Siletz Bay NWR was established in 1991 under the authority of the Fish and Wildlife Act of 1956 [U.S.C. 742f(a)(4) and 16 U.S.C. 742f(b)(1)]. Additional establishment authorities include the Emergency Wetlands Resources Act of 1986 [16 U.S.C. 39 100 Stat 3583] and the Endangered Species Act of 1973, as amended [16 U.S.C. 1534-1544].

Refuge Purpose(s):

- "for the development, advancement, management, conservation, and protection of fish and wildlife resources" [U.S.C. 742f(a)(4)]…"for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude" [16 U.S.C. 742f (b)(1) (Fish and Wildlife Act of 1956)].
- for "the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to fulfill international obligations contained in various migratory bird treaties and conventions"; [16 U.S.C. 39 100 Stat 3583] (Emergency Wetlands Resources Act of 1986)
- "to conserve (a) fish or wildlife which are listed as endangered species or threatened species…or (b) plants" [16 U.S.C. 1534 (Endangered Species Act of 1973)]

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(s):

Under the management direction described in the CCP for Siletz Bay NWR, the U.S. Fish and Wildlife Service (Service) will allow the hunting of waterfowl, defined here as ducks, geese, and coots on portions of Siletz Bay NWR. Waterfowl hunting will be permitted from October through January in accordance with State and Federal regulations and seasons.

The Service will allow waterfowl hunting seven days per week on Refuge-owned lands that are west of U.S. Highway 101 (87 acres). These lands consist of salt marsh where the Siletz River empties into the bay near the development of Siletz Keys and uplands and wetlands at the mouth of Drift Creek. Waterfowl hunting has occurred on the state-owned tidelands of Siletz Bay west of U.S. Highway 101 for many decades. The tidelands are managed by the Oregon Department of State

Lands and are legally open to hunting so long as the hunter remains 200 yards (183 meters) or more from the shoreline/road. However, Refuge-owned lands west of U.S. Highway 101 in Siletz Bay have been closed to waterfowl hunting since the Refuge was established in 1991. Though it has been surveyed, the seaward boundary of the tidal marsh near Siletz Keys has not been posted with official refuge boundary signs due to the difficulty in keeping posts upright and intact in the marsh where tides inundate the site twice daily. Consequently, there is often confusion among hunters as to where the refuge boundary ends and the state-owned tidelands begin. The Refuge has maintained that as long as hunters were in the mudflats and not east of the vegetation line they were most likely on state tidelands; however, this boundary has been difficult to legally enforce. Opening refuge lands west of U.S. Highway 101 will not only enhance waterfowl hunting in Siletz Bay but it will also decrease the uncertainty of legal hunt boundaries and eliminate the issue of hunters trespassing over refuge lands to access the state hunting area. The Service will also establish a 100-yard (91-meter) no-hunting zone to prohibit waterfowl hunting on refuge property that extends westward from the refuge property line on the west side of the housing development of Siletz Keys. Access to the Refuge will be allowed from one hour before sunrise to one hour after sunset. Hunters accessing lands west of U.S. Highway 101 will be directed to use caution since no parking will be provided by the Refuge.

The Service will also allow waterfowl hunting three days per week on 112 acres of refuge lands that are east of U.S. Highway 101 and south of Millport Slough. Specifically, hunters will be allowed to hunt ducks, geese, and coot on Wednesday, Saturday, and Sunday during the Oregon Department of Fish and Wildlife (ODFW) established hunt season from October through January. Hunters accessing lands east of U.S. Highway 101 and south of Millport Slough will access the site by using a short trail and a small gravel parking lot located on South Millport Slough Road. The parking lot and trail will be constructed by the Service to support this planned use. To minimize potential conflict between refuge users and reduce associated safety issues, lands south of Millport Slough that are open to waterfowl hunting will remain closed to wildlife observation, photography, and interpretation. For boat access, hunters can reach refuge lands on both the east and west side of U.S. Highway 101 during high tides from a private boat launch on the Siletz River. The launch is on the north side of the Siletz River near the junction with Highway 101 and is privately-owned with an associated launch fee. Hunters accessing lands west of U.S. Highway 101 via foot will be directed to use caution since no parking or official access point will be provided by the Refuge.

There is a demand for public hunting around Siletz Bay, especially in areas that have walk-in access and do not require the use of a boat. Opening the Refuge to waterfowl hunting and providing walk-in opportunities, at both Millport Slough and on refuge lands west of U.S. Highway 101, will enhance and slightly increase waterfowl hunting opportunities in the area. Lands west of Highway 101 get the most use by waterfowl, and since the state tidelands adjacent to the Refuge are already hunted, opening the Refuge will effectively expand this hunting area and therefore will likely provide the highest quality waterfowl hunting opportunity on the Refuge.

For both areas no permanent blinds are allowed; however, hunters will be allowed to use portable blinds or blinds constructed of onsite dead vegetation or driftwood under the condition that they either be removed or disassembled at the end of each hunt day.

Although dogs are prohibited on the Refuge, they are a vital part of the waterfowl hunting tradition and can reduce the loss of waterfowl to the hunter's bag and hence prevent waste and reduce the overall impact to the resource. Because of their role, both as part of the waterfowl hunting tradition and their contribution to increasing the likelihood of retrieval of birds that have been shot, properly trained dogs used in the act of hunting will be allowed on Siletz Bay NWR per Service Policy in 50 CFR 32.26.21.

Hunters must comply with all State and Federal regulations regarding waterfowl hunting including provisions outlined in the Code of Federal Regulation 50 CFR 32.2 which states:

1. Each person shall secure and possess the required State license and waterfowl validation.
2. Each person 16 years of age and older shall secure and possess a Federal Migratory Bird Hunting Stamp while hunting migratory waterfowl.
3. Each person shall comply with the terms and conditions authorizing access or use of wildlife refuges.
4. The distribution of bait and the hunting over bait is prohibited on wildlife refuges.
5. The use or possession of alcoholic beverages while hunting is prohibited.
6. Hunters may possess only approved nontoxic shot while in the field or on certain other areas of the National Wildlife Refuge System.

Availability of Resources:

The following funding/annual costs will be required to administer and manage hunting activities as described above:

Costs to Administer Waterfowl Hunting at Siletz Bay NWR under the CCP's Management Direction

Activity or Project	One-Time Expense	Recurring Expense
Develop a hunt opening package	$10,000	
Build a small gravel parking lot at South Millport Slough Road	$42,200	$500
Law Enforcement patrols		$2,000
Kiosk at S. Millport Slough Road	$2,800	
Brochures, signs, posters		$500
Maintenance		$2,000
Staff		$2,000

Anticipated Impacts of the Use(s):

The Service is committed to providing quality opportunities for wildlife-oriented recreation at Siletz Bay NWR. As part of the Service mission and refuge goals for Siletz Bay, five of the six Refuge System priority wildlife-dependent uses will be offered at Siletz Bay: hunting, fishing, wildlife observation and photography, and interpretation. Offering hunting will help fulfill refuge purposes and goals and by extension, does not conflict with the mission of the Refuge System.

Harvest of Waterfowl:
Hunting, by its nature, results in the intentional take of individual animals, as well as wounding and disturbance (DeLong 2002). Indirect impacts such as displacement of animals by hunters or disturbance from gunfire also occurs in and adjacent to, areas opened for hunting. It can also alter behavior (e.g., foraging time), population structure (young birds are generally more susceptible), and distribution patterns of wildlife (Owens 1977, Raveling 1979, White-Robinson 1982, Thomas 1983,

Bartlett 1987, Madsen 1985, and Cole and Knight 1990). Prolonged and extensive disturbances may cause large numbers of waterfowl to leave disturbed areas and migrate elsewhere (Madsen 1985).

The Refuge seeks to reduce the magnitude of these impacts by providing a sanctuary area north of Millport Slough where hunting and visitation does not occur and birds can feed and rest relatively undisturbed. In addition, refuge lands adjacent to Drift Creek located east of U.S. Highway 101 provides marsh and open water sanctuary areas that are suitable habitat for some waterfowl species and are not open to hunting. The Refuge also attempts to mitigate impacts by only allowing hunting a limited number of days per week. The area south of Millport Slough will be limited to hunting three days per week and thus providing sanctuary the remainder of the week.

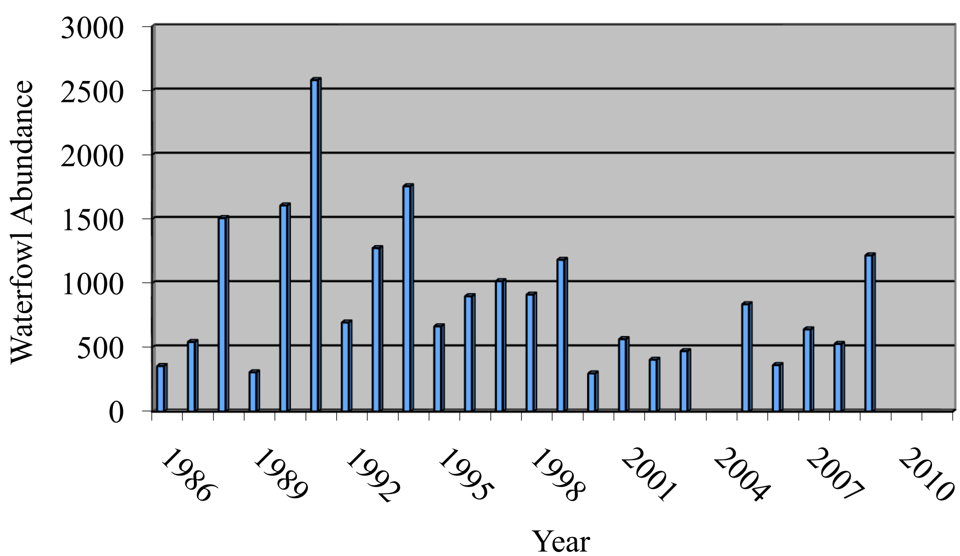
The Service conducts annual surveys that are used to estimate waterfowl hunting activity, success, and harvest by species. Results are used by the Service and State wildlife agencies, in part, to establish season lengths and bag limits designed to maintain healthy, sustainable waterfowl populations. During 2010-11 seasons, waterfowl hunters in Oregon harvested an estimated 419,100 ±18% ducks (Raftovich et al. 2011). On state-owned tidelands of Siletz Bay during 2010-11, hunters harvested very few ducks and the harvest numbers are considered to be below reportable levels (B. Reishus, ODFW, personal observation). Waterfowl harvest data are unavailable because only a small number of hunters pursue waterfowl in the Siletz Bay area and no hunters were surveyed in 2010-11. At any given time there are only 1-2 hunting parties in the bay because space and hunting quality is best at only a few spots (e.g., the mouth of the sloughs). Consequently, waterfowl hunters tend to self-limit their numbers. Most hunting in Siletz Bay occurs in October and November and tides influence hunting times. In late November when rain increases and causes prolonged flooding and development of seasonal wetland habitat further inland, waterfowl disperse to newly flooded areas. Thus, there is almost no hunting occurring on Siletz Bay after mid-December due to the lower abundance of birds.

The most heavily harvested duck species in Oregon are mallard, American wigeon, northern pintail, green-winged teal, and northern shoveler (Raftovich et al. 2011). In 2011, continental populations of northern shoveler, green-winged teal, and mallard were all above their long-term averages (USFWS 2011). American wigeon were 20% below their long-term average and northern pintail were similar to their long-term average. Hunters are also permitted to harvest coots, but while this species is common on the Refuge, coots are not popular with hunters. Given the low harvest rates of these species relative to the State harvest, the refuge hunt program will not significantly contribute to the population changes of these species. The Refuge will conform to ODFW established bag limits for waterfowl.

Biologists from state and Federal agencies annually conduct the Midwinter Waterfowl Survey to provide a measure of the relative numbers or trends of duck populations. The survey identifies winter waterfowl distribution and habitat use throughout the United States. The survey also provides estimates of the size of goose and swan populations and tracks population trends of duck species that nest outside of breeding survey areas. Surveys have indicated waterfowl make significant use of the open bay, mud flats, and tidal marsh with heaviest use occurring from September through December and again during spring migration. The southern portions of the bay from the mouth of Drift Creek to Salishan receive the most use. Some of the more commonly found birds in the Siletz estuary include common loon, double-crested cormorant, great blue heron, gulls, and western Canada geese. Common dabbling ducks include mallard, northern pintail, American wigeon, and green-winged teal and diving ducks include bufflehead, greater and lesser scaup, common goldeneye, red-breasted merganser, and surf scoter.

Midwinter Waterfowl Surveys are conducted during the first two weeks in January along the Oregon coast. Observers count divers, dabblers, sea ducks, geese, swans, and American coots from a fixed-wing aircraft and an overall abundance is estimated (USFWS unpublished data). Data were compiled for all waterfowl observed at Siletz Bay during the midwinter waterfowl surveys from 1986 to 2009 and are displayed in Figure B-1. The overall mean count was 896 individuals and the lowest count was 297 individual birds recorded in 2000 and the largest was 2,582 in 1991. These data are collected from a fixed-wing aircraft at 200-300 foot altitude and traveling 80-120 miles per hour, which limits ability to survey all areas and all habitats and count every individual present. However, general abundance and population trends can be inferred, and Siletz Bay is an important use area for waterfowl. Waterfowl abundance is usually lower during the January mid-winter survey compared to fall months, when birds are concentrated on the bay prior to dispersing throughout the area due to field and seasonal wetland flooding. Given the low waterfowl harvest rates relative to the large wintering duck population, the refuge hunt program will not significantly contribute to waterfowl population changes and the area should support a sustainable harvest. A program will be implemented to monitor waterfowl population numbers and habitat use.

Figure B-1. Waterfowl abundance at Siletz Bay, Oregon from 1986 to 2009 (USFWS unpublished data).



Impacts to Non-Target Species:
The refuge waterfowl hunt program is expected to indirectly impact species other than those targeted by hunters. The presence of hunters and dogs, sounds of gunfire, and the sight of hunters traveling to and from hunt areas can disturb other wildlife species such as pied-billed grebe, great blue heron, bald eagle, great egrets, and northern harrier which forage in refuge wetlands and water bodies. This disturbance, especially when repeated over a period of time, may result in some wildlife species altering food habits or moving to other areas. At Siletz Bay NWR, hunting will occur outside of the breeding season for these species and hunt areas are located away from known eagle nests and heron roosts to limit disturbance to these sensitive areas. Hunters' foot trails and temporary blinds in the tidal marsh could slightly alter wetland vegetation; however, impacts to refuge fish populations and other wildlife are expected to be negligible.

Impacts to Other Priority Public Uses:
Siletz Bay NWR is committed to providing quality opportunities for wildlife-dependent recreation. The Refuge will support five of the six Refuge System's priority wildlife-dependent uses including hunting, fishing, wildlife observation and photography, and interpretation. The direct impacts to refuge visitors engaged in the other priority public uses either via foot or boat during the waterfowl hunting season (October through January) are expected to be minor, since the hunt period occurs during the time of year when the activities of wildlife observation, photography and interpretation receive the lowest amount of use by visitors due to rainy and windy weather. To minimize potential conflict between refuge users and reduce associated safety issues, lands south of Millport Slough that are open to waterfowl hunting will remain closed to wildlife observation, photography, and interpretation. Refuge lands west of U.S. Highway 101 will be open to wildlife observation and photography year-round so there is a potential for conflict to arise between these users and waterfowl hunters. However, the Service anticipates very few, if any, visitors will spend time observing or photographing wildlife via foot in this area due to the lack of an access point for parking and entry into the site and the extreme difficulty involved in walking through mudflats. It is likely that visitors will engage in wildlife observation and photography from boats but most recreational boating from canoes and kayaks occurs from May-September (due to inclement weather from October through January) thus reducing the likelihood of conflicts between hunters and people observing or photographing wildlife from boats.

Law enforcement patrols will be conducted on a regular basis to ensure compliance with State, Federal, and Refuge regulations. The refuge law enforcement officer will also monitor and collect data on hunting activities in the field to ensure the waterfowl hunting program does not conflict with other wildlife-dependent uses. If necessary, the program will be modified accordingly.

Offering hunting at Millport Slough is not expected to directly impact other refuge visitors during the hunt season since those lands will remain closed to unrestricted walking for wildlife observation, photography, and interpretation. It is possible that refuge visitors using Alder Island during this time could be impacted by hunting on both Millport Slough and refuge lands west of U. S. Highway 101 though it is expected to be minor due to the distance of hunters from Alder Island. These distances are as follows: Alder Island to hunting lands west of Highway 101 is 360 yards (330 meters) and Alder Island to lands south of Millport Slough is 600 yards (549 meters). The Refuge offers interpreter-led paddle trips in Millport Slough but they will only be offered during the summer and thus will not overlap with the hunt period. There is very little recreational non-motorized boating occurring in the bay or along the river in the fall and winter due to inclement weather, so impact from hunting on these visitors is expected to be minor. To ensure safety and minimize conflict between hunters and refuge visitors engaged in other activities, the Service will provide information about hunting boundaries and seasons to the general public and those utilizing other refuge programs. Information will be provided at the interpretive kiosks, on the refuge website, and in refuge offices.

Other Impacts:
No significant effects to roads, trails, or other refuge infrastructure from the hunting program are foreseen. Normal road, trail, and facility maintenance will continue. There will be a minor impact on some members of the refuge staff because construction of the parking lot and maintenance of the site will increase staff workload. For the Millport Slough area, hunters will access the site by using a small gravel parking lot and trail associated with this unit located on South Millport Slough Road. The public may also access the Millport Slough by boat during higher tides from the Siletz River. There is one private boat launch nearby that hunters occasionally use to launch their watercraft. The launch is on the north side of the Siletz River near Highway 101 and is privately-owned with an

associated launch fee. Boating provides access to the restored tidal marsh via the small channel which branches off the Siletz River. To facilitate hunting, hunters may set up temporary blinds, but to ensure the structures do not interfere with habitat, they must be removed at the end of the hunt day.

There is a potential for waterfowl hunting occurring on refuge lands west of U.S. Highway 101 to disturb and/or distress residents of Siletz Keys. Waterfowl hunting already occurs on state tidelands adjacent to the Refuge so this will be additive. To mitigate for the increase in noise and potential distress for some homeowners, the Service will establish a 100-yard (91-meter) no-hunting zone that prohibits waterfowl hunting on refuge property that extends westward from the refuge property line on the west side of the housing development of Siletz Keys.

Public Review and Comment:

Waterfowl hunting was discussed at two public meetings held in conjunction with the Comprehensive Conservation Plan (CCP) process. To initiate the CCP process, a Notice of Intent was published in the Federal Register on November 29, 2010 (Volume 75, Number 228). Written comments were solicited from the public about proposed wildlife-dependent recreational uses including waterfowl hunting. Two CCP planning updates were prepared to summarize the progress of the CCP and to discuss issues related the planning process. This compatibility determination was submitted for public review and comment as an appendix to the Draft Comprehensive Conservation Plan and Environmental Assessment for Siletz Bay NWR. Appendix K of the CCP contains a summary of the comments and Service responses.

Determination:

__________ Use is Not Compatible

____X____ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility:

The refuge hunting program is designed to provide a safe, quality experience with reasonable harvest opportunities, while avoiding significant impacts to other users and non-target wildlife resources. The Refuge has developed the following stipulations to reduce impacts and promote safety:

- Only ducks, geese, and coots may be taken in accordance with Oregon Department of Fish and Wildlife bag and possession limits.
- Access to the Refuge is allowed from one hour before sunrise to one hour after sunset.
- Law enforcement patrols will be conducted on a regular basis to ensure compliance with State, Federal, and Refuge regulations. The refuge law enforcement officer will also monitor and collect data on hunting activities in the field to ensure the hunting program does not interfere with other wildlife-dependent uses. If necessary, the program will be modified accordingly.
- The Refuge will ensure safety and minimize conflict with other priority public uses by providing information about hunting boundaries and seasons to the general public and those utilizing other refuge programs. Information will be provided at interpretive kiosks, on the refuge website, and in refuge offices.

- The Refuge will provide signs and brochures to promote appropriate use of refuge lands to minimize wildlife and habitat disturbance, including boating practices such as no-wake and slower speeds. These materials will clearly state pertinent refuge-specific regulations.
- Hunters will only be allowed to hunt geese, ducks, and coot on lands east of U.S. Highway 101 and south of Millport Slough three days per week. The established days for hunting will be Wednesday, Saturday, and Sunday. On Refuge-owned lands that are west of U.S. Highway 101 hunters will be allowed to hunt geese, ducks, and coot seven days per week.
- Hunters accessing lands east of U.S. Highway 101 and south of Millport Slough will use the gravel parking lot along South Millport Slough Road. Hunters accessing lands west of U.S. Highway 101 will use caution since no parking is provided by the Refuge. Hunters accessing refuge lands via boat must secure/anchor boat and use established boat launch areas.
- Camping, overnight use, and fires are prohibited.
- Permanent blinds are not allowed; however, hunters will be allowed to use portable blinds or blinds constructed of onsite dead vegetation or driftwood under the condition that they either be removed or disassembled at the end of each day.
- Hunters must comply with all State and Federal regulations regarding waterfowl hunting including provisions outlined in 50 CFR 32.2 which states:
- Each person shall secure and possess the required State license and waterfowl validation.
- Each person 16 years of age and older shall secure and possess a Federal Migratory Bird Hunting Stamp while hunting migratory waterfowl.
- Each person shall comply with the terms and conditions authorizing access or use of wildlife refuges.
- The distribution of bait and the hunting over bait is prohibited on wildlife refuges.
- The use or possession of alcoholic beverages while hunting is prohibited.
- Only approved nontoxic shot is allowed on refuge lands to hunt waterfowl.
- Dogs used for hunting will be allowed but they must be engaged in hunting activity and under the immediate control of a licensed hunter (see 50 CFR 26.21(b)).
- Waterfowl hunting prohibited within a 100-yard (91-meter) no-hunting zone that extends westward from the refuge property line on the west side of Siletz Keys housing development.
- The Service will implement a program to monitor waterfowl population numbers and habitat use and reserves the right to modify existing programs to accommodate existing or changing conditions.

Justification:

Hunting is a wildlife-dependent recreational use as defined in the National Wildlife Refuge System Improvement Act of 1997. More specifically, it is one of the six priority public uses of the National Wildlife Refuge System and is by definition an appropriate use on a national wildlife refuge, and if it is officially determined to be compatible, should be allowed. Refuge hunting programs are designed to provide high-quality, safe experiences, with a reasonable opportunity to harvest game species. By allowing this use on Siletz Bay NWR, we will increase visitors' knowledge and appreciation of fish and wildlife, which may lead to increased public stewardship of wildlife and their habitats on the Refuge. Increased public stewardship supports and complements the Service's actions in achieving the Refuge's purposes and the mission of the National Wildlife Refuge System.

It is anticipated that an adequate amount of quality, non-hunted estuarine habitat will be available to the majority of waterfowl in the watershed for Siletz Bay. Furthermore, it is anticipated that birds will find sufficient food resources and resting places such that their abundance and use of the Refuge will not be measurably lessened, hunting pressure will not cause premature departure from the area, the physiological condition and production of waterfowl and other waterbirds will not be impaired, their behavior and normal activity patterns will not be altered dramatically, and their overall status will not be impaired. Thus, allowing waterfowl hunting under the stipulations described above will not materially detract or interfere with the purposes for which the Refuge was established or the refuge mission.

Mandatory Re-Evaluation Date:

____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

____X____ Environmental Assessment and Finding of No Significant Impact

__________ Environmental Impact Statement and Record of Decision

References:

Bartlett, G.A. 1987. Effects of disturbance and hunting on the behavior of Canada goose family groups in east central Wisconsin. Journal of Wildlife Management 51:517-522.

Cole, D.N. and R.L. Knight. 1990. Impacts of recreation on biodiversity in wilderness. Logan, UT: Utah State University.

DeLong, A. 2002. Managing visitor use and disturbance of waterbirds. a literature review of impacts and mitigation measures. Appendix L in: Stillwater National Wildlife Refuge Complex final environmental impact statement for the comprehensive conservation plan and boundary revision, Volume 2. U.S. Department of the Interior, Fish and Wildlife Service, Region 1, Portland, OR. 114 pp.

Madsen, J. 1985. Impact of disturbance on field utilization of pink-footed geese in West Jutland, Denmark. Biological Conservation 33:53-63.

Owens, N. W. 1977. Responses of wintering brant geese to human disturbance. Wildfowl 28:5-14.

Raftovich, R.V., K.A. Wilkins, S.S. Williams, H.L. Spriggs, and K.D. Richkus. 2011. Migratory bird hunting activity and harvest during the 2009 and 2010 hunting seasons. U.S. Fish and Wildlife Service. Laurel, MD. 68 pp.

Raveling, D.G. 1979. The annual cycle of body composition of Canada geese with special reference to control of reproduction. Auk 96:234-252.

Thomas, V.G. 1983. Spring migration: the prelude to goose reproduction and a review of its implication. Pages 73-81 in: H. Boyd, ed. Fourth Western Hemispheric Waterfowl and Waterbird Symposium. Canadian Wildlife Service. Ottawa, Canada.

USFWS (U.S. Fish and Wildlife Service). 2011. Waterfowl population status, 2011. U.S. Department of the Interior. Washington, D.C. 80 pp.

White-Robinson, R. 1982. Inland and saltmarsh feeding of wintering brent geese in Essex. Wildfowl 33:113-118.

Refuge Determination:

Prepared by:	Rebecca G. Chuck (Signature)	12/18/12 (Date)
Refuge Manager/ Project Leader Approval:	Rebecca G. Chuck Acting (Signature)	12/18/12 (Date)

Concurrence:

Refuge Supervisor:	(Signature)	12/18/12 (Date)
Regional Chief, National Wildlife Refuge System:	(Signature)	12-19-12 (Date)

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B.4 Compatibility Determination

Use: Fishing and Clamming

Refuge Name: Siletz Bay National Wildlife Refuge

County and State: Lincoln County, Oregon

Establishing and Acquisition Authorities:

Siletz Bay NWR was established in 1991 under the authority of the Fish and Wildlife Act of 1956 [U.S.C. 742f(a)(4) and 16 U.S.C. 742f(b)(1)]. Additional establishment authorities include the Emergency Wetlands Resources Act of 1986 [16 U.S.C. 39 100 Stat 3583] and the Endangered Species Act of 1973, as amended [16 U.S.C. 1534-1544].

Refuge Purpose(s):

- "for the development, advancement, management, conservation, and protection of fish and wildlife resources" [U.S.C. 742f(a)(4)]…"for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude" [16 U.S.C. 742f (b)(1) (Fish and Wildlife Act of 1956)].
- for "the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to fulfill international obligations contained in various migratory bird treaties and conventions"; [16 U.S.C. 39 100 Stat 3583] (Emergency Wetlands Resources Act of 1986)
- "to conserve (a) fish or wildlife which are listed as endangered species or threatened species…or (b) plants" [16 U.S.C. 1534 (Endangered Species Act of 1973)]

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 National Wildlife Refuge System Improvement Act of 1997 defined six wildlife-dependent recreational uses and required that they receive priority consideration in refuge planning when they are appropriate and compatible with the refuge mission. Fishing is one of the six wildlife-dependent recreational uses. Because there is often substantial overlap between activities associated with bank fishing and clamming and state fishing regulations also consider the uses to be related, these uses are evaluated together in this compatibility determination.

Under the management direction described in the CCP for Siletz Bay NWR, the U.S. Fish and Wildlife Service will open recreational bank fishing from Alder Island and allow clamming access to state managed tidelands near Drift Creek. Access to fish and clamming will be permitted year-round but the activities of fishing and clamming will be conducted in accordance with State, Federal, and Refuge-specific regulations and seasons to ensure that these activities will not interfere with the conservation of fish and wildlife and their habitats.

Currently there is no fishing program on Siletz Bay NWR. Recreational fishing is already a very popular sport on the navigable waters of the Siletz River and takes place mainly from boats. The Service will allow bank fishing (e.g., salmonids, cutthroat trout, perch) along the south bank of the Siletz River from Alder Island. The Service will develop one or more dedicated sites along the trail where anglers can access the Siletz River. The designated sites along the trail will concentrate anglers and potentially generate trash including monofilament line, which can entangle wildlife and is therefore a hazard. The Service will provide containers for anglers to discard their used monofilament line. Anglers will access the island itself by using the paved public parking lot and trailhead that will be developed by the Service and located on the east side of U.S. Highway 101 along the abandoned Highway 101 spur. Access to bank fishing will require users to access the river bank from the Alder Island Nature Trail. Anglers will be permitted to use pole and line or rod and reel while bank fishing, and under ODFW regulations for fishing in the Siletz Bay, anglers will be allowed to use either bait or artificial lures. The Alder Island Nature Trail will be open for anglers to access during daylight hours only. Camping, overnight use, and fires will be prohibited. Pets and dogs will only be allowed outside of vehicles while in the parking lot and must be kept on-leash any time they are outside of a vehicle. Pets will be prohibited on the trail and on Alder Island outside of the parking lot.

Clamming is currently allowed in Siletz Bay on state-owned tidelands on the west side of U.S. Highway 101. The Service will allow clammers to cross refuge lands on foot to access state-owned tidelands where clamming beds occur. This access will eliminate refuge trespass issues associated with clamming in this location and provide clammers with an easier route to clamming beds. Clamming provides a recreational experience to harvest softshell clams by digging with a hand shovel or using a clam gun (i.e., aluminum or PVC piped suction device). In addition to the harvest of clams, the harvest of shrimp other marine invertebrates for bait is included within the term clamming. Clamming access to state-managed tidelands will require users to observe daily tide cycles and walk across mudflats and/or small tidal channels. The Service will not provide infrastructure on these lands to enhance clamming or any other public use. Visitors using the area will be advised to use caution since no parking on the west side of U.S. Highway 101 will be provided.

The Service will develop a fishing information tear sheet and an informational kiosk and will share information about fishing and other available wildlife-dependent recreational uses with refuge visitors through the internet via a refuge website and/or social media site. These forms of interpretive material will help educate the public on refuge regulations and how they can minimize wildlife and habitat disturbance.

Anglers must comply with all State and Federal regulations regarding fishing and clamming including provisions outlined in the Code of Federal Regulation (50 CFR 32.5).

Availability of Resources:

There are substantial costs associated with the development of infrastructure to support bank fishing and other wildlife-dependent recreational uses on the 10-acre Alder Island. The most significant one-time expenses are the development of the parking lot and the accessible loop trail that will follow the perimeter of Alder Island. The trail will provide pedestrian access to the areas open for bank fishing. It will also provide visitors with a designated route of travel which will provide protection for sensitive resources through proper routing and construction techniques. The Service will develop a parking lot to provide safe access to Alder Island from U.S. Highway 101; the location for this will be along the former roadbed for Highway 101 currently owned and managed by the Oregon Department of Transportation. An informational kiosk will be developed to share information on fishing access and refuge rules and regulations.

Once infrastructure is in place, the recurring costs related to management of a fishing program at Siletz Bay NWR will be more than minimal but not significant. Expenses will consist primarily of posting and maintaining “Public Fishing Area” signs, maintenance of the trail, parking lot and boat launch, trash pick-up, law enforcement patrols, retrieval of monofilament line deposited in waste containers, and production and dissemination of materials regarding fishing access and regulations.

Costs to Administer and Manage a Fishing Program on Alder Island under the CCP’s Management Direction

Activity or Project	One-time Expense	Recurring Expense
Develop a Fishing Program opening package	$5,000	
Build an accessible loop trail (also listed in Wildlife Observation program costs)	$154,300	
Develop a parking lot (also listed in Wildlife Observation program costs)	$331,000	
Develop welcoming kiosk	$2,800	
Brochures		$500
Develop non-motorized boat launch	$87,300	
Law enforcement patrols		$2,500
Recruit and train volunteers to help manage the program		$16,500 (Vol. coordin. Salary, volunteer expenses, intern cost)
Maintain refuge trail, parking lot, and boat launch		$7,000

Anticipated Impacts of the Use(s):

The Service is committed to providing quality opportunities for fish and wildlife-oriented recreation at Siletz Bay NWR. As part of the Service mission and refuge goals for Siletz Bay NWR, five of the six Refuge System’s priority wildlife-dependent uses will be offered at Siletz Bay NWR, including fishing, hunting, wildlife observation, photography, and interpretation. Offering these public uses will help fulfill refuge purposes and goals and does not conflict with the mission of the Refuge System.

Impacts to Wildlife and Habitat:
Effect of disturbance intensity: Some researchers have attempted to correlate disturbance events in wildlife to the intensity, proximity, or loudness of human disturbance. While studying shorebirds on an eastern coastal refuge, Burger (1986) 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 studied the effect of human proximity on wildlife. 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 meters (328 feet) increased. Erwin (1989) studied colonial wading and seabirds in Virginia and North Carolina. Mixed colonies of common terns and black skimmers responded at the greatest distances, with respective means of 142 meters (466 feet) and 130 meters (427 feet); mixed wading bird species were more reluctant to flush (30-50 meters [98-164 feet] 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.

Miller et al. (2001) defined an “area of influence” as the area that parallels a trail or line of human movement within which wildlife will flush from a particular activity with a certain probability. In a study analyzing response distance from hiking and mountain biking in sagebrush-grassland habitat in Utah, Taylor and Knight (2003) found that at 100 meters (328 feet) from the line of movement of an off-trail trial, mule deer showed a 96 percent probability of flushing. That probability did not drop to 70 percent until the perpendicular distance increased to 390 meters (1,280 feet).

Taylor and Knight (2003) also found that the area of influence around a recreationist on a trail did not differ between mountain biking and hiking. This may mean that wildlife do not differentiate between hikers and bikers, but are instead reacting to the presence of a moving human on a trail, regardless of the person's activity. However, the area of influence differed considerably between on-trail and off-trail trials.

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 meters (1,562 feet) at the approach of a pedestrian. A multiple regression model including number of previous disturbances, date, and time of day, explained 82 percent of the variability in flush distance and predicted a maximum flush distance at the first disturbance of 503 meters (1,650 feet). Skagen (1980), studying bald eagles in northwest Washington, found a statistically significant decrease in the proportion of eagles feeding when human activity was present within 200 meters (656 feet) 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 (328 feet) in general did not result in a behavioral response (DeLong 2002).

Effects from pedestrian access: Wildlife is frequently more sensitive to disturbance from people on foot than in vehicles (Skagen 1980, Grubb and King 1991, MacArthur et al. 1982). 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 1995). Taylor and Knight (2003), in a logistic regression analyzing mule deer, pronghorn antelope, and bison response to mountain biking and hiking on- and off-trail found that the variables best explaining wildlife response included wildlife species, perpendicular distance of animals to trail (closest distance of animal to trail, regardless of recreationist position), trail position (on-trail or off-trail), and degree of vegetation cover.

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 and found 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 meters (262 feet) 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 percent versus 91 percent) and spent more time running (33 percent versus 2 percent), fighting with other chicks (4 percent versus 0.1 percent), and standing alert (9 percent versus 0.1 percent) when pedestrians or moving vehicles were closer than 100 meters (328 feet) than when they were undisturbed. In addition, plover chicks spent less time out on the feeding flats (8 percent versus 97 percent) and more time up in the grass (66 percent versus 0.1 percent) during periods of human disturbance.

Predictability of disturbance (habituation): 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 meters (1,312 feet) of highways, railroads, and mines; cranes also were tolerant of helicopter flyovers. Visits to nests and development-induced alterations of surface water drainage were implicated in 24 percent of the nest failures. Taylor and Knight (2003) found that for mule deer, the area of influence around off-trail trials was much greater than that for on-trail trials, suggesting habituation to trails. However, the time it takes for wildlife to habituate, and what wildlife use is like compared to pre-disturbance uses, remains a fertile question. A study by Fairbanks and Tullous (2002) measured the distance of pronghorn from recreational trails on Antelope Island State Park in Utah. The study gathered data the year before the trails were opened for public use, and compared these to data gathered in three consecutive years after recreational use began. Groups of pronghorn were observed significantly farther from trails in years with recreational use than in the year before recreational areas were opened.

Fishing-specific impacts: Fishing, when practiced as a solitary and stationary activity, tends to be less disturbing to wildlife than hunting or motorized boating (Tuite et al. 1983). Direct habitat impacts include a certain amount of litter and general garbage left at fishing sites. Installation and use of parking areas and access trails can decrease impacts to vegetation and soil adjacent to fishing areas, by concentrating visitors on hardened surfaces.

Fishing will cause minor and localized disturbance to birds and other wildlife using refuge mudflats and tidal marsh. Fishing activities may influence the composition of bird communities, as well as distribution, abundance, and productivity of waterbirds (Tydeman 1977, Bouffard 1982, Bell and

Austin 1985, Edwards and Bell 1985, and Cooke 1987). Anglers often fish in shallow, sheltered bays and creeks that birds prefer, negatively impacting distribution and abundance of waterfowl, grebes, and coots (Cooke 1987). Increases in anglers and associated shoreline activity discouraged waterfowl from using otherwise suitable habitat (Jahn and Hunt 1964). In Britain, anglers displaced waterfowl from their preferred feeding and roosting areas and caused wigeon, green-winged teal, pochard, and mallard to depart from a reservoir prematurely (Jahn and Hunt 1964). On fishing days, anglers influenced the numbers, behavior, and diurnal distribution of avian scavengers present at sites in Washington when compared to nonfishing days (Knight et al. 1991). Shoreline activities, such as human noise, could cause some birds to flush and go elsewhere. In addition, vegetation trampling, and deposition of human waste are expected to occur (Liddle and Scorgie 1980). Disturbance and destruction of riparian vegetation, and impacts to bank stability and water quality, may result from high levels of bank fishing activities.

Effects from boat proximity: Boating, both motorized and non-motorized, can alter the distribution, reduce use of particular habitats or entire areas by waterfowl and other birds, alter feeding behavior and nutritional status, and cause premature departure from areas (Knight and Cole 1995). More sensitive species may find it difficult to secure adequate food or loafing sites as their preferred habitat becomes fragmented and recreation related disturbance increase (Skagen et al. 1991, Pfister et al. 1992). However, disturbance to birds in general was reduced when boats traveled at or below five miles per hour speed limit.

Motorized boats can generally have more impact on wildlife than non-motorized boats because motorboats produce a combination of movement and noise (Tuite et al. 1983, Knight and Cole 1995). Motorized boats can also cover a larger area in a relatively short time, in comparison to non-motorized boats. Motorized boats introduce noise and pollution, in the form of gas and oil, and particulates in the air, in estuarine and riverine habitats of the Refuge. Hydrocarbon pollution has been found to bio accumulate with the complex food web, posing a serious threat to the marine environment (Tjarnlund et al. 1993). Hydrocarbons can also be transferred to eggs from the plumage of incubating birds. Extremely small amounts of petroleum hydrocarbons can be toxic to eggs and birds that ingest these contaminants (Hoffman 1989).

Canoes and kayaks can cause significant disturbance effects based on their ability to penetrate into shallower marsh areas (Speight 1973, Knight and Cole 1995). In the Ozark National Scenic

Riverway, green heron activity declined on survey routes when canoes and boat use increased on the main river channel (Kaiser and Fritzell 1984). Canoes or slow moving boats have also been observed to disturb nesting great blue herons (Vos et al. 1985). Huffman (1999) found that non-motorized boats within 30 meters of the shoreline in south San Diego Bay caused all wintering waterfowl to flush between the craft and shore. However, compared to motorboats, canoes and kayaks appear to have less disturbance effects on most wildlife species (Jahn and Hunt 1964, Huffman 1999, DeLong 2002).

The total number of boats and people can be an inappropriate measure of recreational intensity because the presence of a single boat might be just as disturbing as that of many (Tuite et al. 1983, Knight and Knight 1984). Even a low level of boating activity affects the duration and pattern of use by wildlife (Bratton 1990).

Refuge-specific Impacts:
People engaging in fishing and clamming generally access the Refuge by motorized vehicles travelling on public roads, and using pullouts and parking lots. Pullouts, parking lots, and public roads have minimal direct impacts because they occupy a relatively small acreage.

Currently the Siletz Bay NWR does not provide fishing and clamming opportunities. Under the CCP's management direction, the Refuge will add river bank fishing from Alder Island and undeveloped access to state managed intertidal mudflat habitat for clamming through Refuge-owned Snag Alley. Along river banks and within mudflats, foot travel will result in a minor amount of habitat degradation (vegetation modification and soil compaction) from fishing activities.

Pedestrian access: Pedestrian access for fishing to the Refuge creates the highest potential for disturbance or damage to natural resources. Foot travel associated with bank fishing and clamming could potentially result in temporary and minor vegetation trampling. Foot travel may also potentially create disturbance in or near any habitat.

Angler access is limited to the Alder Island Nature Trail and clamming access on the Refuge is unrestricted west of U.S. Highway 101. The trail will provide anglers with a designated route of travel to fishing access points, and will provide protection for sensitive resources through proper routing and construction techniques. The remainder of the island will be closed to pedestrian access. This sanctuary area limits pedestrian disturbance during the migratory bird seasons (e.g., spring and fall) and during resident bird breeding season (e.g., spring and summer).

Since most visitors to a nature area with trails actually remain on designated trails, direct effects to vegetation from trampling and wildlife disturbance effects off trail are expected to be minor. In addition, since research indicates that wildlife habituate best to predictable disturbance, once the trail and fishing access points are established and use becomes regular, direct effects to wildlife from use of the trail and access points should further diminish. Providing and maintaining access points indirectly impacts wildlife by creating barriers to movement, through vegetation removal and human use of the access point, and abrupt edge creation which may lead to increased predation (Ratti and Reese 1988). Trail edges may concentrate prey species and may be used by predators as travel corridors. Other indirect impacts may include the deposition of litter and erosion caused by the damage to vegetation from trampling. To mitigate for these impacts, refuge staff will monitor the parking area and the trail, removing litter and replanting if necessary to maintain clearly delineated access points and encourage anglers to use them.

Both fishing and clamming visitation and emphasis devoted to fishing are projected to increase under the CCP's management direction. Given this, future disturbance effects are likely to be somewhat higher than present. Most studies cited above have demonstrated immediate, rather than long-term responses to disturbance. Long-term responses are inherently more difficult and expensive to determine. If disturbance to wildlife or damage to habitat reaches unacceptable levels, the Service will reevaluate the access and consider revising regulations to reduce impacts.

Under the CCP's management direction, bank fishing and clamming access will be opened within Alder Island and west of U.S. Highway 101. Over the life of the CCP, none of these uses is expected to conflict with wildlife observation, photography, interpretation, or waterfowl hunting activities due to the limited numbers of individuals engaged in fishing and clamming, and the limited areas where the uses will be allowed.

Impacts to listed species: The listed species found on Siletz Bay NWR are the threatened coho salmon, Pacific smelt (eulachon), and green sturgeon. Effects from bank fishing and clamming access on coho and green sturgeon are expected to be negligible. The highest potential for impacts to these species is from accidental capture during fishing for other species. Impacts to this fish species are minimized through adopting state regulations for fishing in Siletz Bay and by the small scope and limited capacity of this new fishing opportunity. It is expected no impact or a neutral effect on eulachon will occur because of fishing activities. In addition, specific public education (e.g., handouts) can assist in raising awareness and preventing undue impacts to these species.

Sport fishing in waters containing coho salmon is an approved recreational activity by the National Marine Fisheries Service under a Section 7 consultation of the Endangered Species Act within a Biological Opinion (Pacific Fisheries Management Council [PFMC] 1999) and under ODFW's "Oregon Coastal Coho, Coastal Rivers Coho Sports Fishery" Fisheries and Management Plan (National Marine Fisheries Service concurred with under limit 4 of the Endangered Species Act 4(d) rule; ODFW 2009, NMFS 2009).

Impacts to Other Priority Public Uses:
Siletz Bay NWR is committed to providing quality opportunities for wildlife-dependent recreation. The Refuge supports five of the six Refuge System priority wildlife-dependent uses including hunting, fishing, wildlife observation and photography, and interpretation. The majority of the refuge lands west of Highway 101 will be opened to other public uses (e.g., wildlife observation and photography) during the fishing and clamming seasons and may overlap with waterfowl hunting season as well. If there is seasonal overlap, there could be very minor impacts to waterfowl hunters and possibly visitors observing wildlife in the mudflats west of the highway; however, since these uses are largely conducted under differing tides and weather conditions the conflict should be negligible.

Bank fishing and clamming generally result in little disturbance to other visitors. However, some anglers may inadvertently flush waterfowl being pursued by hunters on the west side of Highway 101. While clamming does occur it is not as popular in the fall and winter due to inclement weather. Also the impact of clammers on waterfowl hunters is expected to be negligible since clammers are accessing the site at low tide and hunters are accessing the site during high tide. Therefore, the direct impact to waterfowl hunters is expected to be minor. The lack of conflicts between the uses and the low potential for development of these conflicts in the future should allow these uses to occur simultaneously. This conflict is expected to be minimal on these lands, because waterfowl hunting will occur only during late fall and winter, a time of year when visitors engaged in clamming are fewer in number.

Recreational bank fishing in the Siletz River will be allowed from one or more designated locations along the Alder Island Nature Trail and will be designed to minimize conflicts with other public uses. Both anglers and visitors engaged in wildlife observation, photography, and interpretation will be using Alder Island at the same time. The direct impacts from fishing on Alder Island visitors engaged in wildlife observation and photography are expected to be very minimal since wildlife observers will likely walk the trail and anglers usually choose a fishing spot and stay there.

No significant effects to roads, trails, or other infrastructure from the fishing programs are foreseen. Normal road, trail, and facility maintenance will continue to be necessary. There will be a minor recurring impact on some members of the refuge staff as their workload will increase through such tasks as overseeing the construction of the parking lot at the Alder Island trailhead, law enforcement patrols, and maintenance of the site will increase staff workload.

Law enforcement patrols will be conducted on a regular basis to ensure compliance with State, Federal, and Refuge regulations. The refuge law enforcement officer will also monitor and collect data on fishing activities in the field to ensure they do not interfere with other wildlife-dependent uses. If necessary, the program will be modified accordingly.

Public Review and Comment:

Fishing was discussed at two public meetings held in conjunction with the Comprehensive Conservation Plan process. To initiate the CCP process, a Notice of Intent was published in the Federal Register on November 29, 2010 (Volume 75, Number 228). Written comments were solicited from the public about proposed wildlife-dependent recreational uses including fishing and clamming. Three CCP planning updates were prepared to summarize the progress of the CCP and to discuss issues related the planning process. This compatibility determination was submitted for public review and comment as an appendix to the Draft Comprehensive Conservation Plan and Environmental Assessment for Siletz Bay NWR. Appendix K of the CCP contains a summary of the comments and Service responses.

Determination:

__________ Use is Not Compatible

____X____ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility:

- Fishing is allowed only during daylight hours.
- Anglers will be permitted to use pole and line or rod and reel. Anglers must attend their line.
- The Service will provide containers for anglers along the Alder Island Nature Trail to discard their used monofilament line.
- The Refuge will ensure safety and minimize conflict with other priority public uses by providing information about fishing and clamming to the general public and those utilizing other refuge programs. These materials will clearly state pertinent State Federal, and Refuge-specific regulations. Information will be provided at interpretive kiosks, on the refuge website and in refuge offices.
- Anglers are required to comply with ODFW fishing regulations.
- The Refuge will provide signs and brochures to promote appropriate use of refuge lands to minimize wildlife and habitat disturbance, including boating practices such as no-wake and slower speeds. These materials will clearly state pertinent refuge-specific regulations.
- For Alder Island anglers will access the area by a paved parking lot on the east side of U.S. Highway 101 and the Alder Island Nature Trail that traverses the perimeter of the island.
- The Service will not provide infrastructure or parking on refuge lands west of U.S. Highway 101 to enhance clamming so visitors will be advised to use caution.
- The Alder Island Nature Trail and associated parking lot and refuge lands east of U.S. Highway 101 will be open year-round during daylight hours only.
- Pets and dogs will only be allowed outside of vehicles in parking areas (not on trails) and must be kept on-leash any time they are outside vehicles.

- Camping, overnight use, and fires are prohibited.
- The Service will implement a program to monitor fish population numbers and habitat use and reserves the right to modify existing programs to accommodate existing or changing conditions.

Justification:

Wildlife-dependent recreational uses including fishing receive enhanced consideration in the Comprehensive Conservation Planning process. Given the limited locations of bank fishing and clamming access, these uses are expected to have a minor direct impact on refuge resources. The associated disturbance to wildlife from these activities, though larger than at present, is also expected to be minor. It is anticipated that wildlife populations will find sufficient food resources and resting places such that their abundance and use of the Refuge will not be measurably lessened from allowing these activities to occur. The relatively limited number of individual animals and plants expected to be adversely affected will not cause wildlife populations to materially decline, the physiological condition and production of refuge species will not be impaired, their behavior and normal activity patterns will not be altered dramatically, and their overall welfare will not be negatively impacted. Thus, allowing fishing and clamming access under the stipulations described above will not materially detract or interfere with the purposes for which the Refuge was established or the refuge mission. Furthermore, bank fishing and clamming access on the Siletz Bay NWR will create a greater awareness among anglers about the importance of estuaries and unimpeded coastal creeks for salmonids. Fishing provides visitors with the joy of experiencing wildlife on their public lands, and as such, helps fulfill the mission of the National Wildlife Refuge System.

Mandatory Re-Evaluation Date:

____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

____X____ Environmental Assessment and Finding of No Significant Impact

__________ Environmental Impact Statement and Record of Decision

References:

Bell, D.V. and L.W. Austin. 1985. The game-fishing season and its effects on overwintering wildfowl. Biological Conservation 33:65-80.

Bouffard, S.H. 1982. Wildlife values versus human recreation: Ruby Lake National Wildlife Refuge. Transactions of the North American Wildlife and Natural Resources Conference 47:553-556.

Boyle, S.A. and F.B. Samson. 1985. Effects of non-consumptive recreation on wildlife: a review. Wildlife Society Bulletin 13:110-116.

Bratton, S.P. 1990. Boat disturbance of ciconiiformes in Georgia estuaries. Colonial Waterbirds 13:124-128.

Burger, J. 1986. The effect of human activity on shorebirds in two coastal bays in northeastern United States. Biological Conservation 13:123-130.

Burger, J. and M. Gochfeld. 1991. Human activity influence and diurnal and nocturnal foraging of sanderlings (*Calidris alba*). Condor 93:259-265.

Cooke, A.S. 1987. Disturbance by anglers of birds at Grafham Water. Pages 15-22 in: P.S. Maitland and A.K. Turner, eds. Angling and wildlife in fresh waters. ITE Symposium 19.

DeLong, A. 2002. Managing visitor use and disturbance of waterbirds. a literature review of impacts and mitigation measures. Appendix L in: Stillwater National Wildlife Refuge Complex final environmental impact statement for the comprehensive conservation plan and boundary revision, Volume 2. U.S. Department of the Interior, Fish and Wildlife Service, Region 1, Portland, OR. 114 pp.

Dwyer, N.C. and G.W. Tanner. 1992. Nesting success in Florida sandhill cranes. Wilson Bulletin 104:22-31.

Edwards, R.W. and D.V. Bell. 1985. Fishing in troubled waters. New Science 1446(7 March):19-21.

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

Fairbanks, W.S. and R. Tullous. 2002. Distribution of pronghorn (*Antilocapra americana* Ord) on Antelope Island State Park, USA, before and after establishment of recreational trails. Natural Areas Journal 22:277-282.

Fraser, J.D., L.D. Frenzel, and J.E. Mathisen. 1985. The impact of human activities on breeding bald eagles in north-central Minnesota. Journal of Wildlife Management 49:585-592.

Freddy, D.J. 1986. Responses of adult mule deer to human harassment during winter. Page 286 in: R.D. Comer, T.G. Baumann, P. Davis, J.W. Monarch, J. Todd, S. VanGytenbeek, D. Wills, and J. Woodling, eds. Proceedings II. Issues and technology in the management of impacted western wildlife: Proceedings of a national symposium. Thorne Ecological Institute. Boulder, CO.

Grubb, T.G. and R.M. King, 1991. Assessing human disturbance of breeding bald eagles with classification tree models. Journal of Wildlife Management 55:500-511.

Hoffman, D.J. 1989. Embryotoxicity and teratogenicity of environmental contaminants to bird eggs. Review of Environmental Contamination and Toxicology 115:41-50.

Huffman, K. 1999. San Diego South Bay survey report-effects of human activity and water craft on wintering birds in South San Diego Bay. USFWS. 45 pp.

Jahn, L.R. and R.A. Hunt. 1964. Duck and coot ecology and management in Wisconsin. Technical Bulletin No. 33. Wisconsin Conservation Department. Madison, WI. 212 pp.

Kaiser, M.S. and E.K. Fritzell. 1984. Effects of river recreationists on green-backed heron behavior. Journal of Wildlife Management 48:561-567.

Klein, M.L. 1989. Effects of high levels of human visitation on foraging waterbirds at J.N. "Ding" Darling National Wildlife Refuge, Sanibel, Florida. Final report to the U.S. Fish and Wildlife Service. Gainesville, FL. 103 pp.

Knight, R.L., D.P. Anderson, and N.V. Marr. 1991. Responses of an avian scavenging guild to anglers. Biological Conservation 56:195-205.

Knight, R.L. and D.N. Cole. 1995. Wildlife responses to recreationists. Pages 51-70 in: R.L. Knight and K.J. Gutzwiller, eds. Wildlife and recreationists: coexistence through management and research. Washington, D.C.: Island Press.

Knight, R.L. and S.K. Knight. 1984. Responses of wintering bald eagles to boating activity. Journal of Wildlife Management 48:999-1004.

Liddle, M.J. and H.R.A. Scorgie. 1980. The effects of recreation on freshwater plants and animals: a review. Biological Conservation 17:183-206.

MacArthur, R.A., V. Geist, and R.H. Johnston. 1982. Cardiac and behavioral responses of mountain sheep to human disturbance. Journal of Wildlife Management 46:351-358.

Miller, S.G., R.L. Knight, and C.K. Miller. 2001. Wildlife responses to pedestrians and dogs. Wildlife Society Bulletin 29:124-132.

NMFS (National Marine Fisheries Service). 2009. Letter from Barry Thom, NMFS, to Ed Bowles, ODFW, dated September 1, 2009, concurring with ODFW's "Oregon Coastal Coho, Coastal Rivers Coho Sports Fishery" Fisheries Management and Evaluation Plan under limit 4 of the 4(d) rule. Northwest Region, Salmon Management Division, Roseburg, Oregon.

ODFW (Oregon Department of Fish and Wildlife). 2009. Fisheries management and evaluation plan: Oregon coastal coho, coastal rivers coho sports fishery. Available at: http://www.nwr.noaa.gov/Salmon-Harvest-Hatcheries/State-Tribal-Management/upload/FMEP-OCC-coastal-rivers-final.pdf. Accessed March 2, 2012.

PFMC (Pacific Fisheries Management Council). 1999. Final amendment 13 to the Pacific Coast salmon plan. National Oceanic and Atmospheric Administration Award Number NA97FC0031. Available at: http://www.pcouncil.org/wp-content/uploads/finala13.pdf. Accessed March 2, 2012.

Pfister, C., B.A. Harrington, and M. Lavine. 1992. The impact of human disturbance on shorebirds at a migration staging area. Biological Conservation 60:115-126.

Ratti, J.T. and K.P. Reese. 1988. Preliminary test of the ecological trap hypothesis. Journal of Wildlife Management 52:484-491.

Skagen, S.S. 1980. Behavioral responses of wintering bald eagles to human activity on the Skagit River, Washington. Pages 231-241 in: R.L. Knight, G.T. Allen, M.V. Stalmaster, and C.W. Servheen, eds. Proceedings of the Washington bald eagle symposium. Seattle, WA. 254 pp.

Skagen, S.K., R.L. Knight, and G.H. Orians. 1991. Human disturbances of an avian scavenging guild. Ecological Applications 1:215-225.

Speight, M.C.D. 1973. Outdoor recreation and its ecological effects: a bibliography and review. Discussion Papers in Conservation 4. University College. London, United Kingdom. 35 pp.

Strauss, E.G. 1990. Reproductive success, life history patterns, and behavioral variation in a population of piping plovers subjected to human disturbances. Ph.D. dissertation. Tufts University, Medford, MA.

Taylor, A.R. and R.L. Knight. 2003. Wildlife responses to recreation and associated visitor perceptions. Ecological Applications 13:951-963. doi:10.1890/1051-0761(2003)13[951:WRTRAA]2.0.CO;2.

Tjarnlund, U., G. Ericson, E. Landesjoo, I. Petterson, and L. Balk. 1995. Investigation of the biological effects of two-cycle outboard engines' exhaust on fish. Marine Environmental Research 39:313-316.

Tuite, C.H., M. Owen, and D. Paynther. 1983. Interaction between wildfowl and recreation at Llangorse Lake and Talybont Reservoir, South Wales. Wildfowl 34:48-63.

Tydeman, C.F. 1977. The importance of the close fishing season to breeding bird communities. Journal of Environmental Management 5:289-296.

Vos, D.K., R.A. Ryder, and W.D. Graul. 1985. Response of breeding great blue herons to human disturbance in northcentral Colorado. Colonial Waterbirds 8:13-22.

Refuge Determination:

Prepared by:	Rebecca G. Chuck (Signature)	12/18/12 (Date)
Refuge Manager/ Project Leader Approval:	Rebecca G. Chuck Acting (Signature)	12/18/12 (Date)

Concurrence:

Refuge Supervisor:	(Signature)	12/18/12 (Date)
Regional Chief, National Wildlife Refuge System:	(Signature)	12-19-12 (Date)

B.5 Compatibility Determination

Use: Research, Scientific Collecting, and Surveys

Research: Planned, organized, and systematic investigation of a scientific nature.

Scientific collecting: Gathering of refuge natural resources or cultural artifacts for scientific purposes.

Surveys: Scientific inventory or monitoring.

Refuge Name: Siletz Bay National Wildlife Refuge

County and State: Lincoln County, Oregon

Establishing and Acquisition Authorities:

Siletz Bay NWR was established in 1991 under the authority of the Fish and Wildlife Act of 1956 [U.S.C. 742f(a)(4) and 16 U.S.C. 742f(b)(1)]. Additional establishment authorities include the Emergency Wetlands Resources Act of 1986 [16 U.S.C. 39 100 Stat 3583] and the Endangered Species Act of 1973, as amended [16 U.S.C. 1534-1544].

Refuge Purpose(s):

- "for the development, advancement, management, conservation, and protection of fish and wildlife resources" [U.S.C. 742f(a)(4)]…"for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude" [16 U.S.C. 742f (b)(1) (Fish and Wildlife Act of 1956)].
- for "the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to fulfill international obligations contained in various migratory bird treaties and conventions"; [16 U.S.C. 39 100 Stat 3583] (Emergency Wetlands Resources Act of 1986)
- "to conserve (a) fish or wildlife which are listed as endangered species or threatened species…or (b) plants" [16 U.S.C. 1534 (Endangered Species Act of 1973)]

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(s):

The refuge staff receives periodic requests from non-Service entities (e.g., universities, state or territorial agencies, other Federal agencies, nongovernmental organizations) to conduct research, scientific collecting, and surveys on refuge lands. These project requests can involve a wide range of natural and cultural resources as well as public-use management issues including basic absence/presence surveys, collection of new species for identification, 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, bioprospecting, 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 lands to larger landscapes (e.g., ecoregion, region, flyway, national, international) issues and trends.

The Service's Research and Management Studies (4 RM 6) and Appropriate Refuge Uses (603 FW1.10D(4)) policies 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 needs for resource and/or wilderness management goals and objectives, where applicable, will be given a higher priority over other requests.

Availability of Resources:

Refuge staff responsibilities for projects by non-Service entities will be primarily be limited to the following: review of proposals, prepare SUP(s) and other compliance documents (e.g., Section 7 of the Endangered Species Act of 1973, Section 106 of the National Historic Preservation Act), and monitor project implementation to ensure that impacts and conflicts remain within acceptable levels (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 Service employees will be determined for each project. Sufficient funding in the general operating budget of the Refuge must be available to cover expenses for these projects. The terms and conditions for funding and staff support necessary to administer each project on the Refuge will be clearly stated in the SUP(s).

The Refuge has the following staffing and funding to administratively support and monitor research that is currently taking place on refuge lands (see table below). Any substantial increase in the number of projects will 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 may result in finding a project not compatible unless expenses are offset by the investigator(s), sponsoring agency, or organization.

Category and Itemization	One-time ($)	Annual ($/yr)
Administration and management		$1,000
Maintenance		$500
Monitoring		$1,750
Special equipment, facilities, or improvement		
Totals		**$3,250**

Itemized costs in the previous table are current estimates calculated using 30% of the base cost for a GS-11 refuge biologist and a 3% cost of a GS-11 refuge manager.

Anticipated Impacts of the Use(s):

Use of the Refuge to conduct research, scientific collecting, and surveys will generally provide information that will benefit fish, wildlife, plants, and their habitats. 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.

If project methods impact or conflict with Refuge-specific resources, priority wildlife-dependent public uses, other high-priority research, wilderness, and refuge habitat and wildlife management programs, then it must be clearly demonstrated that its scientific findings will contribute to resource management and that the project cannot be conducted off refuge lands for the project to be compatible. The investigator(s) must identify methods/strategies in advance required to minimize or eliminate the potential impact(s) and conflict(s). If unacceptable impacts cannot be avoided, then the project will not be compatible. 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 CFR 29.1).

Impacts will be project- and site-specific, and they will vary depending upon nature and scope of the field work. Data collection techniques will generally have minimal 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 will 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.

Investigator(s) obtaining required State or Territorial, and Federal collecting permits will also ensure minimal impacts to fish, wildlife, plants, and their habitats. If, even after incorporating the above strategies, projects would result in long-term or cumulative effects, projects would not be compatible. A Section 7 consultation under the Endangered Species Act (16 U.S.C. 1531-1544, 87 Stat. 884, as amended Public Law 93-205) will be required for activities that may affect a federally listed species and/or critical habitat. Only projects that have no effect or will result in not likely to adversely affect determinations will be considered compatible.

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 (see Attachment 4). If after all practical measures are taken and unacceptable spread of invasive species is anticipated to occur, then the project will be found not compatible without a restoration or mitigation plan.

There also could be localized and temporary effects from vegetation trampling, collecting of soil and plant samples, or trapping and handling of wildlife. Impacts may also occur from infrastructure necessary to support a projects (e.g., permanent transects or plot markers, exclosure devices, monitoring equipment, solar panels to power unattended monitoring equipment). Some level of disturbance is expected with these projects, especially if investigator(s) enter areas closed to the public and collect samples or handle wildlife. However, wildlife disturbance (including altered behavior) will usually be localized and temporary in nature. Where long-term or cumulative unacceptable effects cannot be avoided, the project will not be found compatible. Project proposals will be reviewed by refuge staff and others, as needed, to assess the potential impacts (short, long-term, and cumulative) relative to benefits of the investigation to refuge management issues and understanding of natural systems.

At least 6 months before initiation of field work (unless an exception is made by prior approval of the refuge manager), project investigator(s) must submit a detailed proposal using the format provided in Attachment 1. Project proposals will be reviewed by refuge staff and others, as needed, to assess the potential impacts (short, long-term, and cumulative) relative to benefits of the investigation to refuge management issues and understanding of natural systems. This assessment will form the primary basis for allowing or denying a specific project. Projects that result in unacceptable refuge impacts will not be found compatible. If allowed and found compatible after approval, all projects also will be assessed during implementation to ensure impacts and conflicts remain within acceptable levels.

If the proposal is approved, then the refuge manager will issue a SUP(s) with required stipulations (terms and conditions) of the project to avoid and/or minimize potential impacts to refuge resources as well as conflicts with other public-use activities and refuge field management operations. After approval, projects also are monitored during implementation to ensure impacts and conflicts remain within acceptable levels based upon documented stipulations.

The combination of stipulations identified above 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. As a result, these projects will help fulfill refuge purpose(s); contribute to the Mission of the NWRS; and maintain the biological integrity, diversity, and environmental health of the Refuge.

Projects that are not covered by the CCP (objectives under Goal 5 [Gather scientific information (surveys, research, and assessments) to support adaptive management decisions under objectives for Goals 1-4]) will require additional NEPA documentation.

Public Review and Comment:

This CD was prepared concurrently with the Siletz Bay NWR CCP/EA. Public notice was provided and open houses were held and written comments were solicited from the public during the scoping period for the CCP/EA. Public review and comment were solicited during the draft CCP/EA comment period. Appendix K of the CCP contains a summary of the comments and Service responses.

Determination: (check one below)

__________ Use is Not Compatible

____X____ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility:

Each project will require a SUP. Annual or other short-term SUPs are preferred; however, some permits will be for a longer period, if needed, to allow completion of the project. All SUPs will have a definite termination date in accordance with 5 RM 17.11. Renewals will be subject to refuge manager review and approval based timely submission of and content in progress reports, compliance with SUP stipulations, and required permits.

- Projects will adhere to scientifically defensible protocols for data collection, where available and applicable.
- Investigators must possess appropriate and comply with conditions of State or Territorial and Federal permits for their projects.
- If unacceptable impacts to natural resources or conflicts arise or are documented by the refuge staff, then the refuge manager can suspend, modify conditions of, or terminate an on-going project already permitted by SUP(s) on a refuge(s).
- Progress reports are required at least annually for multiple-year projects. The minimum required elements for a progress report will be provided to investigator(s) (see Attachment 2).
- Final reports are due one year after completion of the project unless negotiated otherwise with the refuge manager.
- Continuation of existing projects will require approval by the refuge manager.
- The refuge staff will be given the opportunity to review draft manuscript(s) from the project before being submitted to a scientific journal(s) for consideration of publication.
- The refuge staff will be provided with copies (reprints) of all publications resulting from a refuge project.
- 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, all equipment and markers (unless required for long-term projects), must be removed and sites must restored to the refuge manager’s satisfaction. Conditions for clean-up and removal of equipment and physical markers will be stipulated in the SUP(s).
- 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 understand will be necessary (see Attachment 3).
- Sampling equipment as well as investigator(s) clothing and vehicles (e.g., ATV, boats) will be thoroughly cleaned (free of dirt and plant material) before being allowed for use on refuge lands to prevent the introduction and/or spread of pests. Where necessary, utilize quarantine methods (see Attachment 4).
- The NWRS, specific refuge, names of refuge staff, and other Service personnel who supported or contributed to the project will be appropriately cited and acknowledged in all written and oral presentations resulting from projects on refuge lands.
- At any time, refuge staff may accompany investigator(s) in the field.
- Investigator(s) and support staff will follow all Refuge-specific regulations that specify access and travel on the refuge(s).

Justification:

Research, scientific collecting, and surveys on refuge lands are inherently valuable to the Service because they will expand scientific information available for resource management decisions. In addition, only projects that 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 refuge staff providing access to refuge lands and waters along with some support, the project would never occur and less scientific information will be available to the Service to aid in managing and conserving the refuge resources. By allowing the use to occur under the stipulations described above, it is anticipated that wildlife species which could be disturbed during the use will find sufficient food resources and resting places 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; contributing to the Mission of the NWRS; and maintaining the biological integrity, diversity, and environmental health of the Refuge.

Mandatory Re-Evaluation Date:

__________ 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

____X____ Environmental Assessment and Finding of No Significant Impact

__________ Environmental Impact Statement and Record of Decision

Refuge Determination:

Prepared by:	Rebecca G. Chuck (Signature)	12/18/12 (Date)
Refuge Manager/ Project Leader Approval:	Rebecca G. Chuck Acting (Signature)	12/18/12 (Date)

Concurrence:

Refuge Supervisor:	[illegible] (Signature)	12/18/12 (Date)
Regional Chief, National Wildlife Refuge System:	[illegible] L. West (Signature)	12-19-12 (Date)

Attachment 1

FORMAT FOR PROPOSALS TO CONDUCT RESEARCH OR LONG-TERM MONITORING ON NATIONAL WILDLIFE REFUGES

A Special Use Permit (SUP) is required to conduct research and/or long-term monitoring on refuge lands. To receive a SUP, a detailed project proposal using the following format must be submitted to the Refuge Manager approximately 6 months prior to the start of the project.

Title:

Principal Investigator(s):
Provide the name(s) and affiliation(s) of all principal investigator(s) that will be responsible for implementation of the research and/or long-term monitoring described in the proposal. In addition, provide a brief description or attach vitae of expertise for principal investigator(s) germane to work described in the proposal.

Background and Justification:
In a narrative format, describe the following as applicable:

7. The resource management issue (e.g., decline in Pisonia rainforest) and/or knowledge gap regarding ecological function that currently exists with any available background information.
8. Benefit of project findings (e.g., management implications) to resources associated with refuge.
9. Potential consequences if the conservation issue and/or knowledge gap regarding ecological function is not addressed.

Objectives:
Provide detailed objective(s) for the proposed project.

Methods and Materials:
Provide a detailed description of the methods and materials associated with field and laboratory work (if applicable) to be conducted for the project. Methods should include the following:

10. study area(s)
11. number of samples;
12. sampling dates and locations
13. sampling techniques
14. data analyses including statistical methods and significance levels.

Previously published methods should be cited without explanation; whereas, new or modified techniques should be described in detail. Include number of personnel as well as all facilities and equipment (e.g., vehicles, boats, structures, markers) required to collect samples/data. Provide a clear description of the relationships among study objectives, field methods, and statistical analyses.

Permits:
Identify all State or Territorial and Federal permits required if applicable.

Potential Impacts to Refuge Resources:

Describe potential impacts to threatened or endangered species as well as other refuge plants, wildlife, and fish species that could result from the implementation of project activities on the refuge. Consider the cumulative impacts associated with this project.

Animal Welfare Plan:
If appropriate, attach a copy of the Institutional Animal Care and Use review and/or animal welfare plans that are required by the principle investigator's affiliation.

Partnerships and Funding Sources:
List other participating institutions, agencies, organizations, or individuals as well as the nature and magnitude of their cooperative involvement (e.g., funding, equipment, personnel).

Project Schedule:
Provide estimated initiation and completion dates for field sampling, laboratory work, data analyses, and report/manuscript preparation. If the project is divided into phases to be accomplished separately provide separate initiation and completion dates for each phase.

Reports and Raw Data:
Establish a schedule for annual progress and final reports; include adequate time for peer review of the final report/manuscript. Draft reports/manuscripts should be submitted to the Refuge Manager for review prior to submission for consideration of publication. At the conclusion of a research study (manuscripts accepted for publication), an electronic copy of the data (e.g., GIS vegetation layers, animal species composition and numbers, genetics) should be provided to the Refuge Manager. For long-term monitoring projects, the Service also requires raw data for management and planning purposes for the refuge(s).

Publications:
Describe the ultimate disposition of study results as publications in scientific journals, presentation at professional symposiums, or final reports.

Disposition of Samples:
If the project entails the collection of biotic and/or abiotic (e.g., sediment) samples, then describe their storage. Although the samples may be in the possession of scientists for the purposes of conducting the project in accordance with the SUP, the Service retains ownership of all samples collected on refuge lands. If the samples will be used for subsequent research activities that are not described within the original proposal, a new proposal must be submitted to the Refuge Manager to obtain a SUP before initiation of the follow-up project. After conclusion of the research activities, consult with the Refuge Manager regarding the final disposition of the samples. If specimens will be curated at a museum, then prepare a MOU using the format provided in Attachment 3.

Attachment 2

ANNUAL PROGRESS REPORTS FOR REFUGE RESEARCH AND LONG-TERM MONITORING PROJECTS

Study title:

Fiscal year:

Progress:
In a narrative format, summarize the work that was completed on the study including the number and types of samples collected and/or data analyses.

Important findings:
In narrative format, generally describe any conclusions and/or management recommendations that may be drawn from the work completed to date.

Describe problems encountered:
In narrative format, describe any problems that were encountered during the year and their effects upon the study.

Proposed resolution to problems:
For each problem encountered, describe the actions that have been taken to remediate it.

Preparer:

Date prepared:

Attachment 3

MEMORANDUM OF UNDERSTANDING FOR CURATORIAL SERVICES BETWEEN THE

(Name of the Federal agency) AND THE (Name of the Repository)

This Memorandum of Understanding is entered into this (**day**) day of (**month and year**), between the United States of America, acting by and through the (**name of the Federal agency**), hereinafter called the Depositor, and the (**name of the Repository**), hereinafter called the Repository, in the State/Territory of (**name of the State/Territory**).

The Parties do witnesseth that

WHEREAS, the Depositor has the responsibility under Federal law to preserve for future use certain collections of paleontological specimens and/or biological samples as well as associated records, herein called the Collection, listed in Attachment A which is attached hereto and made a part hereof, and is desirous of obtaining curatorial services; and

WHEREAS, the Repository is desirous of obtaining, housing and maintaining the Collection, and recognizes the benefits which will accrue to it, the public and scientific interests by housing and maintaining the Collection for study and other educational purposes; and

WHEREAS, the Parties hereto recognize the Federal Government's continued ownership and control over the Collection and any other U.S. Government-owned personal property, listed in Attachment B which is attached hereto and made a part hereof, provided to the Repository, and the Federal Government's responsibility to ensure that the Collection is suitably managed and preserved for the public good; and

WHEREAS, the Parties hereto recognize the mutual benefits to be derived by having the Collection suitably housed and maintained by the Repository;

NOW THEREFORE, the Parties do mutually agree as follows:

1. The Repository shall:

    a. Provide for the professional care and management of the Collection from the (**names of the resources**) sites, assigned (**list site numbers**) site numbers. The collections were recovered in connection with the (**name of the Federal or federally-authorized project**) project, located in (**name of the nearest city or town**), (**name of the county, if applicable**) county, in the State/Territory of (**name of the State/Territory**)-

    b. Assign as the Curator, the Collections Manager and the Conservator having responsibility for the work under this Memorandum, persons who are qualified museum professionals and whose expertise is appropriate to the nature and content of the Collection.

c. Begin all work on or about (**month, date and year**) and continue for a period of (**number of years**) years or until sooner terminated or revoked in accordance with the terms set forth herein.

d. Provide and maintain a repository facility having requisite equipment, space and adequate safeguards for the physical security and controlled environment for the Collection and any other U.S. Government-owned personal property in the possession of the Repository.

e. Not in any way adversely alter or deface any of the Collection except as may be absolutely necessary in the course of stabilization, conservation, scientific study, analysis and research. Any activity that will involve the intentional destruction of any of the Collection must be approved in advance and in writing by the Depositor.

f. Annually inspect the facilities, the Collection and any other U.S. Government-owned personal property. Every (**number of years**) years inventory the Collection and any other U.S. Government-owned personal property. Perform only those conservation treatments as are absolutely necessary to ensure the physical stability and integrity of the Collection, and report the results of all inventories, inspections and treatments to the Depositor.

g. Within five (5) days of discovery, report all instances of and circumstances surrounding loss of, deterioration and damage to, or destruction of the Collection and any other U.S. Government-owned personal property to the Depositor, and those actions taken to stabilize the Collection and to correct any deficiencies in the physical plant or operating procedures that may have contributed to the loss, deterioration, damage or destruction. Any actions that will involve the repair and restoration of any of the Collection and any other U.S. Government-owned personal property must be approved in advance and in writing by the Depositor.

h. Review and approve or deny requests for access to or short-term loan of the Collection (or a part thereof) for scientific and educational uses. In addition, refer requests for consumptive uses of the Collection (or a part thereof) to the Depositor for approval or denial.

i. Not mortgage, pledge, assign, repatriate, transfer, exchange, give, sublet, discard or part with possession of any of the Collection or any other U.S. Government-owned personal property in any manner to any third party either directly or indirectly without the prior written permission of the Depositor, and redirect any such request to the Depositor for response. In addition, not take any action whereby any of the Collection or any other U.S. Government-owned personal property shall or may be encumbered, seized, taken in execution, sold, attached, lost, stolen, destroyed or damaged.

2. The Depositor shall:

a. On or about (month, date and year), deliver or cause to be delivered to the Repository the Collection, as described in Attachment A, and any other U.S. Government-owned personal property, as described in Attachment B.

b. Assign as the Depositor's Representative having full authority with regard to this Memorandum, a person who meets pertinent professional qualifications.

c. Every (number of years) years, jointly with the Repository's designated representative, have the Depositor's Representative inspect and inventory the Collection and any other U.S. Government-owned personal property, and inspect the repository facility.

d. Review and approve or deny requests for consumptively using the Collection (or a part thereof).

3. Removal of all or any portion of the Collection from the premises of the Repository for scientific or educational purposes; any conditions for handling, packaging and transporting the Collection; and other conditions that may be specified by the Repository to prevent breakage, deterioration and contamination.

4. The Collection or portions thereof may be exhibited, photographed or otherwise reproduced and studied in accordance with the terms and conditions stipulated in Attachment C to this Memorandum. All exhibits, reproductions and studies shall credit the Depositor, and read as follows: "Courtesy of the (**name of the Federal agency**)."The Repository agrees to provide the Depositor with copies of any resulting publications.

5. The Repository shall maintain complete and accurate records of the Collection and any other U.S. Government-owned personal property, including information on the study, use, loan and location of said Collection which has been removed from the premises of the Repository.

6. Upon execution by both parties, this Memorandum of Understanding shall be effective on this (**day**) day of (**month and year**), and shall remain in effect for **(number of years**) years, at which time it will be reviewed, revised, as necessary, and reaffirmed or terminated. This Memorandum may be revised or extended by mutual consent of both parties, or by issuance of a written amendment signed and dated by both parties. Either party may terminate this Memorandum by providing 90 days written notice. Upon termination, the Repository shall return such Collection and any other U.S. Government-owned personal property to the destination directed by the Depositor and in such manner to preclude breakage, loss, deterioration and contamination during handling, packaging and shipping, and in accordance with other conditions specified in writing by the Depositor. If the Repository terminates, or is in default of, this Memorandum, the Repository shall fund the packaging and transportation costs. If the Depositor terminates this Memorandum, the Depositor shall fund the packaging and transportation costs.

7. Title to the Collection being cared for and maintained under this Memorandum lies with the Federal Government.

IN WITNESS WHEREOF, the Parties hereto have executed this Memorandum.

Signed: (signature of the Federal Agency Official) Date: (date)

Signed: (signature of the Repository Official) Date: (date)

Attachment 3A: Inventory of the Collection

Attachment 3B: Inventory of any other U.S. Government-owned Personal Property

Attachment 3C: Terms and Conditions Required by the Depositor

Attachment 4

ALIEN SPECIES QUARANTINE RESTRICTIONS FOR NATIONAL WILDLIFE REFUGES

A. Introduction

Thank you for your interest in conducting research/monitoring on the refuge(s). To protect wildlife and habitat communities found on the refuge, visitation is carefully regulated and requires that each individual, or group, secure a Special Use Permit (SUP) to gain access to the refuge. Each SUP clearly outlines the responsibilities of each permittee, including specific quarantine policies, which may be more detailed than the policies listed within this document. Details for securing a SUP can be found by contacting the Refuge Manager. Prospective scientific researchers must apply for the SUP at least 6 months prior to their proposed study period.

One of the gravest threats to the refuge(s) is the introduction of alien plant and animal species. The practices described below are complex, but the Service has found them to be effective at greatly reducing additional introductions of invasive species on refuge(s).

B. Definitions

1. **Clothing** - all apparel, including shoes, socks, over and under garments.
2. **Soft gear** - all gear such as books, office supplies, daypacks, fannypacks, packing foam or similar material, camera bags, camera/binocular straps, microphone covers, nets, holding or weighing bags, bedding, tents, luggage, or any fabric or material capable of harboring seeds or insects.
3. **New Clothing/Soft Gear** - new retail items, recently purchased and never used.
4. **Refuge Dedicated Clothing/Soft Gear** - items that have ONLY been used at the refuge(s), and which have been stored in a quarantined environment between trips to the refuge(s).
5. **Sensitive Gear - computers, optical** equipment, and other sensitive equipment.
6. **Non-Sensitive Equipment and Construction Materials** - building materials, power and hand tools, generators, misc. machinery etc.
7. **Suitable Plastic Packing Container -** packing containers must be constructed of smooth, durable plastic which can be easily cleaned and will not harbor seeds or insects. Packing containers may be re-used for multiple trips to the refuge(s), but must be thoroughly cleaned before each trip and strictly dedicated to refuge-related projects.
    - Examples of APPROPRIATE plastic packing containers are 5 gallon plastic buckets and plastic totes constructed with a single layer and having a smooth surface. All appropriate packing containers must have tight fitting plastic lids.
    - An example of an INAPPROPRIATE plastic packing container is US mail totes. Mail totes are typically constructed of cardboard-like plastic that provides a porous multi-layered surface, allowing seeds and insects to easily hitch-hike.

C. Special Use Permit (SUP)

All persons requesting use of the refuge(s) must secure a SUP, as described in Section A above, and agree to comply with all refuge requirements to minimize the risk of alien species introductions.

D. Quarantine Inspections

All personal gear, supplies, equipment, machinery, vehicles (e.g., ATVs, trucks, trailers), and vessels (e.g., planes, boats, ships, barges) will be inspected for quarantine compliance by Service staff prior to entering the refuge(s) and again before departing the refuge(s). A concerted effort will be made to ensure that alien pests are not transported. Service staff on the refuge(s) will inspect outbound cargo prior to transport.

E. Prohibited Items (Transport of the following items are strictly prohibited)

1. Rooted plants, cuttings, flowers, and seeds (raw or propagative).
2. Soil, sand, gravel, or any other material that may harbor unwanted plant and animal species.
3. Animals (no exceptions).
4. Cardboard (paper and plastic cardboard harbors seeds and insects).

F. Regulated Items (Transport of the following items are strictly regulated)

1. Food items have the potential to carry alien pests and are therefore selected, packed and shipped with great care for consumption on the refuge(s). Foods will not be allowed on the refuge(s) without prior authorization.
2. Because wood products often harbor seeds and insect, only treated wood that has been painted or varnished may be allowed on the refuge(s). Approved wood products must also be frozen for 48 hours or fumigated as described in Section K below.

G. Packing Procedures

Ensure that the environment selected for packing has been well cleaned and free of seeds and insects. Keep packing containers closed as much as possible throughout the packing process so insects cannot crawl in before the containers have been securely closed. Quarantine procedures should be performed as close to the transportation date as possible to ensure that pests do not return as hitch-hikers on the packing containers.

H. Packing Containers

1. All supplies and gear must be packed and shipped in SUITABLE PLASTIC PACKING CONTAINERS (see Section A for definitions of packing containers). Packing containers must be constructed of smooth, durable plastic that has been thoroughly cleaned prior to use.
2. Packing containers may be re-used for multiple trips to the refuge(s), but must be thoroughly cleaned before each trip and strictly dedicated to refuge-related projects. Cardboard containers are strictly prohibited because they can harbor seeds and insects.

I. Clothing and Soft Gear

1. All persons entering the refuge(s) must have NEW or REFUGE DEDICATED clothing and soft gear (including all footwear).
    a. Freeze all clothing and soft gear for 48 hours (including both new and refuge dedicated).
    b. Fumigation under a tarp or in a large container is also an option.

J. Sensitive Equipment

All sensitive gear (e.g., optical equipment, computers, satellite phones, other electronic equipment) must be thoroughly inspected and cleaned.

K. Non-Sensitive Equipment and Construction Materials

1. All non-sensitive equipment, machinery, and construction materials that are water resistant must be steam cleaned or pressure washed to ensure the removal of all dirt, insects, and seeds from external surfaces.
2. All non-water resistant items must be tented and fumigated to kill unwanted pests or frozen for 48 hours.
3. Quarantine procedures should be performed as close to the transportation date as possible to ensure that pests do not return to the equipment or packing containers.

L. Aircraft Quarantine

Aircraft personnel will ensure that the plane has been thoroughly cleaned and free of any alien species prior to flying to refuge(s). The aircraft captain will notify the Service at least 10 full working days prior to all flights departing for the refuge(s) in order to arrange a quarantine inspection of all cargo bound for the refuge(s). Inspections will take place the scheduled day of departure.

M. Commercial Ships and Barges, and Private Sailing and Motor Vessel Quarantine

1. Ship owners or captains will notify the Service at least 10 full working days prior to all vessels departing for the refuge(s) in order to arrange a quarantine inspection of all vessels and cargo bound for the refuge(s). The inspection will be scheduled as close to the departure date as possible.
2. Ship owners or captains will ensure that all ships and barges entering the refuge(s) have had their hulls cleaned of fouling marine/freshwater organisms. The ships and barges must depart for the refuge(s) within 14 days of having had the hulls cleaned. All ship and barge hulls must be re-cleaned should the vessel return to a port for greater than 14 days before returning to the refuge(s). Results of all hull cleanings must be submitted to the Service 2 full working days prior to the vessel departure. Contact the refuge office for additional details.
3. No discharge of ballast water, grey water, sewage, or waste of any kind will be allowed by any vessel within the refuge boundary (e.g., 12-mile territorial sea).

(Date)

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Appendix C. Implementation

C.1 Introduction

Implementation of the comprehensive conservation plan (CCP) will require increased funding, which will be sought from a variety of sources including Congressional allocations and public and private partnerships and grants. There are no guarantees that additional federal funds will be made available to implement any of these projects. Activities and projects identified will be implemented as funds become available.

The CCP identifies several projects to be implemented over the next fifteen years. Some of the 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. Visitor Facility and Enhancement (VFE) projects considered for funding must be requested through the Division of Visitor Services. Currently, a backlog of maintenance needs exists for Siletz Bay National Wildlife Refuge (NWR or Refuge). Prioritized staffing needs identified in the RONS will be necessary to implement the CCP to meet refuge goals and objectives and legal mandates. The SAMMS database documents and tracks repairs, replacements, and maintenance of facilities and equipment. Smaller projects will be implemented as funding allows, and funding will be sought for these projects through a variety of sources.

Annual Refuge Revenue Sharing payments, associated with Siletz Bay NWR in Lincoln County, will continue. USFWS paid the Lincoln County $2,375 in 2010 for 512 acres of refuge lands within Lincoln County.

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. Actual monitoring and evaluation procedures will be detailed in step-down management plans. General monitoring activities are discussed in Chapter 2 under Goal 5, which addresses the collection of scientific information (inventories, monitoring, feasibility studies, assessments, and research) to support adaptive management decisions on Siletz Bay NWR.

C.2 Step-Down Plans

The Comprehensive Conservation Plan is one of several necessary plans used by managers, biologists, and staff for refuge management. The CCP provides guidance in the form of goals, objectives, and strategies for several refuge program areas but may lack some of the specifics needed for implementation. Step-down management plans will be developed for individual program areas within approximately 5 years after CCP completion. All step-down plans require appropriate NEPA compliance and implementation may require additional county, state, and federal permits. Project-specific plans, with appropriate NEPA compliance, may be prepared outside of these step-down plans. Step-down plans for the Refuge follow in Table C-1.

Table C-1. Siletz Bay NWR Step-down Management Plans

Step-down Management Plan	Status (date completed and/or date to be prepared/updated)
Habitat Management Plan (HMP)	CCP meets requirement for HMP
Waterfowl Hunt Plan	Initiate planning after completion of CCP
Fishing Plan	Initiate planning after completion of CCP
Integrated Pest Management Plan	Prepared concurrently with CCP, Appendix G
Fire Management Plan	Updated 2012
Visitor Services Plan	Initiate planning after completion of CCP
Inventory and Monitoring Plan	Initiate planning after completion of CCP

C.3 Costs to Implement CCP

The following sections detail both one-time and recurring costs for various projects described within the CCP. One-time costs reflect the initial costs associated with a project, whether it is purchase of equipment, contracting services, construction, a research project, or other activity. 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 visitor and administrative facilities, habitat restoration, research, and monitoring and surveys. The scope and costs for “administrative” activities such as the development and implementation of cooperative documents (e.g., memorandum of understanding, agreements), reporting, and establishment of partnerships are difficult to estimate in advance and thus are not accounted for in the tables below.

C.3.1 One-time Costs

One-time costs are project costs that have a start-up cost associated with them, such as purchasing equipment necessary for wildlife and habitat monitoring, or designing, constructing and installing an interpretive sign. Some cost estimates are for 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 C-2 show one-time start-up and implementation costs, such as those associated with building and facility needs including replacement of buildings, public use facilities, road/trail improvements, and new signs. One-time costs in Table C-2 are also associated with projects such as habitat restoration, invasive plant and animal control, and research. In many cases, new research projects, because of their relatively high initial establishment cost, are considered one-time projects and include costs of contracting services or hiring a temporary staff position for the short-term project. Some project costs are estimated from past projects; 2011 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. Estimates of costs for Visitor Facility projects not yet in a database but have been calculated by the Portland Regional Office’s Engineering Division.

Table C-2. 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	Type	Current Management	Future Management	Potential Fund Source
Research				
Conduct research on salt marshes to determine accretion and subsidence rates	Study	7	10	1260 funds, grants
Conduct research on the potential effects of climate change and sea level rise on salt marshes	Study	8	11	1260 funds, grants, partnerships
Subtotal (thousands)		**15**	**21**	
Surveys and Assessments				
Monitor invasive/nuisance plant and animal species in mudflats, salt marsh, uplands, and forested habitats to determine distribution and infestation	Project	0	3	1260 funds
Monitor mammals, migratory landbirds, shorebirds, waterfowl, insects, and amphibians to determine populations, distributions, and habitat use	Project	3	10	
Conduct long-term hydrological, biological, and physical monitoring to determine effectiveness of salt marsh restoration projects	Project	0	3	1260 funds
Conduct baseline vegetation surveys and monitoring	Survey	3	10	1260 funds, Partnerships
Monitor habitat parameters including vegetation associated with respective habitat types to determine health of ecosystem	Survey	3	5	1260 funds, Partnerships
Survey native plant species (salt grass, pickleweed, Lyngby’s sedge, slough sedge, tufted hairgrass, Pacific silverweed and Henderson’s checkermallow) to determine distribution and density	Survey	3	5	
Subtotal (thousands)		**12**	**36**	
Habitat Management and Restoration				
Where appropriate, plant rare, native species (e.g., Henderson’s checkermallow) to increase native vegetation presence	Project	0	3	1260 funds
Install woody debris (i.e., logs and root wads) in stream channels to promote diverse hydrological and physical structure, and plant and maintain stream side vegetative cover	Project	0	6	1260 funds
Use appropriate forest management techniques where needed to thin trees in Sitka spruce-western hemlock forest	Project	0	6	1260 funds
Subtotal (thousands)		**0**	**15**	
Facilities Maintenance				
Subtotal (thousands)		**0**	**0**	

Table C-2. 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	Type	Current Management	Future Management	Potential Fund Source
Public Use				
Create an Architectural Barriers Act (ABA) accessible loop trail on Alder Island	Project	0	155	VFE funds
Develop a parking lot and viewing platform on the old Highway 101 spur road to provide visitors with walk-in access to Alder Island	Project	0	331	1260 funds, VFE
Develop a bird checklist for the Siletz Bay	Project	0	2	1260 funds, grants
Build a non-motorized boat launch along the old highway 101 spur road to provide visitors with safe access to Millport Slough	Project	0	88	1260 funds, grants
Improve the graveled parking lot along Millport Slough road to provide hunters with walk-in access	Project	0	8	1260 funds
Develop informational tear sheet on waterfowl hunting regulations	Project	0	2	1260 funds
Develop an informational kiosk and place at Millport Slough parking lot to convey refuge rules and regulations regarding waterfowl hunting	Project	0	3	1260 funds
Subtotal (thousands)		**0**	**589**	
Total of all one time project costs		**27**	**661**	

C.3.2 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 C-3 displays projected annual operating costs to implement strategies under the CCP. The CCP will require increased funding for new or expanded public uses and facilities, habitat management and restoration 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 C-3 include administrative support for all programs and projects as well as 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 C-3. Annual Operational (recurring) Costs

Activity Description	Current Management Cost Est. (K)	Future Management Cost Est. (K)	Potential Fund Source
Research: Facilitate and cooperate in specific research projects to benefit refuge resources	2	3	1260, Special Projects, Grants
Surveys and assessments: Aerial and land surveys and assessments; GIS-based inventory and monitoring programs for plants and wildlife; invasive species monitoring; monitor biodiversity trends; provide administrative and material support for all biological activities.	17	24	1260 and special project funds
Habitat management and restoration: inventory, remove, control and prevent new establishment of invasive plants and treat infestations with IPM.	19	25	1260 and special project funds
Facilities maintenance: Maintain and make minor repairs on refuge infrastructure and facilities, equipment, and interpretive and regulatory signs.	15	40	1260, SAMMS (DM)
Public use opportunities and education: Provide funding for and manage a variety of both on-refuge and off-refuge interpretive and education programs; maintain interpretive panels located on and off the Refuge to offer interpretation through self-guided experience; conduct and manage volunteer program; patrol, enforce regulations and educate visitors to the sensitivity of wildlife resources, replace boundary and regulatory signage as needed.	37	56	1260 VFE funds
Total Recurring Costs	**90**	**148**	

C.3.3 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" needs that have come due but are as yet unfunded, as well as the increased maintenance need associated with new facilities.

The existing facilities associated with Siletz Bay NWR that require maintenance include regulatory signs, fencing, two residences, and associated garage buildings. The planned facilities also include trails, kiosks, interpretive panels, roads, and parking lots. Operational (non-project) maintenance funding for the Oregon Coast NWR Complex is expended on all six Complex refuges including Siletz Bay NWR and varies significantly by year.

C.3.4 Staffing

Current (2012) staffing and future staffing to implement the programs detailed within the CCP are shown in Table C-4. Current positions described below serve all six refuges within the Oregon Coast NWR Complex. There is no separate budget for the individual refuges; thus, the staffing costs presented include the entire Complex staff in Table C-4. There is currently no staff stationed at Siletz Bay NWR. Under the CCP's management direction, a North Coast Manager will be stationed at Nestucca Bay NWR and will manage Siletz Bay, Nestucca Bay, Cape Meares and Three Arch Rocks NWRs and the north half of Oregon Islands NWR. Other Complex staff positions will expend varying amounts of time at Siletz Bay with the remainder of Complex staff time expended on the other five refuges in the Complex.

Table C-4. Current and Future Staffing

Current Position	Status	GS & Grade	Annual Salary Cost (K)* (FY12 $$)	% Expended on Siletz Bay NWR	Annual Salary (K)* Expended on Siletz Bay NWR
Project Leader	PFT	GS-0485-13	126.1	10	13
Deputy Project Leader	PFT	GS-0485-12	113.0	10	11
Wildlife Biologist	PFT	GS-0486-11	93.1	5	5
Administrative Officer	PFT	GS-0341-09	82.9	10	8.3
Visitor Services Manager	PFT	GS-0025-11	88.9	5	5
Wildlife Refuge Law Enforcement Officer	PFT	GL-1801-09	79.2	10	8
Facilities Operations Specialist	PFT	GS-1640-09	76.9	20	15.4
Office Automation Clerk	TPT	GS-0326-04	8.8	10	1
South Coast Refuge Manager	PFT	GS-0485-12	117.3	0	0
Restoration Biologist	TFT	GS-0401-11	84.3	0	0
Maintenance Worker	PFT	WG-4749-08	65.0	0	0
Total salary currently expended on Siletz Bay NWR					**66.7**
Future Position	**Status**	**GS & Grade**	**Annual Salary Cost (K)* (FY12 $$)**	**% Planned for Siletz Bay NWR**	**Annual Salary (K)* Planned for Siletz Bay NWR**
Environmental Education Specialist	PFT	GS-1001-07	49.3	0	0
South Coast Wildlife Refuge LE Officer	PFT	GL-1801-09	79.2	5	4
Volunteer Coordinator/ Interpreter	PFT	GS-0025-07	49.3	10	5
South Coast Wildlife	PFT	GS-0486-09	60.3	0	0

Table C-4. Current and Future Staffing

Biologist					
North Coast Refuge Manager	PFT	GS-0485-11	80	25	20
Complex Wildlife Biologist	PFT	GS-0486-09	60.3	10	6
Total current and future staffing costs					**101.7**

* = salary and benefits
PFT: Permanent Full Time, TFT = Term Full Time, TPT = Temporary Part Time
GS: General Schedule Federal Employee, WG: Wage Grade Federal Employee, GL: Law Enforcement Officers (LEOs)

C.3.5 Budget Summary

Table C-5 summarizes the data from Tables C-2 and C-3 and displays the overall funding needed for the Oregon Coast National Wildlife Refuge Complex to implement the CCP for Siletz Bay NWR.

Table C-5. Budget Summary (one-time projects and annual funding needs for Siletz Bay NWR as identified in the CCP)

Budget Category	Current Management		Future Management	
	One-time Cost (K)	Annual Recurring Cost (K)	One-time Cost (K)	Annual Recurring Cost (K)
Research	15	2	21	3
Surveys and assessments	12	17	36	24
Habitat management and restoration	0	19	15	25
Facilities and maintenance	0	15	0	40
Public use, education and law enforcement	0	37	589	56
Totals	**27**	**90**	**661**	**148**

C.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. Siletz Bay NWR's location along the Pacific Coast Scenic Byway and interspersed with the Lincoln City facilitates many opportunities for partnerships; however, the absence of staff stationed at this Refuge has resulted in fewer partnerships than the Refuge's location and resources could sustain. Current and past partners include Federal and state agencies, nonprofit and non-governmental organizations, school volunteers, and individuals.

The Oregon Coast NWR Complex already enjoys positive relationships with partners including state and Federal agencies, Tribes, volunteers, schools, conservation organizations, and individuals. 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 set forth in this CCP.

Oregon Department of Fish and Wildlife (ODFW)

The ODFW's management responsibilities along the coast, including lands and waters, fish and wildlife, threatened and endangered species, and other programs, frequently overlap with Service resources and responsibilities. ODFW and the Complex share mutual interests in wildlife surveys, developing joint research projects, education and outreach programs, species management and dissemination of data, results, and information to a wider audience. ODFW has been closely involved with Complex staff in fisheries habitat surveys and restoration, waterfowl surveys, predator management, and restoration project permits. Increased cooperation between ODFW and the Complex will assist both agencies in meeting their missions and mandates, and provide a more systematic and accessible process for sharing information, expertise and funding.

Oregon Parks and Recreation Department (OPRD)

The OPRD manages Oregon beaches, numerous coastal State Parks, and State Scenic Viewpoints along the Oregon coast. The OPRD's management responsibilities, including lands, facilities, and interpretive and educational programs, frequently overlap with Refuge Complex goals and responsibilities for public outreach and education. The Refuge Complex works closely with OPRD to maintain visitor use facilities, develop new facilities, collaborate on interpretive panel messages, develop joint educational and interpretive programs, and utilize shared volunteers.

Law Enforcement Entities

The Refuge Complex has only one full time Law Enforcement Officer, and enforcement coverage on Siletz Bay NWR as well as all the other refuges will continue to rely on coordination with city police, county sheriff departments, Oregon State Police, and Federal officers from USCG, NMFS, USFS, and BLM. Specific LE tasks include: (1) Clarifying jurisdictions of Service and all other enforcement agencies regarding refuge regulations, determine the extent of proprietary state law authority on Federal lands, and enable joint enforcement of wildlife protection and refuge trespass laws and regulations; and (2) Developing LE assistance agreements with OSP; county sheriffs and associated Marine Patrol officers; city police departments in cities where refuge lands are located; USCG; and NOAA for enforcement of wildlife and refuge regulations including joint enforcement of Marine Mammal Protection Act regulations.

Volunteers

Volunteers are extremely important in helping reduce wildlife disturbance, educating the public, and disseminating information on the mission of the National Wildlife Refuge System. A resident volunteer is usually stationed at Siletz Bay NWR and is instrumental in helping to monitor and treat invasive species, maintain the grounds, and assist with occasional guided tours.

Appendix D. Wilderness Review

D.1 Introduction

D.1.1 Refuge Overview

Siletz Bay National Wildlife Refuge (Refuge or NWR), established in 1991, is located near Lincoln City on the central coast of Oregon. The Service originally proposed to establish the Refuge in 1989 by initially accepting a donation of 46 acres of muted salt marsh, further seeking to acquire partial or whole interest in up to 830 acres of land, and cooperatively managing 1,060 acres for tidelands with the State of Oregon. The approved refuge acquisition boundary (defined as the area within which the Service may acquire lands from willing sellers) totals 1,936 acres and encompasses the northern tip of the Siletz Spit, vegetated and unvegetated tidelands of the bay, a portion of the diked former tidelands of the Siletz River floodplain, and forested headlands near the mouth of Schooner Creek and Drift Creek. Currently, refuge lands (defined as lands managed and owned or under easement by the USFWS) total 568 acres. The focus of the Refuge is to protect the remaining coastal wetlands and uplands adjacent to Siletz Bay from rapidly encroaching development, and to enhance and restore wetland and upland habitats for a variety of estuarine-dependent fish and wildlife species.

Refuge lands consist primarily of tidal marsh, diked former tidal marsh in varying stages of muted tidal action, and several smaller forested parcels both upland and wetland. Refuge parcels are not contiguous but rather are spread out over a 6-square-mile area around U.S. Highway 101, Millport Slough, the Kernville Highway (Oregon Route 229), Siletz Keys, Drift Creek, and Schooner Creek. On the west side of Highway 101, refuge parcels are for the most part surrounded by or composed of mudflat and/or tidal marsh.

D.1.2 Policy and Direction for Wilderness Reviews

U.S. Fish and Wildlife Service policy (Part 602 FW 3.4 C. (1) (c)) requires that wilderness reviews be completed as part of the CCP process. 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 Refuge System since 1974. A preliminary inventory of the wilderness resources is to be conducted during pre-acquisition planning for new or expanded refuges (341 FW 2.4 B, “Land Acquisition Planning”). Refuge System policy on Wilderness Stewardship (610 FW 1-5) includes guidance for conducting wilderness reviews (610 FW 4 – Wilderness Review and Evaluation).

A wilderness review is the process of determining whether the Service should recommend Refuge System lands and waters to Congress for wilderness designation. The wilderness review process consists of three phases: wilderness inventory, wilderness study, and wilderness recommendation.

Wilderness Inventory

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.

Wilderness Study

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 would achieve the purposes of the Wilderness Act and the National Wilderness Preservation System
3. how each alternative would affect achievement of refuge purpose(s) and the Refuge's contribution toward achieving the Refuge System mission
4. how each alternative would 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 Section 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 the 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 would 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).

D.1.3 Criteria for Evaluating Lands for Possible Inclusion in the National Wilderness Preservation System

The Wilderness Act of 1964, as amended (16 U.S.C. 1131-1136), provides the following description of wilderness:

> "A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this Act as 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…"

The following criteria for identifying areas as wilderness are outlined in Section 2(c) of the Act and are further expanded upon in Refuge System policy (610 FW 4). The first three criteria are evaluated during the inventory phase; the fourth criterion is evaluated during the study phase.

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 a 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 historic 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.

D.1.3 Relationship to Previous Wilderness Reviews

No previous wilderness reviews have been prepared for Siletz Bay NWR.

D.2 Wilderness Inventory

The following constitutes the inventory phase of the wilderness review for the Siletz Bay National Wildlife Refuge.

D.2.1 Lands Considered under This Wilderness Review

All FWS-owned lands and waters (in fee title) within the Siletz Bay NWR boundary were considered during this wilderness review.

D.2.2 Inventory Units

The first step of a wilderness assessment is to divide the refuge or other management entity into preliminary wilderness evaluation units. The boundaries of these artificial units can follow the refuge boundary, but may not cross permanent roadways, private or other non-Federal lands, or non-Service owned waterways. These roads, non-Federal lands, or waterways can form the boundary for an individual evaluation unit. Other obvious incompatible wilderness uses or structures (such as refuge headquarters, residential areas, rights-of-way, and non-jurisdictional waters) may also be eliminated from any evaluation units at this time. Once boundaries have been established for each individual evaluation unit, the criteria in Sections D.2.3 are applied to determine each unit's suitability as potential wilderness and the need for further evaluation under the Wilderness Study.

In determining units to be evaluated for wilderness character per this inventory, the Refuge was mapped using geographic information system (GIS) software. Using the major constraints set by the Wilderness Act, specifically land ownership/refuge boundary and permanent road systems, initial large evaluation units were developed by including all contiguous lands within those intractable confines. GIS acreages, which may differ from acreages contained in Realty records, were calculated and are reported below. Through this process, several units (listed from north to south) were defined for evaluation:

Located on the north end of the Refuge, the **Schooner Creek Tract**, acquired in 1993, is an approximately 36-acre tract is on the east side of Highway 101, immediately north of a small group of residences and businesses. SE 54th Drive leads to the Lincoln City waste treatment plant and bisects the northern portion of this unit. This forested upland unit lying just north of Schooner Creek, is a mixed forest of red alder, Sitka spruce, and western hemlock. There are a number of large second-growth trees on the unit, but the presence of several very large and decayed stumps are evidence of past logging. The large trees in the west central portion of the forest overlooking the bay are the preferred perching sites of a pair of resident bald eagles, and their nest and a great blue heron rookery are located on the southern end of this unit.

The 32-acre **Kangas Tract**, acquired in 2007, is bound to the west by U.S. Highway 101; on the north by SE 64th Street; and on the east by S. Drift Creek Road. Private lands within the authorized refuge boundary occur along the north, northeast and south ends. This tract is considered part of the Drift Creek area of the Refuge, and the majority of the tract is classified as freshwater wetlands. Historically, this entire lowland area was intertidal wetlands providing habitat to a host of migratory birds, salmonids, and other estuarine-dependent fish and wildlife species. The area is now diked, ditched, and drained and until the mid-1990s was heavily grazed by cattle. When it was actively grazed, this action maintained a short-grass condition and provided habitat for a variety of waterfowl, shorebirds, and wading birds. Large numbers of birds are attracted to the area following heavy rainfall when the fields were flooded with freshwater runoff. When the former owner terminated grazing, vegetation grown was rapid and sedges now occur over much of the site; however, invasive vegetation such as reed canarygrass and Scotch broom is also present. The ditches on the property receive extremely muted tidal flows through a failed tidegate on private property and through a severely undersized culvert under U.S. Highway 101, which is scheduled for replacement in 2012. Beaver dams in the ditches and plugging of the Highway 101 culvert have caused water inundation on some parts of the property and flooding of private lands on the east side.

Additional refuge lands in the Drift Creek area are located on the east and west side of U.S. Highway 101 at Drift Creek. The 27-acre **Schaffer Tract** is bordered on the west by Drift Creek, north by Gorton Road, on the east by private farmland, and on the south by Drift Creek Slough. Historically, this area was comprised of tidal marsh, and floodplain overflow areas were dominated by Sitka spruce. This and other adjoining parcels were diked and drained and converted to pastureland for grazing of livestock. A severe flood event in the late 1996 resulted in the complete loss of the water control structure on private land located adjacent to the southeast corner of the property. Loss of the water control structure and subsequent breaches in the dikes adjacent to Drift Creek Slough and along Drift Creek now allow significant but muted tidal flows on the property. Grazing is not allowed on this refuge tract and a seasonal electric fence is installed in the late-spring through fall along the east boundary to prevent cattle from entering from the adjoining property although some trespass grazing occurs when the fence fails. This area contains Lyngby's and slough sedge as well as invasive reed canarygrass.

The 26-acre **Watson Tract** is located south of the Drift Slough tidal channel. This tract contains a refuge residence and east of the residence is a diked tidal marsh with muted tidal flow. The culvert at the northwest corner of the site formerly contained a tidegate that failed and now allows limited tidal flow, which is restricted due to beaver dams.

West of Highway 101 on the south bank of Drift Creek is the approximately 7-acre **Kromer Tract East** which was formerly the site of a fish buying station and dock prior to 1940 and a cedar shake and shingle lumber mill from 1952 through the 1970s. This parcel contains a band-tailed pigeon mineral spring on the south side. The refuge bunkhouse is located on this parcel. Just west of the Kromer East Tract is a tidally-influenced high salt marsh island. The east end of this island, the **Kromer Tract West**, is owned by the Service and totals approximately 5 acres. The western half of this island is owned by the Bureau of Land Management.

West of Highway 101 on the north bank of Drift Creek is the approximately 10-acre **Schnuelle/Sanders Tract** on which the Service breached the dikes in four places in 2000 to restore tidal flows into the marsh.

West of Highway 101 and adjacent to the Siletz River entrance into Siletz Bay, refuge ownership consists of high and low saltmarsh, intertidal mudflats, tidal sloughs and small forested wetlands comprised primarily of Sitka spruce. Collectively, these refuge wetlands comprise the **Siletz Keys Area** as they are located west of the Siletz Keys residential development. The largest contiguous area within this unit is approximately 42 acres while the smallest areas are less than half an acre.

In 2008 the Refuge acquired the 9-acre **Alder Island (formerly Schoen Tract)**, located on an island on the south bank of the Siletz River as it empties into Siletz Bay just east of U.S. Highway 101. It is bounded to the south and east by refuge lands, west by the old abandoned Highway 101 and to the north by the Siletz River. This tract contains a dike running around the perimeter of the property. The upland portion of the property was used as a dredged spoil site for the Siletz Keys in 1998 and the dredge spoils were approved through permits by the Army Corps of Engineers and the Oregon Department of Environmental Quality. This dredge spoil area is currently comprised of a young red alder forest, although invasive blackberry and Scotch broom are present but are being treated. The lower portion of the property serves marsh habitat that receives some tidal flows during extreme high tides. Riparian forest vegetation occurs on the perimeter dike.

The 157-acre **Millport Slough North** is bordered by U.S. Highway 101 on the west, Siletz River on the north and east, and Millport Slough to the south. This area is a relatively undisturbed tidal prairie with diverse plant communities dominated by tufted hairgrass. These plant communities are typical of undisturbed high marsh and reflect the range of tidal salinities within this area. Evidence of intact tidal hydrology is provided by the condition of tidal channels on the site (Brophy 2001, Brophy 2002).

The 112-acre **Millport Slough South** is bordered by U.S. Highway 101 on the west, Millport Slough on the north, private lands on the east, and Millport Slough Road and Immonen Road on the south. This area is a tidal wetland that was diked and managed as pasture for many decades until dike failures occurred in the 1980s and 1990s. A restoration project was completed in fall 2003 which included removing as much of the dike system as possible and placing large woody debris in the restoration area as well as in the natural marsh in Millport Slough North. The western half has been subjected to muted tidal influence since water control structure failure in 1981.

D.2.3 Process of Analysis

The following evaluation process was used in identifying the suitability of refuge units for wilderness designation:

- Determination of refuge unit sizes.
- Assessment of the units' capacity to provide opportunities for solitude or primitive and unconfined recreation.
- Assessment of "naturalness" of refuge units.

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 they evolved and they should 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.

Supplemental Values–the Wilderness Act states that an area of wilderness may contain ecological, geological, or other features of scientific, educational, scenic, or historical value. Supplemental values of the area are optional, but the degree to which their presence enhances the area's suitability for wilderness designation should be considered. The evaluation should be based on an assessment of the estimated abundance or importance of each of the features.

More detail on the factors considered and used for each assessment step follows.

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 Service 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.

Outstanding Solitude or Primitive or Unconfined Recreation:

A designated wilderness area must provide outstanding opportunities for solitude or a primitive and unconfined type of recreation. Possession of only one of these outstanding opportunities is sufficient for an area to qualify as wilderness, and it is not necessary for one of these outstanding opportunities to be available on every acre. Furthermore, an area does not have to be open to public use and access to qualify under these criteria.
Opportunities for solitude refer to the ability of a visitor to be alone and secluded from other visitors in the area. Primitive and unconfined recreation means non-motorized, dispersed outdoor recreation activities that are compatible and do not require developed facilities or mechanical transport. Primitive recreation activities may provide opportunities to experience challenge and risk, self-reliance, and adventure.

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; roads 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 being: 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 knowledge and understanding of the ecological systems which are being evaluated as potential wilderness. Ecological systems are comprised of three primary attributes—composition, structure, and 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.

D.2.4 Summary of Inventory Results and Conclusion

Table D-1 summarizes the above evaluation factors for each of the units that were delineated and evaluated as described in Sections D.2.2 and D.2.3.

In this inventory of Siletz Bay NWR, none of the identified refuge units were found to meet the minimum wilderness criteria for size, outstanding opportunities for solitude and primitive/unconfined recreation, or naturalness. Thus, none of these areas are recommended for Wilderness Study.

Table D-1. Results of Wilderness Inventory for Siletz Bay NWR

Refuge Unit	Size	Outstanding Opportunities for Solitude or Primitive/unconfined Recreation	Naturalness	Summary: Area Will Move Forward for Wilderness Study
Schooner Creek Tract	No	NE	NE	No
Kangas Tract	No	NE	NE	No
Schaffer Tract	No	NE	NE	No
Watson Tract	No	NE	NE	No
Kromer Tract East	No	NE	NE	No
Kromer Tract West	No	NE	NE	No
Schnuelle/Sanders Tract	No	NE	NE	No
Siletz Keys Area	No	NE	NE	No
Alder Island	No	NE	NE	No
Millport Slough North	No	NE	NE	No
Millport Slough South	No	NE	NE	No

Notes:
NE – Not evaluated (once any wilderness criteria was not met, further evaluation was not conducted.)

D.3 References

Brophy, L.S. 2001. Siletz estuary plant community mapping. Prepared for the Confederated Tribes of Siletz Indians. Green Point Consulting. Corvallis, OR. 44 pp.

Brophy, L.S. 2002. Siletz Bay NWR and Nestucca Bay NWR tidal marsh restoration and reference sites: baseline plant community monitoring and mapping. Green Point Consulting. Corvallis, OR. 98 pp.

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Appendix E. Biological Resources of Concern

E.1 Introduction

Management direction of individual refuges is driven by refuge purposes and statutory mandates, coupled with species and habitat priorities. Management on a refuge should first and foremost address the individual refuge purposes. Additionally, management should address maintenance and, where appropriate, restoration of biological integrity, diversity, and environmental health as well as management for NWRS Resources of Concern. In this approach, the refuge contributes to the goals of the NWRS (601 FW 1) and achievement of the NWRS Mission.

In concert with this approach, and as an initial step in planning, the planning team identified resources of concern for Siletz Bay National Wildlife Refuge (NWR or Refuge). As defined in the Policy on Habitat Management Plans (620 FW 1), resources of concern are:

> "all plant and/or animal species, species groups, or communities specifically identified in refuge purpose(s), System mission, or international, national, regional, State, or ecosystem conservation plans or acts. For example, waterfowl and shorebirds are a resource of concern on a refuge whose purpose is to protect 'migrating waterfowl and shorebirds.' Federal or State threatened and endangered species on that same refuge are also a resource of concern under terms of the respective endangered species acts (620 FW1.4G)."

To provide a framework for development of goals and objectives in the CCP, the planning team identified resources of concern, following the process outlined in the handbook Identifying Refuge Resources of Concern and Management Priorities: A Handbook (USFWS 2008b).

E.2 Comprehensive Resources of Concern

A comprehensive list of potential resources of concern was created early in the planning process. The team identified species, species groups, and communities of concern, based upon a review of the Refuge's establishing history and purposes, a description of the key habitat types existing at the Refuge and a review of numerous conservation plans (see Section 1.7 of the CCP), many of which highlight priority species or habitats for conservation. The Comprehensive Resources of Concern list is contained in Table E-1.

Table E-1. Siletz Bay National Wildlife Refuge Table of Comprehensive Resources of Concern

Species/ Habitat	Refuge Purpose Species	BIDEH	Federal T&E	State T&E	BCC - BCR # 5 (Table 6)	BCC - 2008 Region 1 (Table 39)	BCC National (Table 48)	BMC Region 1 Status	PIF Regional Important Species	State Wildlife Action Plan Priorities (SGCN)	Shorebird Plan- NP Regional Score	Waterbird Plan Category	NA Waterfowl Management Plan	Fisheries Status Review	OR Natural Heritage Program State Rank
Habitat															
Coastal wetlands (estuarine, tidal salt marsh) and upland buffer	X	X											X		
Temperate Pacific Tidal Salt and Brackish Marsh		X											X		
Temperate Pacific Freshwater Emergent Marsh		X											X		
Temperate Pacific Intertidal Mudflat		X											X		
North Pacific Intertidal Freshwater Wetland		X											X		
North Pacific Hypermaritime Sitka Spruce Forest		X													
North Pacific Wet-Mesic Douglas-fir-Western Hemlock Forest		X													
North Pacific Lowland Riparian Forest and Shrubland		X													

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Birds															
Migratory waterfowl	X														
Shorebirds	X				X	X	X	X							
Raptors	X				X	X	X	X	X						
Neotropical songbirds	X				X	X	X	X	X						
Greater white-fronted goose								GBBDC					X		
Black brant										X			X		
Aleutian Canada goose										X			X		S2
Cackling Canada goose								GBBDC					X		
Taverner's Canada goose													X		
Dusky Canada goose								GBBDC					X		S2
Lesser Canada goose													X		
Western Canada goose													X		
Tundra swan													X		
Wood duck								GBBDC							
Gadwall													X		
American wigeon								GBBDC					X		
Mallard								GBBDC					X		
Blue-winged teal													X		
Cinnamon teal													X		

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Northern shoveler													X		
Northern pintail								GBBDC					X		
Green-winged teal													X		
Ring-necked duck								GBBDC							S3
Greater scaup								GBBDC					X		
Lesser scaup								GBBDC					X		S3
Bufflehead															S2
Common loon								X							SH
Pied-billed grebe												H			
Horned grebe												H			S2
Western grebe					X										S2
California brown pelican			DL	LE				T/E		X					S2
Brandt’s cormorant												H			
Pelagic cormorant					X							H			
Little blue heron												H			
American bittern								X				H			
American bald eagle			DL	LT	X	X	X	T/E	X	X					
Northern harrier								BCC/N							
American peregrine falcon			DL	DL	X	X	X	BCC/N		X					S2
Sora												H			

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Black-bellied plover											4				
Semipalmated plover											3				
Killdeer											4				
Spotted sandpiper											3				
Greater yellowlegs											4				
Willet											2				
Lesser yellowlegs					X		X				2				
Whimbrel					X	X	X	BCC/N			4				
Marbled godwit					X	X	X	BCC/N			4				
Black turnstone								BCC/N			4				
Sanderling											4				
Western sandpiper											4				
Least sandpiper											3				
Dunlin							X				4				
Short-billed dowitcher					X	X	X	BCC/N			4				
Long-billed dowitcher											3				
Wilson’s snipe											4				
Red-necked phalarope											4				
Red phalarope											4				
Glaucous-winged gull															S2
Caspian tern					X			BCC/BCR		X					

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Band-tailed pigeon			SOC	NSS				GBBDC	X	X					S3
Mourning dove								GBBDC							
Northern pygmy-owl									X						
Northern saw-whet owl									X						
Vaux's swift									X						
Rufous hummingbird					X	X	X	BCC/N	X						
Belted kingfisher									X						
Pacific-slope flycatcher								X	X						
Steller's jay									X						
Chestnut-backed chickadee									X						
Bewick's wren							X	X							
Golden-crowned kinglet									X						
Varied thrush									X						
American pipit															SU
Orange-crowned warbler									X						
Townsend's warbler									X						
Hermit warbler								X	X						
MacGillivray's warbler									X						
Purple finch					X				X						
Red crossbill									X						

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Mammals															
Marine mammals	X														
Red tree vole			SOC	NSS						X					S1
Townsend’s big-eared bat			SOC	SC						X					S2
Hoary bat										X					S3
Silver-haired bat			SOC	SV						X					S3
California myotis			NFS	SV						X					S3
Long-legged myotis			SOC	SV						X					S3
Amphibians															
Clouded salamander			NFS	SV						X					S3
Western toad			NFS	SV						X					
Northern red-legged frog															S3
Invertebrates															
Invertebrates	X														
Fish															
Anadromous fish (Chinook salmon, coho salmon, chum salmon, steelhead)	X													X	
Resident fish (indigenous)	X														
Western brook lamprey			SOC	SS						X					
Pacific lamprey			SOC	SS						X					S3

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Chinook salmon	X													X	SNR
Coho Salmon	X		LT	SS						X				X	S2
Coastal cutthroat trout			SOC	SV						X					S3
Chum salmon			LT	SC						X				X	S2
Steelhead			C	SS						X				X	S2
Pacific smelt - Eulachon			LT												

Federal Status
LT = Threatened
LE = Endangered
C = Candidate
SOC = Species of Concern
NFS = No federal status
DL = Delisted

State Status
LT = Threatened
LE = Endangered
C = Candidate
SS = Sensitive Species
SV = Sensitive species, vulnerable category
SC = Sensitive species, critical category
NSS = No state status
DL = Delisted

BMC Designations: BCC/N = Birds of Conservation Concern National, GBBDC = Gamebirds Below Desired Condition, T/E = Threatened or Endangered, BCC/BCR = Birds of Conservation Concern/BCR.

SGCN = Species of Greatest Conservation Needs in the Coast Range Ecoregion – Used Oregon Conservation Strategy document.

Shorebird Plan Ranking: 1 = No Risk, 2 = Low Concern, 3 = Moderated Concern, 4 = High Concern, 5 = Highly imperiled, including species listed as threatened or endangered.

Waterbird Plan Category of Conservation: H = High Concern (listed **only** species in the category of high concern).

North American Waterfowl Management Plan: Listed **only** species mentioned in the plan with breeding population objectives or listed habitat to restore/enhance.

Oregon Natural Heritage State Rank: used NatureServe Explorer database to determine state rank. State rank codes include: SX = Presumed Extirpated, SH = Possibly Extirpated, S1 = Critically Imperiled, S2 = Imperiled, S3 = Vulnerable, SU = Unrankable, SNR = Not Yet Ranked.

E.3 Priority Resources of Concern

The Priority Resources of Concern (Table E-2) were selected from the Comprehensive Resources of Concern list as particular indicators by which to gauge habitat conditions. The Priority Resources of Concern table includes focal species, including birds, fish, reptiles, amphibians, invertebrates, and plants that were selected as representatives or indicators for the overall condition of important refuge habitats. Most of the biological emphasis of the CCP is focused on maintaining and restoring these priority resources.

Several different conservation focal species may be listed for specific habitats to cover the variety of habitat structures and plant associations. In addition, species with specific "niche" ecological requirements may be listed as a focal species. Other species utilizing the habitat are generally expected to benefit as a result of management for the focal species.

Definitions for the column headings in Table E-2 are as follows:

- **Focal Species:** Species selected as representatives or indicators for the overall condition of the conservation target. In situations where the conservation target may include a broad variety of habitat structures and plant associations, several different conservation focal species may be listed. In addition, species with specific "niche" ecological requirements may be listed as a focal species. Management will be focused on attaining conditions required by the focal species. Other species utilizing the conservation target are generally expected to benefit as a result of management for the focal species.
- **Habitat Type:** The general habitat description utilized by the focal species.
- **Habitat Structure:** The specific and measurable habitat attributes considered necessary to support the focal species.
- **Life History Requirement:** The general season of use for the focal species.
- **Other Benefiting Species:** Other species that are expected to benefit from management for the selected focal species. The list is not comprehensive; see the Table of Potential Resources of Concern for the Refuge for a more complete list.

Table E-2. Siletz Bay National Wildlife Refuge Priority Resources of Concern

Focal Species	Habitat Type	Habitat Structure	Life History Requirement	Other Benefiting Species
Fish				
Chinook salmon	Riverine and stream habitat, freshwater marsh, coastal bog, saltwater marsh	Barrier free, rivers or streams connected to ocean, gravel channel beds, pools, water quality/chemistry/temperature conducive to fish production and survival, riparian trees (alder) to stabilize bank and provide shade	Anadromous fish rearing, spawning, foraging, year-round utilization	Coho salmon, chum salmon, steelhead, coastal cutthroat trout

Table E-2. Siletz Bay National Wildlife Refuge Priority Resources of Concern

Focal Species	Habitat Type	Habitat Structure	Life History Requirement	Other Benefiting Species
Coho salmon	Riverine and stream habitat, freshwater marsh, coastal bog, saltwater marsh	Barrier free, rivers or streams connected to ocean, gravel channel beds, pools, water quality/chemistry/temperature conducive to fish production and survival, riparian trees (alder) to stabilize bank and provide shade	Anadromous fish rearing, spawning, foraging, year-round utilization	Chinook salmon, chum salmon, steelhead, coastal cutthroat trout
Chum salmon	Riverine and stream habitat, freshwater marsh, coastal bog, saltwater marsh	Barrier free, rivers or streams connected to ocean, gravel channel beds, pools, water quality/chemistry/temperature conducive to fish production and survival, riparian trees (alder) to stabilize bank and provide shade	Anadromous fish rearing, spawning, foraging, year-round utilization	Chinook salmon, coho salmon, steelhead, coastal cutthroat trout
Steelhead	Riverine and stream habitat, freshwater marsh, coastal bog, saltwater marsh	Barrier free, rivers or streams connected to ocean, gravel channel beds, pools, water quality/chemistry/temperature conducive to fish production and survival, riparian trees (alder) to stabilize bank and provide shade	Anadromous fish rearing, spawning, foraging, year-round utilization	Chinook salmon, coho salmon, chum salmon, coastal cutthroat trout
Coastal cutthroat trout	Riverine and stream habitat, freshwater marsh, coastal bog, saltwater marsh	Barrier free, rivers or streams connected to ocean, gravel channel beds, pools, water quality/chemistry/temperature conducive to fish production and survival, riparian trees (alder) to stabilize bank and provide shade	Anadromous fish rearing, spawning, foraging, year-round utilization	Chinook salmon, coho salmon, chum salmon, steelhead
Amphibians				
Clouded salamander	Freshwater marsh, coastal bog, saltwater marsh	Water quality/chemistry/temperature conducive to amphibian production and survival, vegetative cover	Year-round utilization to support and sustain life, breeding, foraging	Northern red-legged frog, western toad
Northern red-legged frog	Freshwater marsh, coastal bog, saltwater marsh	Water quality/chemistry/temperature conducive to amphibian production and survival, vegetative cover	Year-round utilization to support and sustain life, breeding, foraging	Clouded salamander, western toad

Table E-2. Siletz Bay National Wildlife Refuge Priority Resources of Concern

Focal Species	Habitat Type	Habitat Structure	Life History Requirement	Other Benefiting Species
Western toad	Freshwater marsh, coastal bog, saltwater marsh	Water quality/chemistry/temperature conducive to amphibian production and survival, vegetative cover	Year-round utilization to support and sustain life, breeding, foraging	Clouded salamander, northern red-legged frog
Birds				
American wigeon	Freshwater marsh, saltwater marsh, wetlands	Emergent vegetation, mudflats, pools	Year-round utilization to support and sustain life, breeding, foraging	Wood duck, Gadwall, American wigeon, Mallard, Blue-winged teal, Cinnamon teal, Northern shoveler, Northern pintail, Green-winged teal, Canvasback, Redhead, Ring-necked duck, Greater scaup, Lesser scaup, Harlequin duck, Bufflehead, Common loon, Pied-billed grebe, Horned grebe, Western grebe
Mallard	Freshwater marsh, saltwater marsh, wetlands	Emergent vegetation, mudflats, pools	Year-round utilization to support and sustain life, breeding, foraging	Wood duck, Gadwall, American wigeon, Mallard, Blue-winged teal, Cinnamon teal, Northern shoveler, Northern pintail, Green-winged teal, Canvasback, Redhead, Ring-necked duck, Greater scaup, Lesser scaup, Harlequin duck, Bufflehead, Common loon, Pied-billed grebe, Horned grebe, Western grebe

Table E-2. Siletz Bay National Wildlife Refuge Priority Resources of Concern

Focal Species	Habitat Type	Habitat Structure	Life History Requirement	Other Benefiting Species
Northern pintail	Freshwater marsh, saltwater marsh, wetlands	Emergent vegetation, mudflats, pools	Year-round utilization to support and sustain life, breeding, foraging	Wood duck, Gadwall, American wigeon, Mallard, Blue-winged teal, Cinnamon teal, Northern shoveler, Northern pintail, Green-winged teal, Canvasback, Redhead, Ring-necked duck, Greater scaup, Lesser scaup, Harlequin duck, Bufflehead, Common loon, Pied-billed grebe, Horned grebe, Western grebe
Greater scaup	Freshwater marsh, saltwater marsh, wetlands	Emergent vegetation, mudflats, pools	Year-round utilization to support and sustain life, breeding, foraging	Wood duck, Gadwall, American wigeon, Mallard, Blue-winged teal, Cinnamon teal, Northern shoveler, Northern pintail, Green-winged teal, Canvasback, Redhead, Ring-necked duck, Greater scaup, Lesser scaup, Harlequin duck, Bufflehead, Common loon, Pied-billed grebe, Horned grebe, Western grebe
Lesser scaup	Freshwater marsh, saltwater marsh, wetlands	Emergent vegetation, mudflats, pools	Year-round utilization to support and sustain life, breeding, foraging	Wood duck, Gadwall, American wigeon, Mallard, Blue-winged teal, Cinnamon teal, Northern shoveler, Northern pintail, Green-winged teal, Canvasback, Redhead, Ring-necked duck, Greater scaup, Lesser scaup, Harlequin duck, Bufflehead, Common loon, Pied-billed grebe, Horned grebe, Western grebe

Table E-2. Siletz Bay National Wildlife Refuge Priority Resources of Concern

Focal Species	Habitat Type	Habitat Structure	Life History Requirement	Other Benefiting Species
Least sandpiper	Mudflats, grasslands, wetlands, stream and riparian	Short emergent vegetation on grasslands and marsh areas, intertidal zone (flooding and retreat), riparian	Year-round utilization to support and sustain life, breeding, foraging	Greater yellowlegs, Willet, Lesser yellowlegs, Whimbrel, Marbled godwit, Black turnstone, Sanderling, Western sandpiper, Dunlin, Short-billed dowitcher, Long-billed dowitcher, Wilson’s snipe, Red-necked phalarope, Red phalarope
Western sandpiper	Mudflats, grasslands, wetlands, stream and riparian	Short emergent vegetation on grasslands and marsh areas, intertidal zone (flooding and retreat)	Year-round utilization to support and sustain life, breeding, foraging	Greater yellowlegs, Willet, Lesser yellowlegs, Whimbrel, Marbled godwit, Black turnstone, Sanderling, Least sandpiper, Dunlin, Short-billed dowitcher, Long-billed dowitcher, Wilson’s snipe, Red-necked phalarope, Red phalarope
Short-billed dowitcher	Mudflats, grasslands, wetlands, stream and riparian	Short emergent vegetation on grasslands and marsh areas, intertidal zone (flooding and retreat)	Year-round utilization to support and sustain life, breeding, foraging	Greater yellowlegs, Willet, Lesser yellowlegs, Whimbrel, Marbled godwit, Black turnstone, Sanderling, Western sandpiper, Least sandpiper, Dunlin, Long-billed dowitcher, Wilson’s snipe, Red-necked phalarope, Red phalarope

E.4 References

Drut, M. and J.B. Buchanan. 2000. U.S. shorebird conservation plan: northern Pacific Coast regional shorebird management plan. Portland, OR: Fish and Wildlife Service, U.S. Department of the Interior. 31 pp.

Good, T.P., R.S. Waples, and P. Adams, eds. 2005. Updated status of federally listed ESUs of West Coast salmon and steelhead. NOAA Technical Memorandum NMFS-NWFSC-66. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northwest Fisheries Science Center and Southwest Fisheries Science Center. Seattle, WA, and Santa Cruz, CA. 598 pp.

Kushlan, J.A., M.J. Steinkamp, K.C. Parsons, J. Capp, M.A. Cruz, M. Coulter, I. Davidson, L. Dickson, N. Edelson, R. Elliot, R.M. Erwin, S. Hatch, S. Kress, R. Milko, S. Miller, K. Mills, R. Paul, R. Phillips, J.E. Saliva, B. Sydeman, J. Trapp, J. Wheeler, and K. Wohl. 2002. Waterbird conservation for the Americas: the North American waterbird conservation plan, version 1. Waterbird Conservation for the Americas. Washington, D.C. 78 pp. Available at: http://www.waterbirdconservation.org/nawcp.html.

NAWMP (North American Waterfowl Management Plan) Plan Committee. 2004. North American waterfowl management plan 2004. Strategic guidance: strengthening the biological foundation. Canadian Wildlife Service, U.S. Fish and Wildlife Service, Secretaria de Medio Ambiente y Recursos Naturales. 22 pp.

NMFS (National Marine Fisheries Service). 2010. Status review update for eulachon in Washington, Oregon, and California. Eulachon Biological Review Team. 443 pp.

ODFW (Oregon Department of Fish and Wildlife). 2006. Oregon conservation strategy. Oregon Department of Fish and Wildlife. Salem, OR. Available at: http://www.dfw.state.or.us/conservationstrategy/read_the_strategy.asp. Accessed July 31, 2012.

ODFW. 2012a. Threatened, endangered, and candidate fish and wildlife species in Oregon. Available at: http://www.dfw.state.or.us/wildlife/diversity/species/docs/Threatened_and_Endangered_Species.pdf. Accessed May 23, 2012.

ORBIC (Oregon Biodiversity Information Center). 2010. Rare, threatened, and endangered species of Oregon. Institute for Natural Resources, Portland State University. Portland, OR. 105 pp.

PIF (Partners in Flight). 2010. Species assessment database. Available at: http://www.rmbo.org/pif/scores/scores.html. Accessed March 23, 2010.

USFWS (U.S. Fish and Wildlife Service). 2005. Birds of management concern - Region 1 and Region 8 (CNO). U.S. Fish and Wildlife Service, Region 1. Portland, OR. 16 pp.

USFWS. 2008a. Birds of conservation concern 2008. U.S. Fish and Wildlife Service, Division of Migratory Bird Management. Arlington, VA. 85 pp. Available at: http://www.fws.gov/migratorybirds/.

USFWS. 2008b. Identifying refuge resources of concern and management priorities: A handbook. United States Department of the Interior, U.S. Fish and Wildlife Service, National Wildlife Refuge System. 67 pp.

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Appendix F. Statement of Compliance

STATEMENT OF COMPLIANCE
for Implementation of the
Siletz Bay National Wildlife Refuge, Lincoln County, Oregon
Comprehensive Conservation Plan

The following executive orders and legislative acts have been reviewed as they apply to implementation of the Siletz Bay National Wildlife Refuge (NWR or Refuge) Comprehensive Conservation Plan (CCP).

National Environmental Policy Act (1969), as Amended (42 U.S.C. § 4321 et seq.)
The planning process has been conducted in accordance with National Environmental Policy Act (NEPA) implementing procedures, with U.S. Department of the Interior and U.S. Fish and Wildlife Service (Service) procedures, and in coordination with the affected public. The requirements of NEPA (42 U.S. Code [U.S.C.] § 4321 et seq.) and its implementing regulations in 40 Code of Federal Regulations (CFR) 1500-1508 have been satisfied in the procedures used to reach decisions. 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. The start of the scoping period was announced through a *Federal Register* notice, news releases to local newspapers, the Service's refuge planning website, and a planning update. The draft CCP/environmental assessment (EA) was released for a 30-day public comment period. The affected public was notified of the availability of the document 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 were distributed to an extensive mailing list. In addition, the Service participated in a variety of public outreach efforts throughout the planning process (see Appendix J).

The CCP is programmatic in many respects and specific details of certain projects and actions cannot be determined until a later date depending on funding and implementation schedules. Certain projects or actions may require additional NEPA compliance.

National Historic Preservation Act (1966), as Amended (16 U.S.C. § 470 et seq.)
The management of the archaeological and cultural resources of the refuge will comply with the regulations of Section 106 of the National Historic Preservation Act. Historic properties will be maintained and repaired as funding becomes available. Maintenance and improvement of historic resources will result in positive impacts to cultural resources; however, determining whether a particular action has the potential to affect cultural resources is an ongoing process that occurs as step-down and site-specific project plans are developed. Should additional historic properties be identified or acquired in the future, the Service will comply with the National Historic Preservation Act if any management actions have the potential to affect these properties.

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 refuge staff, refuge supervisors and/or inclusion of the appropriate entities on the CCP mailing list.

Executive Order 13175. Consultation and Coordination with Indian Tribal Governments
As required under the Secretary of the Interior Order 3206—American Indian Tribal Rights, Federal Tribal Responsibilities, and the Endangered Species Act—the Project Leader notified and consulted interested tribes. Refuge staff consulted with representatives of The Confederated Tribes of Siletz Indians during the planning process.

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 Preservation Act of 1964 (16 U.S.C. § 1131 et seq.)
The Service has evaluated the suitability of the Refuge for wilderness designation through the "Inventory" phase according to the guidelines of the Wilderness Review process as described in 610 FW 4. In this inventory no areas on the Refuge were found to meet the minimum wilderness criteria for size, naturalness or outstanding opportunities for solitude and primitive/unconfined recreation (see Appendix D for additional details).

Architectural Barriers Act of 1968, as Amended (42 U.S.C. § 4151 et seq.)
The Architectural Barriers Act requires access to Federal facilities for people with disabilities. Access for persons with disabilities has been considered during the planning process, and actions related to access are found in Chapter 2 of the CCP.

National Wildlife Refuge System Administration Act of 1966, as Amended (16 U.S.C. § 668dd-668ee)
This Act requires the Service to develop and implement a comprehensive conservation plan for each refuge. The CCP identifies and describes refuge purposes; the vision and goals for the Refuge; fish, wildlife, and plant populations and related habitats on the Refuge; archaeological and cultural values of the Refuge; issues that may affect populations and habitats of fish, wildlife, and plants; actions necessary to restore and improve biological diversity on the Refuge; and opportunities for wildlife-dependent recreation, as required by the Act.

During the CCP process, the refuge manager evaluated all existing and proposed uses at the Refuge. 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. Compatibility determinations have been prepared for all uses found appropriate (see Appendices A and B).

Executive Order 13186. Responsibilities of Federal Agencies to Protect Migratory Birds
This Order directs agencies to take certain actions to further implement the Migratory Bird Treaty Act. A provision of the Order directs Federal agencies to consider the impacts of their activities, especially in reference to birds on the Fish and Wildlife Service's list of Birds of Conservation Concern. It also directs agencies to incorporate conservation recommendations and objectives in the North American Waterbird Conservation Plan and bird conservation plans developed by Partners in Flight into agency planning as described in Chapter 1. The effects to refuge habitats used by

migratory birds of habitat, public use, and cultural resources actions were assessed within Chapter 6 of the draft CCP/EA, which was incorporated by reference into this document.

Endangered Species Act (1973), as Amended (16 U.S.C. § 1531 et seq.)
This Act provides for the conservation of threatened and endangered species of fish, wildlife, and plants by Federal action and by encouraging the establishment of state programs. Documentation is required under Section 7 of the Act. Refuge policy requires the refuge manager to document issues that affect or may affect endangered species before initiating projects. Consultation on specific projects will be conducted prior to implementation to avoid any adverse impacts to these species and their habitats.

Coastal Zone Management Act, as Amended (16 U.S.C. § 1451 et seq.)
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 Siletz Bay NWR 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 will protect any existing wetlands.

Executive Order 11988. Floodplain Management
Under this order, federal agencies "shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains." The CCP is consistent with Executive Order 11988 because CCP implementation will maintain and enhance riverine, riparian, and wetland habitats located within floodplains on the Refuge, which will minimize flood impacts and continue to contribute to the natural and beneficial fish and wildlife resource values unique to the area.

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.

See 602 FW 3, Exhibit 2 for other potential compliance requirements

Chief, Division of Planning, Visitor Services, and Transportation

12-19-12
Date

Appendix G. Integrated Pest Management

G.1 Background

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. IPM 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 will be used to identify and implement appropriate management strategies that can be modified and/or changed over time to ensure effective, site-specific management of pest species to achieve desired outcomes. In accordance with 43 CFR 46.145, adaptive management will be particularly relevant where long-term impacts may be uncertain and future monitoring will be needed to make adjustments in subsequent implementation decisions. After a tolerable pest population (threshold) is determined considering achievement of refuge resource objectives and the ecology of pest species, one or more methods, or combinations thereof, will be selected that are feasible, efficacious, and most 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 will be considered when determining feasibility/practicality of various treatments.

IPM techniques to address pests are presented as CCP strategies (see Chapter 2 of this CCP) 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 CCP:

- 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 Consequences) of the Siletz Bay National Wildlife Refuge 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 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.

G.2 Pest Management Laws and Policies

In accordance with Service policy 569 FW 1 (Integrated Pest Management), plant, invertebrate, and vertebrate pests on units of the National Wildlife Refuge System can be controlled to ensure 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, 569 FW 1 defines pests as “invasive plants and introduced or native organisms that may interfere with achieving our management goals and objectives on or off our lands, or that jeopardize human health or safety.” 517 DM 1 also 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 CCP, the terms pest and invasive species are used interchangeably because 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 569 FW 1, animal or plant species that 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.

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-establish native species;

- Control non-native (exotic) species in order to support existence for populations of native species;
- Prevent damage to private property; and
- Provide the public with quality, compatible wildlife-dependent recreational opportunities.

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."

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). For example, the incidental removal of beaver 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 considering 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 staff 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. 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 the wildlife. 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]).

G.3 Strategies

To fully embrace IPM as identified in 569 FW 1, the following strategies, where applicable, would be carefully considered on the Refuge for each pest species.

G.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 un-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 re-introductions by various mechanisms including vehicles, personnel, livestock, and horses. Because invasive species are frequently the first to establish 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 un-infested 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 for 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 un-infested 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. Where possible, 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 staff, their authorized agents, and refuge volunteers would, where possible, inspect, remove, and properly dispose of seed and parts of invasive plants found on their clothing and equipment. Proper disposal means bagging the seeds and plant parts and then properly discarding of 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 reasonably available.
- The refuge staff would provide information, training, and appropriate pest identification materials to 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 boating equipment. Where possible, the refuge staff would remove any visible plants, animals, or mud before leaving any waters or boat launching facilities. Where possible, the refuge staff would drain water from motor, live well, bilge, and transom wells while on land before leaving the site. If possible, 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.
- Where feasible, the refuge staff would maintain a 100-foot buffer of aquatic pest-free clearance around boat launches and docks or quarantine areas when cleaning around culverts, canals, or irrigation sites. Where possible, the refuge staff would inspect and clean equipment before moving to new sites or 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 the U.S. Forest Service's *Preventing and Managing Invasive Plants Final Environmental Impact Statement* (2005).

G.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, shearing, girdling, mowing, and mulching of the pest plants.

For animal species, Service employees or their authorized agents could use mechanical/physical methods (including trapping) to control pests as a refuge management activity. Based upon 50 CFR 31.2, trapping can be used on a refuge to reduce surplus wildlife populations for a "balanced conservation program" in accordance with federal or state laws and regulations. In some cases, non-lethally trapped animals would be relocated to off-refuge sites with prior approval from the state.

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 would 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.

G.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 non-susceptible crops, moisture management, addition of beneficial insect habitat, reducing clutter, 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.

G.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 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 would 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 would include the following: 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 agents 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 (the 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 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% success rate (Coombs et al. 2004). Refer to Coombs et al. (2004) 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 (APHIS-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:

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 non-indigenous 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, sub-species 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 species, non-target species, and the environment.

Biological control agents formulated as pesticide products and registered by the USEPA (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, U.S. Department of Agriculture-Animal and Plant Health Inspection Service, 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 (43 CFR 46.135) 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 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.

G.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 569 FW 1. PUP 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://systems.fws.gov/pups). Only Service employees would be authorized to access PUP records for a refuge in this database.

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) 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 a 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 refuge lands in the context of an IPM approach.

G.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 Sheley 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.

G.4 Priorities for Treatments

For many refuges, the magnitude (number, distribution, and sizes of infestations) of 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 refuge purpose(s), NWRS 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 un-infested 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 or managing source populations. Maxwell et al. (2009) found treating fewer populations that are sources represents an effective long-term strategy to reduce of total number of invasive populations and decreasing meta-population growth rates.

Although state-listed noxious weeds would always be of 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.

G.5 Best Management Practices (BMPs)

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 Interior Pesticide Use Policy (517 DM 1) and the Service Integrated Pest Management policy (569 FW 1), the use of applicable BMPs (where feasible) also 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 ground-based 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.

G.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 triple rinse and recycle (where feasible) pesticide containers.
- All unused pesticides would be properly discarded at a local "safe send" collection.
- 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 prevent 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 response plan.

G.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 NWRS 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, MSDSs, and Pesticide Use Proposal (PUPs) for each pesticide, determining the target pest, appropriate mix rate(s), 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.
- Use low-impact herbicide application techniques (e.g., spot treatment, cut stump, oil basal, Thinvert system applications) rather than broadcast foliar applications (e.g., boom sprayer, other larger tank wand applications), where practical.
- Use low-volume rather than high-volume foliar applications where low-impact methods above are not feasible or practical, to maximize herbicide effectiveness and ensure correct and uniform application rates.
- 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<7 mph and preferably 3 to 5 mph) and consistent direction wind conditions with moderate temperatures (typically <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 >30% 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 non-toxic 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 on-site by applicators after treatments to eliminate the potential spread of pests to un-infested areas.
- Cleaning boots (or use rubber boots to aid in sanitation) and brush off clothing in a place where monitoring is feasible to control for new seed transportation.

G.6 Safety

G.6.1 Personal Protective Equipment

All applicators would wear the specific personal protective equipment (PPE) identified on the pesticide label. The appropriate PPE would 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 an NIOSH-approved respirator. 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 would be consistent with label requirements, USEPA and 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.

G.6.2 Notification

The restricted entry interval (REI) is the time period required after the application at which point someone 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.

G.6.3 Medical Surveillance

Medical surveillance may be required for Service personnel and approved volunteers who mix, apply, and/or monitor use of pesticides (see 242 FW 7 [Pesticide Users] and 242 FW 4 [Medical Surveillance]). In accordance with 242 FW 7.12A, Service personnel would be medically monitoring if one or more of the following criteria is met: exposed or may be exposed to concentrations at or above the published permissible exposure limits or threshold limit values (see 242 FW 4); use pesticides in a manner considered "frequent pesticide use"; or use pesticides in a manner that requires a respirator (see 242 FW 14 for respirator use requirements). In 242 FW 7.7A, "**Frequent Pesticide Use** means when a person applying pesticide handles, mixes, or applies pesticides, with a Health Hazard rating of 3 or higher, for 8 or more hours in any week or 16 or more hours in any 30-day period." Under some circumstances, individuals may be medically monitored who use pesticides infrequently (see Section G.7.7), experience an acute exposure (sudden, short-term), or use pesticides with a health hazard ranking of 1 or 2. This decision would consider the individual's health and fitness level, the pesticide's specific health risks, and the potential risks from other pesticide-related activities. 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.

G.6.4 Certification and Supervision of Pesticide Applicators

Appropriate refuge staff or approved volunteers handling, mixing, and/or applying or directly supervising others engaged in pesticide use activities would be trained and state or federally (BLM) licensed to apply pesticides to refuge lands or waters. In accordance with 242 FW 7.18A and 569 FW 1.10B, certification is required to apply restricted use pesticides based upon USEPA regulations. For safety reasons, all individuals participating in pest management activities with general use pesticides also are encouraged to attend appropriate training or acquire pesticide applicator certification. The certification requirement would be for a commercial or private applicator depending upon the state. 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.

G.6.5 Record Keeping

Labels and Material Safety Data Sheets

Pesticide labels and material safety data sheets (MSDSs) would be maintained at the refuge shop and laminated copies in the mixing area. These documents also 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 while mixing is in progress. In addition, approved PUPs stored in the PUPS database typically contain website links (URLs) to pesticide labels and MSDSs.

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 Service guidelines (Director's memo [December 12, 2007]), refuge staff may receive up to five-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 a habitat management plant (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://systems.fws.gov/pups). Only Service employees can access PUP records in this database.

Pesticide Usage

In accordance with 569 FW 1, 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, non-government applicators including cooperators and their pest management service providers with Service permission. For clarification, pesticide means all insecticides, insect and plant growth regulators, desiccants, 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 (% 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 (e.g., Refuge Habitat Management Database), preferably a geo-referenced data management system (e.g., Refuge Lands GIS) to facilitate data analyses and subsequent reporting. 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. Monitoring could also identify short- and long-term impacts to natural resources and environmental quality associated with IPM treatments in accordance with adaptive management principles identified in 43 CFR 46.145.

G.7 Evaluating Pesticide Use Proposals

Pesticides would only be used on refuge lands for habitat management as well as croplands/facilities maintenance after approval of a PUP. In general, proposed pesticide uses on refuge lands 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 and other screening measures. Potential effects to environmental quality would be based upon pesticide characteristics of environmental fate (water solubility, soil mobility, soil persistence, and volatilization) and other quantitative screening tools. Ecological risk assessments as well as characteristics of environmental fate and potential to degrade environmental quality for pesticides would be documented in Chemical Profiles (see Section G.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. In general, only pesticide uses with appropriate BMPs (see Section G.4) for habitat management and cropland/facilities maintenance on refuge lands that would potentially have minor, temporary, or localized effects on refuge biological and environmental quality (threshold values not exceeded) would be approved.

G.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 refuge lands. 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. This quantitative methodology provides an efficient mechanism 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 in the field 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 U.S. Environmental Protection Agency (2004). Assumptions for these risk assessments are presented in Section G.7.2, under Aquatic Exposure.

The toxicological data used in ecological risk assessments are typically results of standardized laboratory studies provided by pesticide registrants to the USEPA to meet regulatory requirements under 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. 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 G.7.5.

Table G-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.

G.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 USEPA's Ecological Risk Assessment Process (USEPA 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., LC_{50} and oral LD_{50}]) to evaluate the potential for adverse effects to species groups (birds, mammals, and fish) representative of legal mandates for managing units of the NWRS. 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 G-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 USEPA (1998 [Table G-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 used 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 LC_{50} and LD_{50} 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. A RQ<LOC would indicate the proposed pesticide use "may affect, not likely to adversely affect" individuals (listed species) and it would not pose an unacceptable risk for adverse effects to populations (non-listed species) for each taxonomic group (Table G-2). In contrast, an RQ>LOC would indicate a "may affect, likely to adversely affect" for listed species and it would also pose unacceptable ecological risk for adverse effects to nonlisted species.

Table G-2. Presumption of Unacceptable Risk for Birds, Fish, and Mammals (USEPA 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

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, Butler et al. 1998, Ramsay et al. 1995, EXTOXNET 1993). 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 it does indicate 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 ECC for exposure to terrestrial wildlife would be quantified using an USEPA screening-level approach (USEPA 2004). This screening-level approach is not affected by product formulation because it evaluates pesticide 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 (USEPA 2004, USEPA 2012, Pfleeger et al. 1996) through the USEPA's Terrestrial Residue Exposure model (T-REX) version 1.2.3 (USEPA 2005). To estimate the maximum (initial) pesticide residue on short grass (<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 lb. ai/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 G-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 G-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 (1,000 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 soft-bodied 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 (a.i.) exposed (e.g., EEC) on the surface of an area equal to 1 square foot by the appropriate LD_{50} value multiplied by the surrogate's body weight (Table G-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% 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% of the applied granules remain available to wildlife. It would be assumed that only 1% of the granules are available on the soil surface following in-furrow applications.

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% 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 (LD_{50}/ft^2) for comparison to USEPA Level of Concerns (USEPA 1998). The T-REX version 1.2.3 (USEPA 2005) contains a submodel which automates Kanaga exposure calculations for granular pesticides and treated seed.

The following formulas would be used to calculate EECs depending upon the type of granular pesticide application:

- In-furrow applications assume a typical value of 1% 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

$$mg\ a.i./ft^2 = [(lbs\ product/1{,}000\ ft.\ row)(\%\ a.i.)(1{,}000\ ft\ row)(453{,}580\ mg/lb.)(1\%\ exposed)$$

$$EEC = [(mg\ a.i./ft.^2)(\%\ of\ pesticide\ biologically\ available)]$$

- Incorporated banded treatments assume that 15% of granules, bait, and seeds are unincorporated.

$$mg\ a.i./ft.^2 = [(lbs.\ product/1{,}000\ row\ ft.)(\%\ a.i.)(453{,}580\ mg/lb.)(1\text{-}\%\ incorporated)] / (1{,}000\ ft.)(band\ width\ (ft.))$$

$$EEC = [(mg\ a.i./ft.^2)(\%\ of\ pesticide\ biologically\ available)]$$

- Broadcast treatment without incorporation assumes 100% 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 be used to calculate an RQ based on the EEC calculated by one of the above equations. The EEC would be divided by the surrogate LD_{50} toxicological endpoint multiplied by the body weight (Table G-3) of the surrogate.

$$RQ = EEC / [LD_{50}\ (mg/kg) * body\ weight\ (kg)]$$

As with other risk assessments, an RQ>LOC would be a presumption of unacceptable ecological risk. An RQ<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 <25 feet of the high water mark of aquatic habitats for habitat management treatments; whereas, no-spray buffers (≥25 feet) would be used for croplands/facilities maintenance treatments.

Habitat Treatments

For the worst-case exposure scenario to non-target aquatic habitats, EECs (Table G-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 <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 G.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% overspray (RQ>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 G-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 USEPA 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 >25 feet from the high water mark. The Spray Drift Task Force AgDRIFT model is publicly available at http://www.agdrift.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 droplet size, EPA-defined wetland, and a ≥25-foot distance (buffer) from treated area to water.

Use of Information on Effects of Biological Control Agents, Pesticides, Degradates, and Adjuvants

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 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 also would reduce the bulk of a Service NEPA document, which only would identify the documents that are incorporated by reference. In addition, relevant portions would be summarized in the Service 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 43 CFR 46.135, the Service would specifically 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* (USFS 2005) and *Vegetation Treatments Using Herbicides on Bureau of Land Management Lands in 17 Western States Programmatic EIS* (PEIS) (Bureau of Land Management 2007). In accordance with 43 CFR 46.120(d), use of existing NEPA documents by supplementing, tiering to, incorporating by reference, or adopting previous NEPA environmental analyses would avoid redundancy and unnecessary paperwork.

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 incorporated by reference:

- 2,4-D
- Chlorsulfuron
- 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 incorporated by reference:

- Bromacil
- Chlorsulfuron
- Diflufenzopyr
- Diquat
- Diuron
- Fluridone
- Imazapic
- Overdrive (diflufenzopyr and dicamba)
- Sulfometuron methyl
- Tebuthiuron
- Pesticide degradates and adjuvants (*Appendix D – Evaluation of risks from degradates, polyoxyethylene-amine (POEA) and R-11, and endocrine disrupting chemicals*)

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 USEPA'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 (USEPA 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 are 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 would 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 are 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 would 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 would require justification and it would 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, these data are 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 (USEPA 2004).
- Exposure through incidental ingestion of pesticide contaminated soil is not considered in the USEPA risk assessment protocols. Research suggests <15% 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 would 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 USEPA 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 USEPA (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% 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 application, and it would pertain to those pesticides with a high vapor pressure. The USEPA 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 risk 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 USEPA 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 USEPA for assessing dermal exposure to pesticides, they would 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 the 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 USEPA is actively developing protocols to quantify drinking water exposures from puddles and dew. If and when protocols are formally established by the USEPA for assessing exposure to pesticides through drinking water, these protocols would 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 USEPA relies on Fletcher (1994) for setting the assumed pesticide residues in wildlife dietary items. The USEPA (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 USEPA represent a 95th percentile estimate. However, research conducted by Pfleeger et al. (1996) indicates USEPA residue assumptions for short grass was not exceeded. Baehr and Habig (2000) compared USEPA residue assumptions with distributions of measured pesticide residues for the USEPA's UTAB database. Overall residue selection level tends 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 LC_{50} 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 effects 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 occurs 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 flow-through, 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 the 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 USEPA 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, 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 [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 effects 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.
- USEPA 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, USEPA 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.

G.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 USEPA (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 USEPA 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). 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 USEPA's IRIS, the Hazardous Substance Data Bank, the Registry of Toxic Effects of Chemical Substances [RTECS]).
- USEPA'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, and 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.

A USEPA-approved label specifies whether a product can be mixed with one or more pesticides. Without product-specific toxicological data, it would not be 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 USEPA 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.

G.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 refuge lands. 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 runoff or wind;
- Dissolve in water that can be subjected to runoff 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 (K_{oc}), groundwater ubiquity score (GUS), and solubility.

Persistence, which is expressed as half-life (t½), represents the length of time required for 50% of the deposited pesticide to degrade (completely or partially). Persistence in the soil can be categorized as the following: non-persistent <30 days, moderately persistent = 30 to 100 days, and persistent >100 days (Kerle et al. 1996). Half-life data are usually available for aquatic and terrestrial environments.

Another measure of pesticide persistence is dissipation time (DT_{50}). It represents the time required for 50% 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 published literature. If field or foliar dissipation data are not available, soil half-life data may be used. The average or representative half-life value of most important degradation mechanism would 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 would 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 (K_{oc}). 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 K_{oc} values are strongly sorbed to soil and, therefore, would be less subject to movement.

Water solubility describes the amount of pesticide that would 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 parts per million [ppm]). Pesticide with solubility <0.1 ppm are virtually insoluble in water, 100-1000 ppm are moderately soluble, and >10,000 ppm highly soluble (USGS 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.

$$GUS = log_{10}(t_{½}) \times [4 - log_{10}(K_{oc})]$$

The potential pesticide movement rating would be based upon its GUS value. Pesticides with a GUS <0.1 would 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 >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 ppm. Solubility is useful as a comparative measure because pesticides with higher values are more likely to move by runoff or leaching. GUS, water solubility, t½, and K_{oc} values are available for selected pesticides from the OSU 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 the pore size would lower the likelihood and rate water that 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 affects pesticide degradation.
- Soil pH would influence chemical reactions that occur in the soil which in turn determines whether or not a pesticide would 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 best management practices (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 runoff 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 persists. In some situations, a hard pan exists above the water table that would prevent pesticide contamination from leaching.

G.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 ($I \times 10^{-7}$), where I represents a vapor pressure index. In general, pesticides with $I<10$ would have a low potential to volatilize; whereas, pesticides with $I>1{,}000$ 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.

G.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 USEPA. 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 are 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

G.5), 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 refuge lands. 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.

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.

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.

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.

Pesticide Type: Service personnel would record the type of pesticide for an active ingredient as one of the following: herbicide, desiccant, fungicide, fumigant, growth regulator, insecticide, piscicide, or rodenticide.

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.

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.

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 % composition.

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 on-line database maintained by Crop Data Management Systems, Inc. (see list below).

G.7.7 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 are available in 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.

Mammalian LD_{50}: For test species in the scientific literature, Service personnel would record available data for oral lethal dose (LD_{50}) in mg/kg-bw (body weight) or ppm-bw. Most common test species in scientific literature are the rat and mouse. The lowest LD_{50} 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 G-1 in Section G.7.1).

Mammalian LC_{50}: For test species in the scientific literature, Service personnel would record available data for dietary lethal concentration (LC_{50}) as reported (e.g., mg/kg-diet or ppm-diet). Most common test species in scientific literature are the rat and mouse. The lowest LC_{50} value found for a rat would be used as a toxicological endpoint for diet-based RQ calculations to assess acute risk (see Table G-1 in Section G.7.1).

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, new born 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 G-1 in Section G.7.1).

Avian LD_{50}: For test species available in the scientific literature, Service personnel would record values for oral lethal dose (LD_{50}) in mg/kg-bw or ppm-bw. Most common test species available in scientific literature are the bobwhite quail and mallard. The lowest LD_{50} value found for an avian species would be used as a toxicological endpoint for dose-based RQ calculations to assess acute risk (see Table G-1 in Section G.7.1).

Avian LC_{50}: For test species available in the scientific literature, Service personnel would record values for dietary lethal concentration (LC_{50}) 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 LC_{50} value found for an avian species would be used as a toxicological endpoint for dietary-based RQ calculations to assess acute risk (see Table G-1 in Section G.7.1).

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 G-1 in Section G.7.1).

Fish LC_{50}: For test freshwater or marine species listed in the scientific literature, Service personnel would record a LC_{50} 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 LC_{50} value found for a freshwater fish species would be used as a toxicological endpoint for RQ calculations to assess acute risk (see Table G-1 in Section G.7.1).

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 G-1 in Section G.7.1).

Other: For test invertebrate as well as non-vascular and vascular plant species available in the scientific literature, Service personnel would record LC_{50}, LD_{50}, LOEC, LOEL, NOAEC, NOAEL, or EC_{50} (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 non-vascular and vascular plants, respectively.

G.7.8 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 USEPA 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 effects 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.

G.7.9 Environmental Fate

Water Solubility: Service personnel would record values for water solubility (S_w), which describes the amount of pesticide that dissolves in a known quantity of water. S_w is expressed as mg/L (ppm). Pesticide S_w values would be categorized as one of the following: insoluble <0.1 ppm, moderately soluble = 100 to 1000 ppm, highly soluble >10,000 ppm (USGS 2000). As pesticide S_w increases, there would be greater potential to degrade water quality through runoff and leaching.

S_w would be used to evaluate potential for bioaccumulation in aquatic species [see **Octanol-Water Partition Coefficient (K_{ow})** below].

Soil Mobility: Service personnel would record available values for soil adsorption coefficient (K_{oc} [µg/g]). It provides a measure of a chemical's mobility and leaching potential in soil. K_{oc} values are directly proportional to organic content, clay content, and surface area of the soil. K_{oc} data for a pesticide may be available for a variety of soil types (e.g., clay, loam, sand).

K_{oc} values would be used in evaluating the potential to degrade groundwater by leaching (see **Potential to Move to Groundwater** below).

Soil Persistence: Service personnel would record values for soil half-life (t½), which represents the length of time (days) required for 50% 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 <30 days, moderately persistent = 30 to 100 days, and persistent >100 days (Kerle et al. 1996).

Threshold for Approving PUPs:

If soil t½ ≤100 days, then a PUP would be approved without additional BMPs to protect water quality.

*If soil t½ >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 runoff 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 <10 feet and average annual precipitation >12 inches.*
- *Do not use on steep slopes if substantial rainfall is expected within 24 hours or ground is saturated.*

Along with K_{oc}, soil t½ values would be used in evaluating the potential to degrade groundwater by leaching (see **Potential to Move to Groundwater** below).

Soil Dissipation: Dissipation time (DT_{50}) represents the time required for 50% 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 are 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 DT_{50} value, environmental persistence in the soil also would be categorized as one of the following: non-persistent <30 days, moderately persistent = 30 to 100 days, and persistent >100 days.

Threshold for Approving PUPs:

If soil DT_{50} ≤100 days, then a PUP would be approved without additional BMPs to protect water quality.

If soil DT_{50} >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 runoff 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 <10 feet and average annual precipitation >12 inches.*
- *Do not use on steep slopes if substantial rainfall is expected within 24 hours or ground is saturated.*

Along with K_{oc}, soil DT_{50} 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.

Aquatic Persistence: Service personnel would record values for aquatic t½, which represents the length of time required for 50% 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: non-persistent <30 days, moderately persistent = 30 to 100 days, and persistent >100 days (Kerle et al. 1996).

Threshold for Approving PUPs:

If aquatic t½ ≤100 days, then a PUP would be approved without additional BMPs to protect water quality.

If aquatic t½ >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 runoff 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 <10 feet and average annual precipitation >12 inches.*
- *Do not use on steep slopes if substantial rainfall is expected within 24 hours or ground is saturated.*

Aquatic Dissipation: Dissipation time (DT_{50}) represents the time required for 50% 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 DT_{50} value, environmental persistence in aquatic habitats also would be categorized as one of the following: non-persistent <30 days, moderately persistent = 30 to 100 days, and persistent >100 days.

Threshold for Approving PUPs:

If aquatic DT_{50} ≤100 days, then a PUP would be approved without additional BMPs to protect water quality.

*If aquatic DT_{50} >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 runoff 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 <10 feet and average annual precipitation >12 inches.*
- *Do not use on steep slopes if substantial rainfall is expected within 24 hours or ground is saturated.*

Potential to Move to Groundwater: Groundwater Ubiquity Score (GUS) = $\log_{10}$(soil t ½) x [4 – $\log_{10}(K_{oc})$]. If a DT_{50} 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<1.0, low—1.0 to 2.0, moderate—2.0 to 3.0, high—3.0 to 4.0, or very high >4.0.

Threshold for Approving PUPs:

If GUS ≤4.0, then a PUP would be approved without additional BMPs to protect water quality.

*If GUS >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 runoff 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 <10 feet and average annual precipitation >12 inches.*
- *Do not use on steep slopes if substantial rainfall is expected within 24 hours or ground is saturated.*

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<10 would have low potential to volatilize; whereas, pesticides with I >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 ≤1,000, then a PUP would be approved without additional BMPs to minimize drift and protect air quality.

If I >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 <2 or >10 mph with existing or potential inversion conditions.*
- *Apply the large-diameter droplets possible for spray treatments.*
- *Avoid spraying when air temperatures >85°F.*
- *Use the lowest spray height possible above target canopy.*
- *Where identified on the pesticide label, soil incorporate pesticide as soon as possible during or after application.*

Octanol-Water Partition Coefficient (K_{ow}): The octanol-water partition coefficient (K_{ow}) 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, K_{ow} would be used to assess potential for a pesticide to bioaccumulate in tissues of aquatic species (e.g., fish). If K_{ow} >1,000 or S_w<1 mg/L and soil t½>30 days, then there would be high potential for a pesticide to bioaccumulate in aquatic species such as fish (USGS 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 (K_{ow}>1,000 or S_w<1 mg/L and soil t½>30 days), then the PUP would not approved, except under unusual circumstances where approval would only be granted by the Washington Office.

Bioaccumulation/Bioconcentration: 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 >1,000 (Calabrese and Baldwin 1993).

Threshold for Approving PUPs:

If BAF or BCF≤1,000, then a PUP would be approved without additional BMPs.

If BAF or BCF>1,000, then a PUP would not approved, except under unusual circumstances where approval would only be granted by the Washington Office.

Worst-Case Ecological Risk Assessment

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.

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 USEPA screening-level approach (USEPA 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.

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 G.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% 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 G.7.2 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 USEPA's 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 (<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 G.7.2 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 USEPA (see Table G-2 in Section G.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 G.7.2 for detailed descriptions of acute and chronic RQ calculations and comparison to LOCs to assess risk.

Threshold for approving PUPs:

If RQs≤LOCs, then a PUP would be approved without additional BMPs.

If RQs>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 non-listed or listed species:*

- *Lower application rate and/or fewer number of applications so RQs≤LOCs*
- *For aquatic assessments (fish) associated with cropland/facilities maintenance, increase the buffer distance beyond 25 feet so RQs≤LOCs.*

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 would provide the appropriate information regarding control of pests to describe in the section.

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 environmental 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, then 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 G.4 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.

References: 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, U.S. Environmental Protection Agency, Washington, D.C. (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, U.S. Department of Agriculture, U.S. 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, Department of Interior; Bonneville Power Administration, U.S. Department of Energy; and Forest Service, U.S. Department of Agriculture. (http://infoventures.com/e-hlth/pesticide/pest-fac.html)

8. Pesticide Fact Sheets. National Pesticide Information Center. (http://npic.orst.edu/npicfact.htm)

9. Pesticide Fate Database. U.S. Environmental Protection Agency, Washington, D.C. (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, D.C. (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. U.S. Geological Survey, Department of Interior, Washington, D.C. (http://www.pwrc.usgs.gov/contaminants-online/)

17. One-liner database. 2000. U.S. 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 (t½):	
Soil Dissipation (DT_{50}):	
Aquatic Persistence (t½):	
Aquatic Dissipation (DT_{50}):	
Potential to Move to Groundwater (GUS score):	
Volatilization (mm Hg):	
Octanol-Water Partition Coefficient (K_{ow}):	
Bioaccumulation/Bioconcentration:	**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)	Minimum Time Between Applications (Days)

[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.

G.10 References

AgDRIFT. 2001. A user's guide for AgDRIFT 2.04: a tiered approach for the assessment of spray drift of pesticides. Spray Drift Task Force. Macon, MO.

ATSDR (Agency for Toxic Substances and Disease Registry) U.S. Department of Health and Human Services. 2004. Guidance manual for the assessment of joint toxic action of chemical mixtures. U.S. Department of Health and Human Services, Public Health Service, ATSDR, Division of Toxicology. 62 pp. (+ appendices).

Baehr, C.H. and C. Habig. 2000. Statistical evaluation of the UTAB database for use in terrestrial nontarget organism risk assessment. Presentation at the American Society for Testing and Materials (ASTM) Tenth Symposium on Environmental Toxicology and Risk Assessment, April 2000, Toronto, Canada.

Baker, J. and G. Miller. 1999. Understanding and reducing pesticide losses. Extension Publication PM 1495. Iowa State University Extension. Ames, IA. 6 pp.

Barry, T. 2004. Characterization of propanil prune foliage residues as related to propanil use patterns in the Sacramento Valley, CA. Proceedings of the International Conference on Pesticide Application for Drift Management. Waikoloa, HI. 15 pp.

Battaglin, W.A., E.M. Thurman, S.J. Kalkhoff, and S.D. Porter. 2003. Herbicides and transformation products in surface waters of the midwestern United States. Journal of the American Water Resources Association (JAWRA) 39(4):743-756.

Beyer, W.N., E.E. Connor, and S. Gerould. 1994. Estimates of soil ingestion by wildlife. Journal of Wildlife Management 58:375-382.

BLM (Bureau of Land Management). 2007. Vegetation treatments using herbicides on Bureau of Land Management Lands in 17 western states Programmatic EIS (PEIS). Bureau of Land Management. Washington, D.C. 539 pp.

Brooks, M.L., C.M. D'Antonio, D.M. Richardson, J.B. Grace, J.E. Keeley, J.M. DiTomaso, R.J. Hobbs, M. Pellant, and D. Pyke. 2004. Effects of invasive alien plants on fire regimes. BioScience 54:77-88.

Butler, T., W. Martinkovic, and O.N. Nesheim. 1998. Factors influencing pesticide movement to ground water. Extension Publication PI-2, University of Florida, Cooperative Extension Service, Gainesville, FL. 4 pp.

Calabrese, E.J. and L.A. Baldwin. 1993. Performing ecological risk assessments. Chelsea, MI: Lewis Publishers.

Center, T.D., J.H. Frank, and F.A. Dray, Jr. 1997. Biological control. Pages 245-263 in: D. Simberloff, D.C. Schmitz, and T.C. Brown, eds. Strangers in paradise: impact and management of nonindigenous species in Florida. Washington, D.C.: Island Press.

Coombs, E.M., J.K. Clark, G.L. Piper, and A.F. Cofrancesco, Jr. 2004. Biological control of invasive plants in the United States. Corvallis, OR: Oregon State University Press.

Cox, R.D. and V.J. Anderson. 2004. Increasing native diversity of cheatgrass-dominated rangeland through assisted succession. Journal of Range Management 57:203-210.

Driver, C.J., M.W. Ligotke, P. Van Voris, B.D. McVeety, B.J. Greenspan, and D.B. Brown. 1991. Routes of uptake and their relative contribution to the toxicologic response of northern bobwhite (*Colinus virginianus*) to an organophosphate pesticide. Environmental Toxicology and Chemistry 10:21-33.

Dunning, J.B. 1984. Body weights of 686 species of North American birds. Western Bird Banding Association. Monograph No. 1. Cave Creek, AZ: Eldon Publishing.

EXTOXNET. 1993. Movement of pesticides in the environment. Pesticide Information Project of Cooperative Extension Offices of Cornell University, Oregon State University, University of Idaho, University of California – Davis, and the Institute for Environmental Toxicology, Michigan State University. 4 pp.

Fletcher, J.S., J.E. Nellessen, and T.G. Pfleeger. 1994. Literature review and evaluation of the EPA food-chain (Kanaga) nomogram, and instrument for estimating pesticide residue on plants. Environmental Toxicology and Chemistry 13:1381-1391.

Hasan, S. and P.G. Ayres. 1990. The control of weeds through fungi: principles and prospects. Tansley Review 23:201-222.

Huddleston, J.H. 1996. How soil properties affect groundwater vulnerability to pesticide contamination. EM 8559. Oregon State University Extension Service. Corvallis, OR. 4 pp.

Kerle, E.A., J.J. Jenkins, and P.A. Vogue. 1996. Understanding pesticide persistence and mobility for groundwater and surface water protection. EM 8561. Oregon State University Extension Service. Corvallis, OR. 8 pp.

Masters, R.A. and R.L. Sheley. 2001. Invited synthesis paper: principles and practices for managing rangeland invasive plants. Journal of Range Management 54:502-517.

Masters, R.A., S.J. Nissen, R.E. Gaussoin, D.D. Beran, and R.N. Stougaard. 1996. Imidazolinone herbicides improve restoration of Great Plains grasslands. Weed Technology 10:392-403.

Maxwell, B.D., E. Lehnhoff, and L.J. Rew. 2009. The rationale for monitoring invasive plant populations as a crucial step for management. Invasive Plant Science and Management 2:1-9

Mineau, P., B.T. Collins, and A. Baril. 1996. On the use of scaling factors to improve interspecies extrapolation to acute toxicity in birds. Regulatory Toxicology and Pharmacology 24:24-29.

Moody, M.E. and R.N. Mack. 1988. Controlling the spread of plant invasions: the importance of nascent foci. Journal of Applied Ecology 25:1009-1021.

Morse, L.E., J.M. Randall, N. Benton, R. Hiebert, and S. Lu. 2004. An invasive species assessment protocol: evaluating non-native plants for their impact on biodiversity. Version 1. NatureServe, Arlington, VA. 40 pp.

Mullin, B.H., L.W. Anderson, J.M. DiTomaso, R.E. Eplee, and K.D. Getsinger. 2000. Invasive plant species. Council for Agricultural Science and Technology Issue Paper (13):1-18.

Oregon State University. 1996. EXTOXNET-Extension Toxicology Network, Pesticide Information Profiles. Oregon State University. Corvallis, OR.

Pfleeger, T.G., A. Fong, R. Hayes, H. Ratsch, and C. Wickliff. 1996. Field evaluation of the EPA (Kanaga) nomogram, a method for estimating wildlife exposure to pesticide residues on plants. Environmental Toxicology and Chemistry 15:535-543.

Pope, R., J. DeWitt, and J. Ellerhoff. 1999. Pesticide movement: what farmers need to know. Extension Publication PAT 36. Iowa State University Extension, Ames, IA, and Iowa Department of Agriculture and Land Stewardship, Des Moines, IA. 6 pp.

Ramsay, C.A., G.C. Craig, and C.B. McConnell. 1995. Clean water for Washington—protecting groundwater from pesticide contamination. Extension Publication EB1644. Washington State University Extension. Pullman, WA. 12 pp.

SDTF 2003 (Spray Drift Task Force 2003). 2003. A summary of chemigation application studies. Spray Drift Task Force. Macon, MO.

Teske, M.E., S.L. Bird, D.M. Esterly, S.L. Ray, and S.G. Perry. 1997. A user's guide for AgDRIFT™ 1.0: a tiered approach for the assessment of spray drift of pesticides. Technical Note No. 95-10. CDI. Princeton, NJ.

Teske, M.E., S.L. Bird, D.M. Esterly, T.B. Curbishley, S.L. Ray, and S.G. Perry. 2002. AgDRIFT®: a model for estimating near-field spray drift from aerial applications. Environmental Toxicology and Chemistry 21:659-671.

Urban, D.J. and N.J. Cook. 1986. Ecological risk assessment. EPA 540/9-85-001. U.S. Environmental Protection Agency, Office of Pesticide Programs. Washington, D.C. 94 pp.

USEPA (U.S. Environmental Protection Agency). 1990. Laboratory test methods of exposure to microbial pest control agents by the respiratory route to nontarget avian species. EPA/600/3-90/070. Environmental Research Laboratory. Corvallis, OR. 82 pp.

USEPA. 1998. A comparative analysis of ecological risks from pesticides and their uses: background, methodology and case study. Environmental Fate and Effects Division, Office of Pesticide Programs, U.S. Environmental Protection Agency. Washington, D.C. 105 pp.

USEPA. 2004. Overview of the ecological risk assessment process in the Office of Pesticide Programs, U.S. Environmental Protection Agency: endangered and threatened species effects determinations. Office of Pesticide Programs. Washington, D.C. 101 pp.

USEPA. 2005. User's guide TREX v1.2.3. Available at: http://www.epa.gov/oppefed1/models/terrestrial/trex_usersguide.htm.

USEPA. 2012. Technical overview of ecological risk assessment risk characterization; approaches for evaluating exposure; granular, bait, and treated seed applications. Available at: http://www.epa.gov/oppefed1/ecorisk_ders/toera_analysis_exp.htm. Accessed July 5, 2012.

USFS (U.S. Forest Service). 2005. Pacific Northwest Region invasive plant program preventing and managing invasive plants final environmental impact statement. U.S. Forest Service. Portland, OR. 359 pp.

USGS (U.S. Geological Survey). 2000. Pesticides in stream sediment and aquatic biota—current understanding of distribution and major influences. USGS Fact Sheet 092-00. U.S. Geological Survey. Sacramento, CA. 4 pp.

Wauchope, R.D., T.M. Buttler, A.G. Hornsby, P.M. Augustijn-Beckers, and J.P. Burt. 1992. The SCS/ARS/CES pesticide properties database for environmental decision making. Reviews of Environmental Contamination and Toxicology 123:1-155.

Woods, N. 2004. Australian developments in spray drift management. Proceedings of the International Conference on Pesticide Application for Drift Management. Waikoloa, HI. 8 pp.

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Appendix H. Acronyms, Glossary, and Scientific Names

H.1 Acronyms

ABA	Architectural Barriers Act
ABC	American Bird Conservancy
ACOE	Army Corps of Engineers
ADA	Americans with Disabilities Act
ARPA	Archaeological Resources Protection Act
BCC	Birds of Conservation Concern
BIDEH	Biological Integrity, Diversity, and Environmental Health
BMC	Birds of Management Concern
BMPs	Best Management Practices
CCP	Comprehensive Conservation Plan
CD	Compatibility Determination
CFR	Code of Federal Regulations
Complex	Oregon Coast National Wildlife Refuge Complex
CWA	Clean Water Act
DBH	Diameter at Breast Height
DCP	Disease Contingency Plan
EA	Environmental Assessment
EDRR	Early Detection Rapid Response
EE	Environmental Education
ENSO	El Niño/Southern Oscillation
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FIRFA	Federal Insecticide, Fungicide, and Rodenticide Act
FLTFA	Federal Land Transaction Facilitation Act
FMP	Fire Management Plan
FR	Federal Register
FWS	U.S. Fish and Wildlife Service (also, Service, USFWS)
GHG	Greenhouse Gases
GIS	Geographic Information System
GPS	Global Positioning System
HMP	Habitat Management Plan
HUC	Hydrologic Unit Code
IBA	Important Bird Areas
IPCC	Intergovernmental Panel on Climate Change
IPM	Integrated Pest Management
LCC	Land Conservation Cooperative
LE	Law Enforcement
LPP	Land Protection Plan
LWCF	Land and Water Conservation Fund
LWD	Large Woody Debris
MHHW	Mean Higher High Water
MHW	Mean High Water
MLLW	Mean Lower Low Water
MLW	Mean Low Water

MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MSL	Mean Sea Level
MTL	Mean Tide Level
NAGPRA	Native American Graves Repatriation Act
NAS	National Audubon Society
NASA	National Aeronautics and Space Administration
NAVD88	North American Vertical Datum 1988
NEPA	National Environmental Policy Act
NGO	Non-governmental Organization
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NRHP	National Register of Historic Places
NWR	National Wildlife Refuge
NWRS	National Wildlife Refuge System
ODEQ	State of Oregon Department of Environmental Quality
ODF	State of Oregon Department of Forestry
ODFW	State of Oregon Department of Fish and Wildlife
ODOT	State of Oregon Department of Transportation
OPRD	State of Oregon Parks and Recreation Department
PCE	Primary Constituent Element
PDO	Pacific Decadal Oscillation
PFD	Personal Floatation Device
PFT	Permanent full time
PIF	Partners in Flight
PRBO	Point Reyes Bird Observatory
PUP	Pesticide Use Proposal
R1	Region 1 of the FWS (WA, OR, HI, ID)
RNA	Research Natural Area
ROC	Resource of Concern
SAMMS	Service Asset Management System
SCORP	Statewide Comprehensive Outdoor Recreation Plan
SHPO	State Historic Preservation Office
SLAMM	Sea Level Affecting Marshes Model
SMU	Species Management Unit
SSSP	Shorebird Sister Schools Program
T & E	Threatened or Endangered Species
TMDL	Total Maximum Daily Load
U.S.C.	United States Code
USDI	U.S. Department of the Interior
USEPA	U.S. Environmental Protection Agency (also, EPA)
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USHCN	U.S. Historical Climatology Network

H.2 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.

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.

Approved refuge boundary. A project boundary which the Regional Director of the U.S. Fish and Wildlife Service approves upon completion of the planning and environmental compliance process. An approved refuge boundary only designates those lands which the Fish and Wildlife Service has authority to acquire and/or manage through various agreements. Approval of a refuge boundary does not grant the Fish and Wildlife Service jurisdiction or control over lands within the boundary, and it does not make lands within the refuge boundary part of the National Wildlife Refuge System. Lands do not become part of the National Wildlife Refuge System unless they are purchased or are placed under an agreement that provides for management as part of the Refuge System.

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.

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.

Biological Integrity. Composition, structure, and function at the genetic, organism, and community levels that are consistent with natural conditions and the biological processes that shape communities, along with organisms and their genetic material.

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; 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 Oregon 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).

Environmental Health. The composition, structure, and functioning of soil, water, air, and other nonliving features comparable with historical conditions, including the natural processes that shape the environment.

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.

Friends Group. Any formal organization whose mission is to support the goals and purposes of its associated refuge and the National Wildlife Refuge Association overall. Includes friends organizations and cooperative and interpretive associations.

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.

Integrated Pest Management (IPM). Methods of managing undesirable species such as invasive plants: education, prevention, physical or mechanical methods of control, biological control, responsible chemical use, and cultural methods.

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).

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. The process of collecting information 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 (Refuge or NWR). A designated area of land, water, or an interest in land or water within the National Wildlife Refuge System.

National Wildlife Refuge System (Refuge System or NWRS). 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.

Non-Governmental Organization (NGO). Any group that is not comprised of Federal, State, tribal, county, city, town, local, or other governmental entities.

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 Public Use. One of six uses authorized by the National Wildlife Refuge System Improvement Act of 1997 to have priority if found to be compatible with the purposes of a national wildlife refuge or wetland management district. Each of the six uses are wildlife-dependent, recreational uses—hunting, fishing, wildlife observation, photography, environmental education, and interpretation.

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.

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.

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.

Restoration. One or more actions that lead to the reestablishment of original or native conditions.

Scoping. The process of obtaining information from the public for input into the planning process for actions and decisions of the U.S. Fish and Wildlife Service.

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

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 Oregon 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.

Wildlife-dependent Recreational Use. Use of a national wildlife refuge or wetland management district that involves hunting, fishing, wildlife observation, photography, environmental education, or interpretation. The National Wildlife Refuge System Improvement Act of 1997 specifies that these are the six priority public uses of the Refuge System.

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).

H.3 Scientific Names

The following tables contain the common and scientific names of plants and animals that are mentioned in this CCP.

Table H-1. Common and Scientific Names of Plants Mentioned in this CCP

Common Name	Scientific Name
Baltic rush	*Juncus balticus*
Beach strawberry	*Fragaria chiloensis*
Black twinberry	*Lonicera involucrata*
Blueberry	*Vaccinium alaskaensis*
Common camas	*Camassia quamash*
Creeping bentgrass	*Agrostis stolonifera*
Douglas-fir	*Pseudotsuga menziesii*
Eelgrass	*Zostera marina*
English ivy	*Hedera helix*
Evergreen huckleberry	*Vaccinium ovatum*
False huckleberry	*Menziesia ferruginea*
Gorse	*Ulex europaeus*
Henderson’s checkermallow	*Sidalcea hendersonii*
Himalayan blackberry	*Rubus armeniacus*
Hooker willow	*Salix hookeriana*

Table H-1. Common and Scientific Names of Plants Mentioned in this CCP

Common Name	Scientific Name
Japanese eelgrass	*Zostera japonica*
Lyngby's sedge	*Carex lyngbyei*
Pacific crabapple	*Malus fusca*
Pacific silverweed	*Potentilla anserina* spp. *pacifica*
Pickleweed	*Salicornia virginica*
Red alder	*Alnus rubra*
Red huckleberry	*Vaccinium parvifolium*
Reed canarygrass	*Phalaris arundinacea*
Salal	*Gaultheria shallon*
Salmonberry	*Rubus spectabilis*
Saltmarsh cordgrass	*Spartina alterniflora*
Saltmeadow cordgrass	*Spartina patens*
Scotch broom	*Cytisus scoparius*
Seashore saltgrass	*Distichlis spicata*
Sea-watch angelica	*Angelica lucida*
Shore pine or lodgepole pine	*Pinus contorta var. contorta*
Sitka spruce	*Picea sitchensis*
Slough sedge	*Carex obnupta*
Tansy ragwort	*Senecio jacobaea*
Thimbleberry	*Rubus parvifloris*
Tufted hairgrass	*Deschampsia cespitosa*
Wax myrtle	*Morella cerifera*
Western hemlock	*Tsuga heterophylla*
Western red cedar	*Thuja plicata*
Western sword fern	*Polystichum munitum*

Table H-2. Common and Scientific Names of Mammals Mentioned in this CCP

Common Name	Scientific Name
Beaver	*Castor canadensis*
Black-tailed deer	*Odocoileus hemionus*
Bobcat	*Lynx rufus*
California myotis	*Myotis californicus*
Cat feral	*Felis domestica*
Coyote	*Canis latrans*
Harbor seal	*Phoca vitulina*
Hoary bat	*Lasiurus cinereus*
Long-legged myotis	*Myotis volans*
Marsh shrew	*Sorex bendirii*
Mink	*Mustela vison*
Muskrat	*Ondatra zibethicus*
Nutria	*Myocastor coypus*
Oregon vole	*Microtus oregoni*
Raccoon	*Procyon lotor*

Table H-2. Common and Scientific Names of Mammals Mentioned in this CCP

Common Name	Scientific Name
Red tree vole	*Arborimus longicaudus*
River otter	*Lutra canadensis*
Roosevelt elk	*Cervus canadensis roosevelti*
Silver-haired bat	*Lasionycteris noctivagans*
Townsend's big-eared bat	*Corynorhinus townsendii*
Vagrant shrew	*Sorex vagrans*

Table H-3. Common and Scientific Names of Birds Mentioned in this CCP

Common Name	Scientific Name
Aleutian Canada goose	*Branta canadensis leucopareia*
American bald eagle	*Haliaeetus leucocephalus*
American bittern	*Botaurus lentiginosus*
American coot	*Fulica americana*
American pipit	*Anthus rubescens*
American wigeon	*Anas americana*
Band-tailed pigeon	*Columba fasciata*
Barrow's goldeneye	*Bucephala islandica*
Belted kingfisher	*Ceryle alcyon*
Bewick's wren	*Thryomanes bewickii*
Black brant	*Branta bernicla*
Black turnstone	*Arenaria melanocephala*
Black-bellied plover	*Pluvialis squatarola*
Black scoter	*Melanitta nigra*
Black-throated gray warbler	*Dendroica nigrescens*
Blue-winged teal	*Anas discors*
Brandt's cormorant	*Phalacrocorax penicillatus*
Bufflehead	*Bucephala albeola*
Cackling Canada goose	*Branta canadensis minima*
California brown pelican	*Pelecanus occidentalis*
Canvasback	*Aythya valisineria*
Caspian tern	*Hydroprogne caspia*
Chestnut-backed chickadee	*Parus rufescens*
Cinnamon teal	*Anas cyanoptera*
Common goldeneye	*Bucephala clangula*
Common loon	*Gavia immer*
Common merganser	*Mergus merganser*
Common raven	*Corvus corax*
Common yellowthroat	*Geothlypis trichas*
Double-crested cormorant	*Phalacrocorax auritus*
Dunlin	*Calidris alpina*
Dusky Canada goose	*Branta canadensis occidentalis*
Gadwall	*Anas strepera*
Glaucous-winged gull	*Larus glaucescen*

Table H-3. Common and Scientific Names of Birds Mentioned in this CCP

Common Name	Scientific Name
Golden-crowned kinglet	*Regulus satrapa*
Gray jay	*Perisoreus canadensis*
Great blue heron	*Ardea herodias*
Great horned owl	*Bubo virginianus*
Greater scaup	*Aythya marila*
Greater white-fronted goose	*Anser albifrons*
Greater yellowlegs	*Tringa melanoleuca*
Green heron	*Butorides virescens*
Green-winged teal	*Anas crecca*
Hairy woodpecker	*Picoides villosus*
Hammond's flycatcher	*Empidonax hammondii*
Harlequin duck	*Histrionicus histrionicus*
Hermit thrush	*Catharus guttatus*
Hooded merganser	*Lophodytes cucullatus*
Horned grebe	*Podiceps auritus*
Killdeer	*Charadrius vociferus*
Least sandpiper	*Calidris minutilla*
Lesser Canada goose	*Branta canadensis parvipes*
Lesser scaup	*Aythya affinis*
Lesser yellowlegs	*Tringa flavipes*
Little blue heron	*Egretta caerulea*
Long-billed dowitcher	*Limnodromus scolopaceus*
Long-tailed duck	*Clangula hyemalis*
MacGillivray's warbler	*Oporornis tolmiei*
Mallard	*Anas platyrhynchos*
Marbled godwit	*Limosa fedoa*
Marbled murrelet	*Brachyramphus marmoratus*
Marsh wren	*Cistothorus palustris*
Mourning dove	*Zenaida macroura*
Northern flicker	*Colaptes auratus*
Northern harrier	*Circus cyaneus*
Northern pintail	*Anas acuta*
Northern pygmy-owl	*Glaucidium gnoma*
Northern saw-whet owl	*Aegolius acadicus*
Northern shoveler	*Anas clypeata*
Northern spotted owl	*Strix occidentalis*
Orange-crowned warbler	*Vermivora celata*
Osprey	*Pandion haliaetus*
Pacific wren	*Troglodytes pacificus*
Pacific-slope flycatcher	*Empidonax difficilis*
Pelagic cormorant	*Phalacrocorax pelagicus*
Peregrine falcon	*Falco peregrinus*
Pied-billed grebe	*Podilymbus podiceps*

Table H-3. Common and Scientific Names of Birds Mentioned in this CCP

Common Name	Scientific Name
Pileated woodpecker	*Dryocopus pileatus*
Red crossbill	*Loxia curvirostra*
Red phalarope	*Phalaropus fulicarius*
Red-breasted merganser	*Mergus serrator*
Red-breasted nuthatch	*Sitta canadensis*
Red-necked phalarope	*Phalaropus lobatus*
Red-tailed hawk	*Buteo jamaicensis*
Ring-necked duck	*Aythya collaris*
Ruddy duck	*Oxyura jamaicensis*
Rufous hummingbird	*Selasphorus rufus*
Sanderling	*Caladris alba*
Savannah sparrow	*Passerculus sandwichensis*
Semipalmated plover	*Charadrius semipalmatus*
Short-billed dowitcher	*Limnodromus griseus*
Song sparrow	*Melospiza melodia*
Sora	*Porzana carolina*
Spotted sandpiper	*Actitis macularius*
Steller’s jay	*Cyanocitta stelleri*
Surf scoter	*Melanitta perspicillata*
Swainson’s thrush	*Catharus ustulatus*
Taverner’s Canada goose	*Branta canadensis taverneri*
Townsend’s warbler	*Dendroica townsendi*
Tundra swan	*Cygnus columbianus*
Varied thrush	*Ixoreus naevius*
Vaux’s swift	*Chaetura vauxi*
Virginia rail	*Rallus limicola*
Western Canada goose	*Branta canadensis moffitti*
Western grebe	*Aechmophorus occidentalis*
Western meadowlark	*Sturnella neglecta*
Western sandpiper	*Calidris mauri*
Western snowy plover	*Charadrius alexandrinus*
Whimbrel	*Numenius phaeopus*
White-crowned sparrow	*Zonotrichia leucophrys*
White-winged scoter	*Melanitta fusca*
Willet	*Tringa semipalmata*
Wilson’s snipe	*Gallinago gallinago*
Wilson’s warbler	*Wilsonia pusilla*
Winter wren	*Troglodytes troglodytes*
Wood duck	*Aix sponsa*
Wrentit	*Chamaea fasciata*
Yellow-rumped warbler	*Dendroica coronata*

Table H-4. Common and Scientific Names of Amphibians and Reptiles Mentioned in this CCP

Common Name	Scientific Name
Clouded salamander	*Aneides ferreus*
Ensatina salamander	*Ensatina eschscholtzii*
Garter snake	*Thamnophis sirtalis*
Long-toed salamanders	*Ambystoma macrodactylum*
Northern alligator lizard	*Elgaria coerulea*
Northern red-legged frog	*Rana aurora*
Northwestern salamander	*Ambystoma gracile*
Pacific giant salamander	*Dicamptodon tenebrosus*
Pacific tree frog	*Hyla regilla*
Rough-skinned newt	*Taricha granulosa*
Tailed frog	*Ascaphus truei*
Western red-backed salamander	*Plethodon vehiculum*
Western toad	*Bufo boreas*

Table H-5. Common and Scientific Names of Invertebrates Mentioned in this CCP

Common Name	Scientific Name
New Zealand mudsnail	*Potamopyrgus antipodarum*
Dungeness crab	*Metacarcinus magister*
Ghost shrimp	*Callianassa californiensus*
Softshell clam	*Mya arenaria*
Varnish clam	*Nuttalia obscurata*

Table H-6. Common and Scientific Names of Fish Mentioned in this CCP

Common Name	Scientific Name
Buffalo sculpin	*Enophrys bison*
Chinook salmon	*Oncorhynchus tshawytscha*
Chum salmon	*Oncorhynchus keta*
Coastal cutthroat trout	*Oncorhynchus clarki Clarki*
Coho salmon	*Oncorhynchus kisutch*
English sole	*Parophrys vetulus*
Green sturgeon	*Acipenser medirostris*
Pacific lamprey	*Entosphenus tridentatus*
Pacific smelt (eulachon)	*Thaleichthys pacificus*
Pacific staghorn sculpin	*Leptocottus armatus*
Shiner perch	*Cymatogaster aggregata*
Sockeye salmon	*Oncorhynchus nerka*
Steelhead	*Oncorhynchus mykiss*
Western brook lamprey	*Lampetra richardsoni*

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Appendix I. CCP Team Members

The CCP was developed primarily by the core team members. The team sought expert advice and review from other professionals from several different agencies and organizations. Extended team members provided critical input during wildlife and habitat and visitor services reviews early in the process and continued to provide review and comment as the document evolved. Core and extended team members are listed below.

Core Planning Team

Name	Title	Organization
Roy Lowe	Project Leader, Oregon Coast National Wildlife Refuge Complex	USFWS
Rebecca Chuck	Deputy Project Leader, Oregon Coast National Wildlife Refuge Complex	USFWS
Shawn Stephensen	Refuge Biologist, Oregon Coast National Wildlife Refuge Complex	USFWS
Dave Ledig	South Coast Refuge Manager, Oregon Coast National Wildlife Refuge Complex	USFWS
Dawn Grafe	Supervisory Park Ranger	USFWS
Jane Bardolf (departed 8/2011)	Conservation Planner, Division of Planning, Visitor Services, and Transportation, Region 1	USFWS
Khemarith So (became planner in 10/2011)	Conservation Planner, Division of Planning, Visitor Services, and Transportation, Region 1	USFWS

Extended Planning Team and Reviewers

Name	Area of Assistance	Organization
Robyn Thorson	General review	USFWS
Robin West	General review	USFWS
Ben Harrison	CCP quality and consistency	USFWS
Bob Flores	General Review	USFWS
Chuck Houghten	CCP quality and consistency	USFWS
Scott McCarthy	CCP quality and consistency	USFWS
Mike Marxen	Visitor services goals and objectives	USFWS
Cathy Sheppard (retired)	Realty Issues	USFWS
Wayne Hill	Realty issues	USFWS
Dave Drescher	GIS coordination and mapping	USFWS
Brad Bortner (retired)	Migratory Birds	USFWS
Fred Paveglio (retired)	Biological goals and objectives	USFWS
Kevin Kilbride	Biological goals and objectives, Integrated Pest Management	USFWS
Joe Engler	Biological goals and objectives	USFWS
Bridgette Flanders-Wanner	Biological goals and objectives	USFWS

Extended Planning Team and Reviewers

Name	Area of Assistance	Organization
Nick Valentine	Cultural Resources	USFWS
Erin Carver	Socio-economics	USFWS
Sam Lohr	Fisheries	USFWS
Scott Neumann	Law enforcement issues	USFWS
Daniel Huckel	Law enforcement issues	USFWS
Nicole McCarthy	Technical writing and editing	USFWS
Lara Bjork	Technical editing	SWCA Environmental Consultants
Malini Roberts	Technical editing	SWCA Environmental Consultants
Joan Jewett	Public involvement/communication	USFWS
Patrick Stark	Layout and design	USFWS
Todd Thompson	Law enforcement issues	Oregon State Police
Robin Sears	Visitor services and law enforcement issues	Oregon Parks and Recreation Department
Brad Bales	Waterfowl	Oregon Department of Fish and Wildlife
Doug Cottam	Hunting, fishing, waterfowl, elk	Oregon Department of Fish and Wildlife
Tony D'Andrea	Shellfish	Oregon Department of Fish and Wildlife
Dan Avery	Estuarine habitat and fish	Oregon Department of Fish and Wildlife
Bob Buckman	Fish	Oregon Department of Fish and Wildlife
Laura Brophy	Tidal marsh ecology and plant communities	Green Point Consulting
Stan Van de Wetering	Fisheries	Confederated Tribes of Siletz Indians
Timothy Fisher	Visitor Services	Bureau of Land Management
Rudy Schuster	Visitor Services	USGS – Fort Collins

Appendix J. Public Involvement

Public involvement was sought throughout the development of the CCP, starting in June 2010 with the preparation of a Public Outreach Plan. Public involvement strategies included face-to-face meetings or phone conversations with key agencies, federally elected officials (or their aides), Tribal representatives, and local refuge users. The Refuge also held open houses and sent planning updates to inform the public, invite discussion, and solicit feedback. This CCP was developed concurrently with CCPs for two other refuges within the Oregon Coast NWR Complex (Bandon Marsh and Nestucca Bay NWRs) so briefings and planning updates covered all three refuges.

A mailing list (postal and email) of approximately 650 persons and organizations is maintained at the Refuge Complex for Bandon Marsh, Nestucca Bay, and Siletz Bay NWRs and was used to distribute planning updates and public meeting announcements. Below is a brief summary of the events, meetings, and outreach tools that were used in our Siletz Bay NWR CCP public involvement efforts.

Meetings with Congressional Representatives and/or Their Aides:

- April 7, 2011. Project Leader Roy Lowe met with Jeremiah Baumann of Senator Jeff Merkley's staff to update the Senator's office on the status of the CCP process. Location: Washington, D.C.
- April 7, 2011. Project Leader Roy Lowe met with Michele Miranda of Senator Ron Wyden's staff to update the Senator's office on the status of the CCP process. Location: Washington, D.C.
- April 7, 2011. Project Leader Roy Lowe met with Ethan Pittleman of Representative Kurt Schrader's staff to update the Representative's office on the status of the CCP process. Location: Washington, D.C.
- March 30, 2012. Project Leader Roy Lowe met with Adrian Deveny of Senator Jeff Merkley's staff to discuss the CCP planning process and draft alternatives. Location: Washington, D.C.
- March 30, 2012. Project Leader Roy Lowe met with Michele Miranda and Alexandra Hackbarth of Senator Ron Wyden's staff to discuss the CCP planning process and draft alternatives. Location: Washington, D.C.
- March 30, 2012. Project Leader Roy Lowe met with Ethan Pittleman of Representative Kurt Schrader's staff to discuss the CCP planning process and draft alternatives. Location: Washington, D.C.

Meetings with Local Community Organizations involving CCP Issues:

- January 9, 2012. Visitor Services Manager Dawn Grafe attended the board meeting of the Siletz Keys Homeowners Association to discuss the preliminary draft alternatives outlined in CCP Planning Update #2.

Meetings with Agency Representatives:

- March 18, 2010. Representatives from ODFW, Oregon DSL, NOAA Fisheries, The Nature Conservancy, Green Point Consulting, and other USFWS programs participated in the on-site Siletz Bay NWR Wildlife and Habitat Review.
- April 15, 2010. Representatives from OPRD, ODFW, U.S. Geological Survey, the Oregon Coast Visitors Association, Oregon State Police, BLM, and the USFWS extended team participated in the on-site Siletz Bay NWR Visitor Services Review.

- December 1, 2010. Representatives from the Region 1 Regional Office and Refuge Project Leaders met with the ODFW to discuss the CCP process and other issues of interest. Location: Tualatin River NWR, Sherwood, OR.
- August 20, 2011. Project Leader Roy Lowe met with ODFW Director Roy Elicker during the NOAA MPOC dedication event in Newport, OR and updated him on the status of the Siletz Bay, Nestucca Bay, and Bandon Marsh CCPs.
- February 3, 2012. Project Leader Roy Lowe and refuge staff met with ODFW representatives Don Whittaker, Doug Cottam, and Bob Buckman to discuss the ODFW's comments regarding draft alternatives for hunting and fishing. Location: USFWS Office, Newport, OR.

Public Open Houses/Scoping Sessions:

- November 29, 2010. Public scoping meeting at the Lincoln City Community Center, Lincoln City, OR.
  Purpose and format: To provide information on CCP process and preliminary issues to be addressed. The public scoping meeting was in an open-house format. At the open house, refuge staff and the lead planner explained the CCP process; refuge purposes, vision, and management; and preliminary management issues, concerns and opportunities that had been identified early in the planning process. They also answered questions from attendees and took written comments.
  Attendance: A total of 12 private citizens and representatives from various organizations attended the open house, providing comments on the issues and opportunities presented.
- November 10, 2011. Public Draft Alternatives meeting at the Lincoln City Council Chambers, Lincoln City, OR.
  Purpose and format: To gather public input on the draft alternatives for Siletz Bay NWR. The draft alternatives meeting was in an open-house format. At the open house, refuge staff gave a presentation on the CCP process, progress to date, how the draft alternatives were developed, and future opportunities for public input. The public was invited to submit comments either in writing or verbally. The attendees then had the opportunity to visit four tables staffed by refuge staff and the lead planner. Each table had a scribe to record verbal comments.
  Attendance: Three people attended the meeting.

Other Meetings:

- August 17, 2010. Preplanning briefing for Region 1 Refuge Chief and staff, USFWS Regional Office, Portland, OR. Refuge CCP team participated by videoconference.
- May 23-25, 2011. Facilities Review attended by CCP team, contractors from Vigil-Agrimis, and Visitor Services and Communication staff from USFWS Regional Office.
- July 27, 2011. Draft Alternatives briefing for Region 1 Refuge Chief and staff, USFWS Regional Office, Portland, OR. Refuge CCP team participated by videoconference.

Press Coverage: (all three refuges)

- November 5, 2010. News release announcing public scoping meetings sent to 17 newspapers and other online venues. The news release resulted in articles being written or published in the following venues. This list may not be inclusive.
  - November 5, 2010 http://www.fws.gov/oregoncoast/news.html
  - November 19, 2010 Medford Mail Tribune
  - November 19, 2010 Pacific City Sun
  - November 25, 2010 Daily Astorian

- November 26, 2010 and December 2 and 9, 2010 Bandon Western World
- November 27, 2010 Newport News-Times
- November 29, 2010 Tillamook Headlight Herald
- November 29, 2010 Oregon Birders On Line posting
- December 1, 2010 Lincoln City News Guard
- December 4, 2010 TheWorldLink.com (Coos Bay)
- January 31, 2011 Neskowin Community Association online

- October 28, 2011. News release announcing availability of preliminary draft alternatives and public open house meetings sent to 17 coastal newspapers and other online venues and resulted in articles in the following media. This list may not be inclusive.
  - October 28, 2010 http://www.fws.gov/oregoncoast
  - October 31, 2011 Salem Statesman Journal
  - November 2, 2011 Lincoln County Birder and Nature Observation online
  - November 3, 2011 Bandon Western World
  - November 22, 2011 Lincoln City News Guard
  - November 4, 2011 Pacific City Sun
- September 18, 2012. News release announcing availability of the draft CCP/EAs for public review and comment sent to 17 coastal newspapers and other online venues and resulted in articles in the following media. This list is not inclusive.
  - September 21, 2012 Lincoln City News Guard (wildlife refuge plans available for review)
  - September 27, 2012 Bandon Western World (USFWS releases marsh plans)
- December 21, 2012. News release announcing availability of the draft waterfowl hunt plans for public review and comment sent to 19 coastal newspapers and other media and resulted in following articles. This list is not inclusive.
  - December 28, 2012 Pacific City Sun (Public comment wanted on waterfowl hunting plan)
  - January 2, 2013 Salem Statesman Journal (Waterfowl hunt plans for Oregon coastal refuges open for comments)
  - January 3, 2013 The World (Influence hunting at Bandon Marsh)
  - January 7, 2013 The World (Help draft plan for Bandon waterfowl hunting)

Planning Updates:

- November 2010: Planning Update #1 sent to a mailing list of approximately 380 recipients, including private individuals, government agencies, and non-governmental organizations. The planning update included information on how and where to send comments as well as notification of upcoming public open house meetings. In addition, the Planning Update was posted on the refuge website, and copies were available at the CCP open houses and at the refuge office.
- November 2011: Planning Update #2, summarizing preliminary draft alternatives, was distributed to a mailing list of approximately 400 recipients. This planning update included notice of upcoming public open house meeting and provided information on how and where to comment. In addition, the Planning Update was posted on the refuge website.
- September 2012: Planning Update #3 was distributed to a mailing list of approximately 600 recipients and posted on the refuge website. This planning update announced the availability of draft CCP/EAs for public review and comment, provided information on

how and where to comment, summarized the public involvement to date, and detailed the different draft management alternatives.

- April 2013: Planning Update #4, announcing the completion of the final CCPs, will be released concurrently with this document. This planning update will summarize comments received on the draft CCP/EAs, detail the Refuges' management directions, and provide information on how and where to obtain copies of the final plans.

Other Tools:

- Website at http://www.fws.gov/oregoncoast/ccp_nes_slz_bdm.htm featuring CCP information, planning updates, maps, press releases, and scoping forms.
- March 2010: Letters sent to invited participants for the Wildlife and Habitat Review.
- April 2010: Letters sent to invited participants for the Visitor Services Review.
- August 25, 2011: Letters sent from the Refuge to extended team members updating them on the planning process draft alternatives and inviting their participation. Team agencies included ODFW and OPRD.
- August 25, 2011: Letters sent from the Refuge to Robert Kentta and Delores Pigsley with the Confederated Tribes of Siletz Indians updating them on the planning process draft alternatives and inviting participation.

Federal Register Notices:

- November 29, 2010: Federal Register published Notice of Intent to Prepare a Draft Comprehensive Conservation Plan and Associated NEPA Document; and Notice of Public Meetings (75 FR 73121).
- September 17, 2012: Federal Register published Notice of Availability of the Draft Comprehensive Conservation Plan and Environmental Assessment; and request for comments (77 FR 57107).
- Federal Register Notice of Availability of the Final Comprehensive Conservation Plan and Finding of No Significant Impact for Environmental Assessment published concurrently with release of this document.

Appendix K. Comments Received During Public/Agency Review Period and Service Responses

K.1 Introduction

The U.S. Fish and Wildlife Service (USFWS or Service) received comments from 10 entities regarding the Draft Comprehensive Conservation Plan/Environmental Assessment (CCP/EA) for Siletz Bay National Wildlife Refuge (NWR or Refuge) during the 30-day comment period (Table K-1). Comments from nine of those entities also addressed the Bandon Marsh and Nestucca Bay NWRs Draft CCP/EAs which were being developed concurrently. All written comments were reviewed and organized so that an objective analysis, summary, and presentation of the comments could be made.

Each original piece of correspondence was assigned an identification number and identified with the last name and first initial of the individual commenter who signed the letter. Note that for simplicity’s sake, the word “letter” is generally used throughout this appendix to refer to any comment or reference document received, whether by letter, fax, email, or comment form. Multiple correspondences from a commenter are counted as one comment letter.

To help analyze the nature and extent of comments received, a number of themes and subthemes were identified within the letters. Comments were coded with the identified themes. Due to the similarity of written comments received, similar comments on a theme were grouped together, and the Service response applies to the comments as a group. Comments that fell outside the scope of the CCP were also considered and were responded to as appropriate.

Table K-1. Source of Comments

Affiliation/Entities	Number of Commenters (September 17, 2012 through October 22, 2012)
Organizations	1
General Public	9
Total	**10**

K.2 Changes Made to the Final CCP

The CCP planning team reviewed and evaluated all of the comments received during the Draft CCP/EA comment period. In some cases, the management direction has been either clarified or modified based upon these comments. Table K-2 shows the major changes between the draft and the final CCP. For additional information, see Chapter 2 and Figure 2-1 in the CCP.

Table K-2. Summary of Changes to Management Direction between the Draft and Final CCP

Key Theme/issue	Alternative C in Draft CCP	Management Direction in Final CCP
Forested Habitat		
Upland forest	122 acres protected and actively managed. Inventory and assess existing conditions and manage for late-successional forest.	No change from draft plan.
Estuarine Habitat		
Intertidal mudflats	Continue to protect and maintain 0.8 acre, using integrated pest management (IPM) techniques, plus work with the Oregon Department of State Lands to cooperatively manage intertidal mudflats and to monitor and treat invasive species.	No change from draft plan.
Tidal marsh	Protect and maintain 314 acres of tidal marsh. Work with private landowners and partners to acquire lands within the authorized refuge boundary to facilitate full tidal restoration. Work with the Oregon Department of Transportation and Oregon Department of Fish and Wildlife (ODFW) to repair or replace culverts to achieve normal tidal function. If feasible, restore tidal flow to Siletz Keys and Alder Island (Schoen Tract) and any additional diked lands acquired. Outplant of rare, native species (e.g., Henderson's checkermallow) to increase native vegetation presence.	No change from draft plan.
Forested Wetlands and Stream-Riparian Habitat		
Forested wetlands and stream-riparian corridor	18 acres protected. Control invasive species with IPM techniques.	No change from draft plan.
Monitoring and Research		
Status monitoring	Continue and expand existing data collection. Collect data on fish, amphibians, small mammals, plants, migratory songbirds.	No change from draft plan.
Effectiveness monitoring	Monitor CCP and other step-down plan objectives.	No change from draft plan.
Research	Continue current research, plus identify priority and long-term research needs and cooperate with partners to accomplish.	No change from draft plan.
Wildlife Observation and Photography		
Wildlife observation and photography	Open Alder Island (Schoen Tract) to observation and photography through development of accessible loop trail. Allow unrestricted walking on refuge lands west of Highway 101. Develop viewing platform off Highway 101.	No change from draft plan.

Interpretation		
Interpretation	Open Alder Island (Schoen Tract) and develop interpretive trail, parking lot, and boat launch, and continue with interpreter-led seasonal paddle trips.	No change from draft plan.
Hunting		
Waterfowl hunting	Allow waterfowl hunting on lands west of Highway 101 (80 acres) 7 days per week. Allow waterfowl hunting 3 days per week on lands south of Millport Slough (97 acres). Establish a 100-yard no-hunting zone to prohibit waterfowl hunting on refuge property that extends westward from the refuge property line on the west side of the housing development of Siletz Keys. Develop gravel parking lot and kiosk.	Same as in draft plan except: Allow waterfowl hunting on lands west of Highway 101 (87 acres) 7 days per week. Allow waterfowl hunting 3 days per week on lands south of Millport Slough (112 acres).
Fishing		
Fishing	Allow bank fishing from Alder Island—walk in only.	No change from draft plan.
Access for clamming	Allow access to clamming through Snag Alley.	No change from draft plan.
Facilities		
Facilities	Keep current refuge facilities and do not build a visitor center.	Same as draft plan but also: Utilize habitat-appropriate native plants for landscaping around public use facilities.
Climate Change Adaptation		
Reduce carbon footprint	Replace current vehicles with more fuel-efficient vehicles. Any new or replaced facilities will be appropriately sized and energy-efficient. Use energy-efficient land management techniques where feasible and in line with management goals. Explore ways of offsetting carbon balance, such as carbon sequestration.	No change from draft plan.

K.3 Summary of Comments Received and Service Responses

Wildlife and Habitat Management

1. **Comment:** A primary goal of the Refuge should be to restore refuge lands to pre-European conditions.

   Response: The Service agrees with the goal of restoring refuge lands to historic conditions, defined as the conditions we believe were present prior to substantial human related changes to the landscape (601 FW 3). The National Wildlife Refuge System Administration Act, as amended, directs the Service to ensure that the biological integrity, diversity, and environmental health (BIDEH) of the National Wildlife Refuge System (NWRS or Refuge System) are maintained for the benefit of present and future generations of Americans. The

BIDEH policy (601 FW 3) defines *biological integrity* as “the biotic composition, structure, and functioning at genetic, organism, and community levels comparable with historic conditions, including the natural biological processes that shape genomes, organisms, and communities.” *Biological diversity* is defined as “the variety of life and its processes, including the variety of living organisms, the genetic differences among them, and communities and ecosystems in which they occur.” *Environmental health* is defined as the “composition, structure, and functioning of soil, water, air, and other abiotic features comparable with historic conditions, including the natural abiotic processes that shape the environment.” In simple terms, elements of BIDEH are represented by native fish, wildlife, plants, and their habitats, as well as those ecological processes that support them. The BIDEH policy directs refuges to move toward historic conditions unless (a) this would conflict with refuge purpose; (b) no feasible alternative exists for accomplishing refuge purpose other than management for non-historic conditions; or (c) management for non-historic conditions would make a greater contribution to BIDEH at a larger landscape scale (Schroeder et al. 2004).

2. **Comment:** Support for the increased habitat monitoring and management activities presented in Alternative C, the preferred alternative.

   Response: The Service acknowledges the support for habitat monitoring and management activities presented in the preferred alternative.

3. **Comment:** Support for salt marsh restoration and planting of *Sidalcea hendersonii*.

   Response: The Service acknowledges the comment in support of the preferred alternative to restore salt marsh (tidal flow) to new parcels and plant native vegetation, including Henderson’s checkermallow (*Sidalcea hendersonii*).

4. **Comment:** How will the Alder Island loop trail development affect restoration activities and priorities?

   Response: The development of a loop trail on Alder Island will not affect plans to restore tidal flow to the island. The intent is to create strategic breaches in the dike at Alder Island to allow greater tidal exchange and mimic the natural hydrology that was present before alterations were made. Footbridges will be constructed over the breaches to allow continuation of the loop trail.

5. **Comment:** Support for the continued restoration of natural hydrological functions to restore, enhance, protect, and maintain salt marsh habitat for the benefit of non-game wildlife species, including shorebirds.

   Response: As stated within Chapter 4 of the CCP, the Refuge System is directed to consider and provide protection for the broad spectrum of fish, wildlife, and habitat resources found on the Refuge and in the associated ecosystem that represents the BIDEH of refuge habitat. To meet this directive, one goal of the Refuge System is to conserve and restore, where appropriate, critical ecosystems (e.g., tidal and freshwater marshes) and ecological processes (e.g., natural hydrological conditions) characteristic of those ecosystems. In addition, the Service identifies resources of concern that are:

> “all plant and/or animal species, species groups, or communities specifically identified in refuge purpose(s), System mission, or international, national, regional, state, or ecosystem conservation plans or acts. For example, waterfowl and shorebirds are a resource of concern on a refuge whose purpose is to protect ‘migrating waterfowl and shorebirds.’ Federal or State threatened and endangered species on that same refuge are also a resource of concern under terms of the respective endangered species acts (620 FW 1.4G)…”
>
> “Habitats or plant communities are resources of concern when they are specifically identified in refuge purposes, when they support species or species groups identified in refuge purposes, when they support NWRS resources of concern, and/or when they are important in the maintenance or restoration of biological integrity, diversity, and environmental health.”

Therefore, resources of concern for a refuge may be a species or species group, or the habitat/plant community that supports a priority species/species groups. At Siletz Bay NWR this includes salt marsh and freshwater habitats that support economically and culturally important fish species as well as non-game wildlife, including shorebirds. The Service’s intention is to use a “surrogate species” approach, which utilizes individual species or a suite of species to represent the habitat and/or management needs of a larger set of species (USFWS 2012e).

6. **Comment:** Support for managing upland forests toward late-successional characteristics.

   Response: The Service acknowledges the comment in support of the preferred alternative to manage upland forests toward late-successional characteristics.

7. **Comment:** The wet-mesic Sitka spruce-western hemlock forest habitat classification is confusing. What plant communities are intended to be included within this habitat classification? If multiple forest types are intended under goals specific to the wet-mesic Sitka spruce-western hemlock forest classification, then perhaps the individual forest types could be separated out into different objectives under this goal.

   Response: A broad range of forest and habitat types existed in coastal areas historically. For the purposes of this CCP, we combined multiple forest types into wet-mesic Sitka spruce-western hemlock forest. This habitat type includes woody habitats that consist of valley forested wetlands and riparian forests along rivers, salt marsh, or mudflats. The reasoning behind combining these multiple forest types is that no active management (e.g., timber harvest) is planned for any of the refuge lands containing these forest types, and all will be managed and restored similarly.

8. **Comment:** Crab, shellfish, and invertebrates should be added to the list of in-stream aquatic habitat species benefiting from enhancement, protection, and maintenance activities.

   Response: Goal 4 has been rephrased as follows: “Enhance, protect, and maintain in-stream aquatic habitat for all dependent species including anadromous fish.” In addition, a reference to Appendix E, Resources of Concern, for a full list of benefiting species has been added to the rationale.

9. **Comment:** The Objective 4.1, strategy b "provide spawning (cutthroat trout) and rearing habitat (salmon)" is vague and should be changed to include "work with partners to implement Siletz Bay component of ODFW coho and multi-species conservation plans."

   Response: A strategy has been added to Objective 4.1 in the CCP that reads as follows: "Work with partners to implement Siletz Bay component of ODFW coho and multi-species conservation plans, particularly the physical habitat restoration actions listed in the Oregon Coast Coho Conservation Plan (http://www.dfw.state.or.us/fish/CRP/docs/coastal_coho/final/Coho_Plan.pdf)."

Invasive Species Management

10. **Comment:** The Refuge should eradicate all non-native species from refuge-managed lands. The long-term eradication of non-native species should take precedence over any concerns about incidental damage to native species caused by eradication efforts, and the use of lethal means (e.g., the hunting of nutria) is encouraged if it is the most cost-effective method.

    Response: Throughout the CCP, the terms *pest* and *invasive species* are used interchangeably because both can prevent/impede achievement of refuge wildlife and habitat objectives and/or degrade environmental quality. Service policy (569 FW 1) defines *pests* as "invasive plants and introduced or native organisms that may interfere with achieving our management goals and objectives on or off our lands, or that jeopardize human health or safety." Department of the Interior policy (517 DM 1) 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."

    The control of non-native and invasive species on the Refuge is proactive and receives high management priority. The likelihood of incidental damage to native species caused by eradication efforts must be determined before implementing IPM techniques. A cost-benefit analysis regarding effects to native species health and population plays a critical role in determining the most effective method to control invasive species with least harm to native species. Decisions to use particular tools and techniques and criteria for their use to control invasive species are based on numerous factors and considerations (e.g., the particular species being targeted, associated natural history characteristics, proximity to sensitive resources and non-target species, etc.). While the CCP provides overall direction and priority for the control of invasive species, naming specific treatments for the variety of possible problems would be premature. 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. Considering refuge objectives and the ecology of pest species, once a pest species population reaches a threshold, one or more methods will be selected that are feasible, efficacious, and most protective of non-target resources, including native species (fish, wildlife, and plants), Service personnel, Service-authorized agents, volunteers, and the public. Staff time and available funding would be considered when determining feasibility/practicality of various treatments. Such methods may include lethal removal of individual animals when those methods do not pose a significant threat to non-target animals.

11. **Comment:** The Refuge should prioritize funds and effort towards effectively and quickly controlling existing or preventing new, invasive species on the Refuge. Refuge management

should use the principles of Early Detection Rapid Response (EDRR), which calls for regular monitoring for invasive plant species and rapid attack of species that pose a significant threat to key habitats.

Response: For Siletz Bay NWR, the magnitude of pest problems is beyond the available capital resources to expect control or eradication during any single field season; therefore it is essential to prioritize treatment of infestations. Some non-native species that are pervasive on refuge lands are the subject of long-term control efforts and will continue to be a high priority for refuge resources. The EDRR model will be used to find and verify the identity of new invasive species as early after entry as possible, when eradication and control are still feasible and less costly. The Service will embark on a systematic effort to eradicate, contain, or control newly discovered invasive species and isolated infestations of a previously established, non-native species, while the infestation is still localized. Regardless of whether the invasive species is well established or newly introduced, it will be essential that the Refuge prioritize 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.

12. **Comment:** An additional strategy to include increased recruitment of volunteers or use of prison crews to assist with invasive eradication should be added.

    Response: Currently the Refuge is using many different forms of labor to assist in monitoring and removal of invasive species including prison crews, school groups, and other volunteers. Per the revised strategies contained in Objective 8.3, the Service will continue to recruit volunteers to assist in invasive species monitoring and removal.

13. **Comment:** Is the cleaning clothes and boating equipment strategy just for refuge personnel or will there be provisions for the public to do that on-site?

    Response: The strategies for cleaning equipment and boats (i.e., Objective 2.1, strategy c; Objective 5.1; and Objective 5.2, strategy e) are for refuge personnel, contractors, and researchers; however, they are recommended for anyone entering salt marsh or intertidal mudflat habitats. When the non-motorized boat launch along the old Highway 101 spur road is completed, we will post a sign to recommend cleaning all equipment before entering the site.

Inventory, Monitoring, Research, and Assessments

14. **Comment:** Support for the monitoring activities identified in the CCP including water quality, non-native species, sedimentation rate, mudflats (and associated species), and climate change parameters. The Service should coordinate monitoring efforts with other agencies across the region and identify potential research projects. Support for monitoring strategies with the caveat that they must be directly tied to quantified management objectives and described with enough detail to determine whether they are warranted. Monitoring for forest disease and pests is already conducted by ODFW and the U.S. Forest Service through aerial surveys and data are available on-line, making USFWS efforts in this area unnecessary.

    Response: The Service acknowledges the support for scientific monitoring and the concern that it be directly tied to quantified management objectives and not duplicative of other agencies' efforts. When evaluating results of past or current monitoring and deciding if it should continue, refuge staff first determine whether that particular monitoring effort is needed to answer specific questions that will promote and support adaptive management. When management objectives lead to an identified need for additional or new monitoring effort, staff will first search for similar monitoring being conducted concurrently and determine if the Service should coordinate with ongoing efforts, such as the ongoing surveys for forest diseases and pests, or establish a refuge-specific protocol.

15. **Comment:** Research should be conducted in a rigorous and scientifically valid manner that includes peer review and publication of results. These results plus all relevant archived reports should be converted to digital formats and made available for use by other researchers, managers, and interested public.

    Response: The Service is committed to using sound science in its decision-making and to providing the public with information of the highest quality possible. The Service is instituting data standards to improve the quality and compatibility of its data. This approach will increase opportunities to share data and reduce incidents of redundant data development. Federal agencies are required to publish guidelines for ensuring the quality, objectivity, utility, and integrity of information we use and disseminate, and to provide mechanisms for allowing the public to seek correction of that information. In order to ensure the quality and credibility of the scientific information the Refuge uses to make decisions, the Service has implemented a formal "peer review" process for influential scientific documents following the Office of Management and Budget memorandum "Final Information Quality Bulletin for Peer Review" (available online at http://www.whitehouse.gov/sites/default/files/omb /memoranda/fy2005/m05-03.pdf).

16. **Comment:** What is the invertebrate availability to shorebirds at Siletz Bay, and are there available high-tide roost areas for shorebirds?

    Response: Shorebirds make less use of Siletz Bay mudflats than some other estuaries along the Oregon coast. Several goals and objectives within the CCP (Objective 2.2, Protect and maintain intertidal mudflats and Objective 5.1, Conduct inventory and monitoring surveys) include strategies to conduct monitor habitat parameters to determine stop-over feeding and loafing habitat quality for shorebirds. Results of this monitoring, along with habitat assessments, will allow the Service to determine if it is possible to improve areas for shorebird use at Siletz Bay NWR.

Public Access

17. **Comment:** The Service should charge a fee that could be used on the Refuge to support road, facilities, and habitat maintenance programs, and these fees should be only used for the Oregon Coast NWR Complex.

    Response: In 2004, Congress passed the Federal Lands Recreation Enhancement Act, which allows the government to charge a fee for recreation use of public lands managed by the USFWS and other federal land management agencies. The Service collects fees at more than 100 national wildlife refuges. At least 80 percent of all fees collected at a refuge are reinvested back into that refuge to provide quality recreational facilities and opportunities to our visitors. The remaining 20 percent is used in that geographic region. The Service may not use recreation fees to pay for biological monitoring of threatened and endangered species; however, fees could be used to support visitor facilities and potentially habitat maintenance in areas open to public access. At this time, the Refuge has no plans to charge a fee for recreational use access or activities due to the lack of recreational public use facilities or opportunities at this refuge (e.g., visitor center, boat launch, duck blinds) that would benefit from the funds generated. As some of these facilities are developed, the Service will refer to established criteria to determine if charging a fee and establishing a fee collection system are warranted at some point in the future.

18. **Comment:** Concern over the ambiguity of the statement regarding "unrestricted walking." Clarification that hunters be able to retrieve downed birds either by boat or by foot should be included.

    Response: The "unrestricted walking" referred to in the CCP is for visitors engaging in wildlife observation. It simply means the visitor can go anywhere by foot on the delineated refuge lands without having to stay on a designated trail. It is not referred to in the waterfowl hunting section because it is acknowledged that at times, a bird that has been shot may continue through the air and land in an area closed to the public, and to leave it without making an attempt to retrieve could constitute wanton waste of game. Dead or crippled game may be retrieved by a hunter from a closed area of the Refuge.

Wildlife Observation and Photography

19. **Comment:** Disappointment that wildlife observation and photography were prohibited in some areas. The Service should allow these uses on more areas.

    Response: Minimizing human disturbance to wildlife is a priority for the Service at Siletz Bay NWR. The Service is committed to providing tidal marsh where wildlife can feed and rest undisturbed. Therefore management strategies to reduce disturbance to wildlife must include areas that are closed to all public use, including wildlife observation and photography, to provide such sanctuary. The Service has offered multiple strategies to allow wildlife observation and photography in the CCP including the construction of a loop trail on Alder Island.

20. **Comment:** Support for facilities to support wildlife observation with specific recommendations about the design of photography/observation blinds. Support for the construction of additional facilities in support of wildlife observation and photography including an auto tour route.

    Response: The Service acknowledges the support for construction of additional facilities in support of wildlife observation and photography. The Service has included the construction of additional facilities in support of wildlife observation and photography in the CCP including the construction of a trail on Alder Island and a non-motorized boat launch on the old Highway 101 spur road. These facilities will allow visitors to engage in interpretation, wildlife observation, and photography. The Service does not have plans to build any observation/photography blinds currently but will take the recommendations of the commenters into consideration if we design and build any in the future. The Service did not consider an auto tour route because the topography of the landscape, lack of road access from Highway 101, and limited refuge acreage make this option unfeasible.

21. **Comment:** Support for banning the usage of audio playback devices to attract birds or other wildlife.

    Response: Human activities on a refuge must be compatible with the primary wildlife purposes of each refuge. The use of audio playback devices is an issue of growing concern to the Service, because the use of technology for birding and wildlife photography continues to increase and evolve. The reason for concern is that when a song is played in a bird's territory, that bird's response to the so-called intruder is recognized by neighboring rivals. As a result, birds that are otherwise too shy and secretive to expose themselves are lured out into the open by the sound of a potential rival, thereby making them more vulnerable to predation. Use of audio playback appears to cause undue stress on the bird, causing the territorial male to waste energy chasing a perceived intruder and distracting birds from more important, energy-intensive activities including nest building, incubation, and/or searching for food. Some birders will use bird calls in the field to verify a call they have heard. On a refuge they may play the call quietly so only they are able to hear it or use headphones, which minimize any potential impact on birds in the wild. When audio playback is used to elicit a response from birds in the wild, there are two refuge regulations that apply: 50 Code of Federal Regulations (CFR) 27.51 prohibits disturbing and attempting to disturb wildlife on any national wildlife refuge; in addition, 50 CFR 27.72 prohibits "the operation or use of audio devices including radios, recording and playback devices, loudspeakers ... so as to cause unreasonable disturbance to others in the vicinity." Use of audio devices to lure birds violates at least one if not both of these regulations. We do not allow the use of audio playback devices on Siletz Bay NWR for the purpose of getting birds to respond since it can disturb wildlife and other visitors and would be difficult if not impossible to avoid violating refuge regulations in doing so.

Environmental Education and Interpretation

22. **Comment:** The Service should provide information in the form of brochures or kiosks on the ethics of watching wildlife.

    Response: Interpretation is identified as one of the priority public uses of the Refuge System. As part of the CCP, the Service intends to develop an interpretive trail and informational brochures so visitors can learn about ducks, shorebirds, anadromous fish and wetland restoration on Siletz Bay NWR with an ultimate goal of enhancing their appreciation, understanding, and enjoyment of the Refuge's natural resources. Interpretation will also be used to help enlist the cooperation of visitors by sharing refuge rules and regulations in a manner that encourages them to respectfully care for the Refuge and its wildlife.

23. **Comment:** Support for the expansion and development of interpretive trails, observational overlooks, and environmental education programs.

    Response: The Service acknowledges the support for expanding environmental education programs on Siletz Bay NWR. The Service believes environmental education plays a key role in encouraging current and future generations to engage in environmentally responsible behavior like supporting the protection of habitat for wildlife through the Refuge System. The Service has several strategies to support environmental education on three other national wildlife refuges along the Oregon coast including the addition of an Environmental Education Specialist. The Service did not propose to add an environmental education program at Siletz Bay NWR for several reasons, including a small land base that would make it very difficult to accommodate school groups for activities and the availability of similar programs offered by other government agencies and/or conservation organizations in the area.

24. **Comment:** The rationale statement in Chapter 2, Objective 6.2 needs to be corrected to reflect that "visitors would be able to act with greater understanding to maximize their role in preventing the spread of invasive species." Support was expressed for the non-motorized boat launch at Millport Slough, and the Refuge was encouraged to install signage about how to prevent spread of invasive aquatic species on watercraft at the launch.

    Response: The Service acknowledges the rationale statement in Chapter 2, Objective 6.2 needed to be corrected and consequently made that change. The Service further acknowledges support for the non-motorized boat launch at Millport Slough and will install signage and develop brochures that provide information on how visitors can help prevent the spread of invasive aquatic species through their watercraft.

Hunting and Fishing

25. **Comment:** Support for Alternative B, which allows hunting on refuge lands north of Millport Slough. Concern that too much of the huntable land in the Siletz Bay area is closed to this activity, thereby creating an unacceptable amount of conflict and competition for the areas that allow hunting. Opening more lands to hunting would reduce conflict between hunters.

    Response: The Service acknowledges that some people want to be able to access additional lands to hunt waterfowl in Siletz Bay. During the preparation of this CCP, the question of whether to allow waterfowl hunting on all refuge-owned tidal marsh lands in Siletz Bay was given careful consideration along with the need to provide sanctuary for waterfowl and other wildlife. The resulting waterfowl hunting opportunity on Siletz Bay NWR was designed to ensure it does not negatively affect other refuge priority objectives including providing undisturbed areas for wintering waterfowl.

26. **Comment:** Support for waterfowl hunting.

    Response: The Service acknowledges the support for waterfowl hunting on Siletz Bay NWR.

27. **Comment:** The Refuge should be allowed to maintain its natural balance without recreational hunting and fishing.

    Response: The National Wildlife Refuge System Administration Act (16 U.S.C. 668dd - 668ee, et seq.), as amended by the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57) recognizes that wildlife-dependent recreational uses including hunting and fishing, when determined to be compatible with the mission of the NWRS and the purposes of the Refuge, are legitimate and appropriate uses of national wildlife refuges. During the preparation of this CCP, waterfowl hunting was given careful consideration along with the need to provide sanctuary for waterfowl and other wildlife. Waterfowl hunting was selected for some refuge lands within Siletz Bay as the preferred alternative because the Service believes the hunting program, as designed, can be implemented to ensure it does not negatively affect other refuge priority objectives, including providing undisturbed areas for wintering waterfowl.

The Service also considered whether adding to the waterfowl harvest totals by establishing a new hunting program would significantly contribute to population changes of the other waterfowl species using the Refuge. We also considered whether the provision of opportunities for bank fishing along the Siletz River would lead to a more than a negligible impact on sport fish in the river. The Service believes the hunting and fishing programs at Siletz Bay NWR can be implemented without causing unreasonable conflicts with other public use and management programs. The numbers of waterfowl expected to be taken from Siletz Bay NWR are expected to make up an extremely small proportion of local, State, or Pacific Flyway total harvest. Both hunting and fishing will be permitted in accordance with carefully designed State regulations and seasons, so these activities are not expected to have more than a negligible impact on waterfowl and sport fish populations.

28. **Comment:** Hunt area boundaries in Siletz Bay are difficult to determine.

    Response: It is acknowledged that in the past there has been confusion among hunters as to where the refuge boundary ends and the State-owned tidelands begin. Maintaining the boundary posting (i.e., keeping posts upright and intact in the marsh) along the tidal marsh and mudflat interface because the marsh is inundated by tides twice daily. Lands west of U.S. Highway 101 get the most use by waterfowl, and since the State tidelands adjacent to the Refuge are already hunted, opening the Refuge will effectively expand this hunting area and therefore will likely provide the highest-quality waterfowl hunting opportunity on the Refuge. Opening refuge lands west of U.S. Highway 101 will not only enhance waterfowl hunting in Siletz Bay, but it will also decrease the uncertainty of legal hunt boundaries and eliminate the issue of hunters trespassing over refuge lands to access the State hunting area.

Visitor Facilities

29. **Comment:** The Service should use native plants that provide natural food for birds and wildlife if landscaping at any buildings, kiosks, or visitor areas.

    Response: The Service supports the use of native plantings around its facilities that provide food, cover, and loafing habitat for birds and other wildlife. The strategy for the use of habitat-appropriate plants for landscaping around buildings, kiosks and other public use facilities will be integrated into the CCP within Chapter 2, Goal 8 concerning the need to provide facilities and materials that welcome and orient visitors to natural wonders of fish and wildlife that use Siletz Bay NWR.

Outreach

30. **Comment:** The Service should actively engage the birding community in volunteer opportunities that arise on the Refuge.

    Response: The Service recognizes the importance of working with the birding community and with volunteers. The Service already works with many birding groups, including Lincoln City Audubon and Yaquina Birders and Naturalists to carry out some of the tasks associated with refuge management (e.g., interpretation, invasive species control). The Service recognizes that groups such as these and their volunteers are key components of the successful management of refuge lands and are vital to the Refuge's biological and public use programs and projects.

Editorial

31. **Comment:** Tract numbers should be included within the text when describing individual parcels.

    Response: Tract numbers have been added within parentheses the first time that an individual parcel is mentioned within the document.

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Appendix L. Waterfowl Hunt Plan

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Siletz Bay National Wildlife Refuge

Waterfowl Hunt Plan

January 2013

U.S. Fish and Wildlife Service

Oregon Coast National Wildlife Refuge Complex

2127 SE Marine Science Drive

Newport, Oregon 97365

Recommended by: ______________________ Date: 1/22/13
Project Leader

Reviewed by: ______________________ Date: 1-23-2013
Refuge Supervisor

Approved by: ______________________ Date: 1/23/13
Regional Chief, National Wildlife Refuge System

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Siletz Bay National Wildlife Refuge Waterfowl Hunt Plan

1. Introduction

In December 2012, the Siletz Bay National Wildlife Refuge (NWR or Refuge) Comprehensive Conservation Plan and Environmental Assessment (CCP/EA or CCP) (USFWS 2012a) was approved by the U.S. Fish and Wildlife Service (USFWS or Service) Regional Director. The CCP will guide the management of Siletz Bay NWR for 15 years. It was finalized after several years of extensive planning and public participation, and it resolved several key issues on the Refuge, including waterfowl hunting. The Siletz Bay NWR CCP/EA describes and analyzes three alternatives and summarizes the planning effort, public comments, and USFWS responses. It is incorporated by reference as part of this Waterfowl Hunt Plan and is available at the following website: http://www.fws.gov/oregoncoast/ccp_nes_slz_bdm.htm. Supporting documents include the Finding of No Significant Impact (FONSI) (December 2012) and the Waterfowl Hunting Compatibility Determination (CCP Appendix B; also appended to this Waterfowl Hunt Plan and incorporated by reference). In accordance with the CCP and its associated FONSI, Siletz Bay NWR will open 87 acres of the Refuge to waterfowl hunting seven days per week on refuge-owned lands that are west of U.S. Highway 101 (Figure 1). Siletz Bay NWR will also open 112 acres to waterfowl hunting three days per week on refuge salt marsh that is east of U.S. Highway 101 and south of Millport Slough (Figure 1).

1.1. About the Refuge

Siletz Bay NWR, established in 1991, is located near Lincoln City on the central coast of Oregon. The approved refuge acquisition boundary totals 1,936 acres, approximately 1,060 acres of which are State-owned tidelands. Currently, refuge lands (defined as lands managed and owned in fee title or under conservation easement by the USFWS) total 568 acres. Refuge lands consist primarily of tidal marsh, diked former tidal marsh in varying stages of muted tidal action, and several smaller forested parcels (Figure 1). The Siletz Bay and River system supports large runs of anadromous fish including Chinook and threatened coho salmon, coastal cutthroat trout, and steelhead.

Large numbers of migratory birds use the marshes and tidal slough areas. Waterfowl species such as mallard, northern pintail, American wigeon, green-winged teal, bufflehead, scaup, red-breasted merganser, and Canada geese feed and rest on the marshes. Eelgrass (*Zostera marina*), which is rare along the Oregon coast, grows in dense stands in shallow areas on mud, gravel, or sand within Siletz Bay. Eelgrass provides a very valuable habitat, including attachment surfaces for clinging invertebrates, spawning areas for many fish species, and a highly sought-after food item for black brant and several species of diving ducks. The largest concentrations of eelgrass in the Siletz Bay area occupy the southern end of Siletz Bay near Siletz Keys, with small patches occurring at the mouth of the bay, the mouth of Schooner Creek, and the southern end of Snag Alley.

Siletz Bay NWR was established with the following purposes:

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

> For “the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to fulfill international obligations contained in various migratory bird treaties and conventions” [16 U.S.C. 39 100 Stat 3583 (Emergency Wetlands Resources Act of 1986)].
>
> “to conserve (a) fish or wildlife which are listed as endangered species or threatened species…or (b) plants” [16 U.S.C. 1534 (Endangered Species Act of 1973)].

The following principles guided the development of the recently completed CCP/EA for Siletz Bay NWR (USFWS 2012a). The Siletz Bay NWR Waterfowl Hunt Plan will guide the implementation of the waterfowl hunt program as detailed in the CCP. These principles are consistent with refuge purposes, the National Wildlife Refuge System (NWRS or Refuge System) mission and goals, the NWRS Improvement Act (Public Law 105-57), USFWS policies, and international treaties.

- Enhance, maintain, and protect refuge habitats (including upland forests; forested wetlands; and estuarine and stream-riparian habitats) and other lands for the benefit of migratory birds and other wildlife.
- Gather sufficient scientific information to guide responsible adaptive management decisions.
- Provide visitors compatible wildlife-dependent public use opportunities that foster an appreciation and understanding of the Refuge’s fish, wildlife, plants, and their habitats, and have limited impacts to wildlife.
- Initiate and nurture relationships and develop cooperative opportunities to promote the importance of the Refuge’s wildlife habitat, and support refuge stewardship.
- Protect and manage the Refuge’s cultural resources, and identify new ways to gain an understanding of the Refuge’s history and cultural resources.

Figure 1 ***Siletz Bay National Wildlife Refuge Waterfowl Hunt Area***

LEGEND

Refuge Managed Lands (Fee Title or Easement)

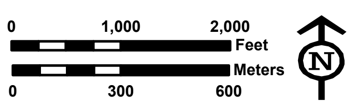
Waterfowl hunting to be allowed 7 days per week

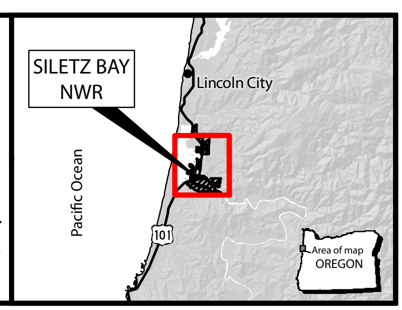
Waterfowl hunting to be allowed 3 days per week

Area closed to all hunting

Parking Area

All other Refuge lands not depicted on this map are closed to all hunting. Hunters must comply with Refuge and ODFW regulations.





Map Date: 11/30/2012 File: 13-018-3.mxd Data Source: Refuge Boundaries from USFWS/R1; Roads from ESRI; Imagery from Bing Maps

1.2. Waterfowl Hunting Opportunities on the Refuge and Surrounding Areas

Siletz Bay NWR has been closed to public use since it was established in 1991. However, the navigable waters that flow through the Refuge including Millport Slough, the Siletz River, and Drift Creek are used by the general public primarily for sport fishing and recreational boating. Since 2005, the Refuge has offered seasonal, guided wildlife interpretive trips via canoe and kayak through the State-owned, navigable waters that flow through Siletz Bay NWR. Fishing occurs on State tidelands and in waterways adjacent to refuge lands but is done primarily from boats in the deeper channels of the bay. The primary clamming area in Siletz Bay, near the Refuge, stretches from the mouth of Drift Creek south across the mudflats in Snag Alley. Clamming is conducted on State-owned tidelands.

Public waterfowl hunting opportunities along the central coast of Oregon (from the Salmon River estuary south to Alsea Bay near Waldport) are limited to small tracts of State-owned lands (D. Cottam, Oregon Department of Fish and Wildlife [ODFW], pers. comm.). Over the past two decades waterfowl hunting in the Siletz Bay area has primarily occurred on the State-owned tidelands of Siletz Bay west of U.S. Highway 101. The tidelands are managed by the Department of State Lands and are legally open to hunting so long as the hunter remains 200 yards or more from the shoreline or road. Waterfowl hunting activity within Siletz Bay is fairly low. Hunting takes place almost exclusively before the end of November, at which time the higher tides and unprotected character of Siletz Bay cause the area to be unattractive to waterfowl hunters. In addition, most resting ducks remain within the 200-yard no-hunting zone separating the Salishan Spit from the tidelands that are open to hunting. The area available for waterfowl hunting is also limited by the availability of public parking and boat access.

Other potential waterfowl hunting areas along the central coast include the Salmon River estuary as well as Yaquina and Alsea Bays. The Salmon River estuary, located approximately 6 miles north of Siletz Bay NWR, receives some light hunting use by hunters using boats, and light or limited use by walk-in hunters. Because it is a narrow river valley and heavily vegetated, its primary use is as a high-tide waterfowl hunt from boats. Yaquina Bay in Newport, approximately 20 miles south of the Refuge, receives very little waterfowl hunting pressure as most of the bay is within the city limits and therefore closed to hunting. Brant use the bay but remain primarily within city limits, and waterfowl hunting occurs almost exclusively upriver and during high tides in the large sloughs off the bay. Alsea Bay in Waldport, located approximately 35 miles south of the Refuge, is recommended by ODFW as the best place to hunt waterfowl on the central coast, although at low tide the entire north bay drains to mudflat, making it inaccessible by boat. Waterfowl hunters in Alsea Bay also compete with anglers for use of the bay in the fall.

2. Conformance with Statutory Authorities

National wildlife refuges are guided by the mission and goals of the NWRS, the purposes of an individual refuge, USFWS policy, and laws and international treaties. Relevant guidance includes the NWRS Administration Act of 1966, as amended by the NWRS Improvement Act of 1997, Refuge Recreation Act of 1962, and selected portions of the Code of Federal Regulations (CFR) and the Fish and Wildlife Service Manual.

The mission of the NWRS 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" (NWRS Administration Act of 1966 as amended, 16 U.S.C. 668dd-668ee).

The NWRS Improvement Act of 1997 provides guidelines and directives for the administration and management of all areas in the NWRS. The Act also recognized that wildlife-dependent recreational uses involving hunting, fishing, wildlife observation, photography, environmental education, and interpretation, when determined to be compatible with the mission of the NWRS and purposes of a refuge, are legitimate and appropriate public uses of the NWRS. Compatible wildlife-dependent recreational uses are the priority public uses of the NWRS, and they receive priority consideration in planning and management.

Conformance of refuge uses with refuge purposes is determined through a formal compatibility determination process. Compatibility means that the use will not materially interfere with or detract from the fulfillment of the purposes of a refuge or mission of the NWRS (603 FW 2). The waterfowl hunt program, as described below in Section 5, was determined to be compatible with refuge purposes, with stipulations (see CCP Appendix B).

The initial cost of establishing a waterfowl hunt program on the Refuge was estimated at $13,000 (USFWS 2012a). Annual costs to administer the waterfowl hunt on the Refuge, if fully staffed, were estimated in 2012 at approximately $7,000. Waterfowl hunting will be permitted in accordance with State and Federal regulations and seasons. Refuge-specific regulations will also govern waterfowl hunting activities (see Section 7.1).

3. Statement of Objectives

Waterfowl hunting objectives and strategies in the Siletz Bay NWR CCP were designed to provide a quality hunting experience that meets refuge guidelines and policies. Opening the Refuge to waterfowl hunting will provide a quality, safe opportunity for hunters to hunt geese, ducks, and coots while minimizing impacts to other wildlife and other recreational users. A quality waterfowl hunting experience on the Refuge is defined as having (1) a high priority on safety; (2) clear and concise regulations that are readily available; (3) minimal conflict with wildlife and habitat objectives; (4) minimal conflict with other priority public use activities; and (5) minimal conflict with neighboring lands.

4. Assessment

4.1. Flyway, Regional, and Local Analysis

4.1.1. Flyway Analysis

Waterfowl follow distinct, traditional migration corridors, also known as "biological flyways," in their annual travels between breeding and wintering areas. Since 1948, waterfowl have been managed through four administrative "Flyways" that are based on those migration paths: the Atlantic, Mississippi, Central, and Pacific Flyways. The review of the policies, processes, and procedures for waterfowl hunting are covered in a number of documents (Flyways.us 2012).

The National Environmental Protection Act (NEPA) considerations by the USFWS for hunted migratory game bird species are addressed by the programmatic document, "Final Supplemental

Environmental Impact Statement: Issuance of Annual Regulations Permitting the Sport Hunting of Migratory Birds (FSES 88-14)," filed with the Environmental Protection Agency on June 9, 1988. The Service published a Notice of Availability for this document in the Federal Register (FR) on June 16, 1988 (53 FR 22582) and the Record of Decision on August 18, 1988 (53 FR 31341). Annual NEPA considerations for waterfowl hunting frameworks are covered under a separate environmental assessment and FONSI. Further, in a notice published in the Federal Register on September 8, 2005 (70 FR 53776), the USFWS announced its intent to develop a new Supplemental Environmental Impact Statement (SEIS) for the migratory bird hunt program. Public scoping meetings were held in the spring of 2006, as detailed in the Federal Register on March 9, 2006 (71 FR 12216). The Service released the draft SEIS on July 9, 2010 (75 FR 39577).

Because the Migratory Bird Treaty Act stipulates that all hunting seasons for migratory game birds are closed unless specifically opened by the Secretary of the Interior, the Service annually promulgates regulations (50 CFR Part 20) establishing the Migratory Bird Hunting Frameworks. The frameworks are essentially permissive in that hunting of migratory birds would not be permitted without them. Thus, in effect, Federal annual regulations both allow and limit the hunting of migratory birds.

The Migratory Bird Hunting Frameworks provide season dates, bag limits, and other options for the States to select. The outcome is intended to result in a level of harvest that is appropriate based upon biological assessments prepared annually by the USFWS. These biological assessments detail the overall status of migratory game bird populations. In North America, the process for establishing waterfowl hunting regulations is conducted annually. In the United States, the process involves a number of scheduled meetings (e.g., Flyway Study Committees, Flyway Councils, USFWS Regulations Committee) in which information regarding the status of waterfowl populations and their habitats is presented to individuals within the agencies responsible for setting hunting regulations. In addition, public hearings are held and the proposed regulations are published in the Federal Register to allow public comment.

For waterfowl, these annual assessments include the Breeding Population and Habitat Survey, which is conducted throughout portions of the United States and Canada and is used to establish an annual waterfowl population status report (for example, USFWS 2012b). In addition, the number of waterfowl hunters and resulting harvest are closely monitored through both the Harvest Information Program and the "Wing Bee," which utilizes duck wings sent in from a sample of hunters to compute the species composition of the duck harvest (see http://central.flyways.us/surveys/surveys-conducted/wing-bee for more information). Since 1995, such information has been used to support the Adaptive Harvest Management (AHM) process (USFWS 2012c) for setting duck hunting regulations. Under AHM, a number of decision-making protocols taking into account population models and environmental conditions iteratively determine the choice (package) of predetermined regulations (appropriate levels of harvest) that constitute the framework offered to the States that year. In Oregon, the ODFW Commission then selects season dates, bag limits, shooting hours, and other options from the Pacific Flyway package. The Commission's selections can be more restrictive, but cannot be more liberal than AHM allows. Thus, the level of hunting opportunity afforded each State increases or decreases each year in accordance with the annual status of waterfowl populations.

Each national wildlife refuge considers the cumulative impacts to hunted migratory species through the Migratory Bird Hunting Frameworks published annually in the Service's regulations on migratory bird hunting. Season dates and bag limits for national wildlife refuges open to hunting are never longer or larger than the applicable State regulations. In fact, based upon the findings of an environmental assessment developed when a refuge opens a new hunting activity, season dates and bag limits may be more restrictive than the State allows.

Oregon is within the Pacific Flyway, which also includes those states and portions of states west of the Continental Divide, including Alaska. The most recent (2011-2012) duck harvest for the Pacific Flyway was 3.2 million birds, which represents approximately 20% of the estimated 15.8 million (±6%) ducks harvested in the United States during the 2011-2012 waterfowl hunting season (Raftovich et al. 2012). The estimated goose harvest for the Pacific Flyway during the 2011-2012 season was 429,900, which represents approximately 15% of the estimated annual U.S. harvest of an estimated 2.9 million (±5%) geese.

4.1.2. Regional and Local Analysis

Every year, the Service conducts surveys that are used to estimate waterfowl hunting activity, success, and harvest by species. Results are used by the USFWS and State wildlife agencies, in part, to establish season lengths and bag limits designed to maintain healthy, sustainable waterfowl populations. During the 2011-2012 waterfowl hunting season, hunters in Oregon harvested an estimated 480,300 (±24%) ducks and 65,400 (±20%) geese (Raftovich et al. 2012).

Waterfowl hunting has occurred on the State-owned tidelands of Siletz Bay west of U.S. Highway 101 for decades. However, refuge-owned lands west of U.S. Highway 101 in Siletz Bay have been closed to waterfowl hunting since the Refuge was established in 1991. On State-owned tidelands of Siletz Bay during the 2010-2011 hunting season, hunters harvested very few ducks and the numbers are considered to be below reportable levels (R. Kerr, Oregon State Police [OSP], pers. comm.). Waterfowl harvest data are unavailable because only a small number of hunters pursue waterfowl in the Siletz Bay area, and no hunters were surveyed for harvest information during the 2011-2012 hunting season. At any given time there are generally only one to three hunting parties in Siletz Bay because the small space open for hunting is further constrained by a limited number of spots with good hunting quality (e.g., the mouth of the sloughs). Waterfowl hunters tend to self-limit their numbers. Most hunting occurs in October and November, and tides influence hunting times. By December tides increase in height and strength so that almost no hunting occurs in Siletz Bay (D. Cottam, ODFW, pers. comm.). The number of waterfowl harvested under the refuge hunt program is not expected to have a measureable effect on refuge waterfowl population numbers.

The most heavily harvested duck species in Oregon are mallard, American wigeon, northern pintail, green-winged teal, and northern shoveler (Raftovich et al. 2012). The most abundant duck species identified at Siletz Bay during the mid-winter waterfowl survey include mallard, northern pintail, American wigeon, green-winged teal, bufflehead, and scaup (USFWS unpublished data). In 2012, continental populations of mallard, green-winged teal, northern shoveler, and scaup were all above their long-term averages (Raftovich et al. 2012). American wigeon and northern pintails were 17% and 14%, respectively, below their long-term average. Overall waterfowl harvest levels in the local area surrounding Siletz Bay NWR represent a very small portion of the waterfowl production for the State and the Pacific Flyway and of the total harvest based on production surveys and mid-winter surveys. Given the low harvest rates of all these species relative to the State harvest, Siletz Bay NWR harvest numbers are expected to make up a very small proportion of local, State, or Pacific Flyway harvest, and the refuge hunt program will not significantly contribute to population changes of these species.

4.2. Are wildlife populations present in numbers sufficient to sustain optimum population levels for priority refuge objectives other than hunting?

The estuarine habitat of Siletz Bay supports several thousands of migratory waterfowl. Waterfowl numbers vary greatly from year to year and within the season depending on habitat conditions and yearly variables such as weather and breeding production. However, waterfowl use in Siletz Bay is generally high. The most abundant duck species at Siletz Bay during the fall and winter are mallard, northern pintail, American wigeon, green-winged teal, bufflehead, and scaup (USFWS unpublished data). Dabbling ducks feed and rest on the marsh and the marsh-mudflat interface. In addition, Siletz Bay contains some eelgrass beds, which are utilized as a food source by migratory waterfowl species including black brant and American wigeon. The largest concentrations of eelgrass occupy the southern end of Siletz Bay near Siletz Keys, with small patches occurring at the mouth of the bay, the mouth of Schooner Creek, and the southern end of Snag Alley (USFWS 1990). Tidal salt marsh restoration on the Refuge on the south side of Millport Slough in 2003 has provided additional quality wetland habitat within the Refuge and can support large numbers of waterfowl. Mallards and wood ducks, which are found wintering in the Siletz Bay area, have been documented as breeders on refuge lands (USFWS unpublished data).

Along the Oregon coast, including Siletz Bay, mid-winter waterfowl surveys are conducted during the first two weeks in January as part of a continent-wide protocol. Observers count ducks, geese, swans, and American coots from a fixed-wing aircraft, and an overall abundance is estimated (USFWS unpublished data). During the mid-winter waterfowl surveys from 1986 to 2009, the overall mean count of waterfowl on Siletz Bay, including refuge lands, was 896 individuals. The lowest count was 297 individual birds recorded in 2000 and the largest was 2,582 in 1991. These data are collected from a fixed-wing aircraft at an altitude of 200-300 feet and traveling 80-120 miles per hour (mph), which limits ability to survey all areas and all habitats and count every individual present. The mid-winter waterfowl survey serves as an index for comparative purposes and is not necessarily representative of the number of ducks that may be present within the entire geographic area. However, general abundance and population trends can be inferred from the results of the mid-winter waterfowl survey. Waterfowl abundance is usually lower during the January mid-winter survey compared to fall months, when birds are concentrated on the bay prior to dispersing throughout the area due to field and seasonal wetland flooding (R. Lowe, pers. comm.). Refuge counts for ducks have generally ranged between 500 and 1,200 over the past several winters.

It is not anticipated that waterfowl hunting will negatively affect priority refuge objectives or wildlife populations on the Refuge. Based on conversations with the OSP officers and ODFW biologists, who include Siletz Bay in their area of responsibility, hunter use of and harvest from Siletz Bay are relatively low. Due to limitations posed by tides and weather, the acreage being opened on Siletz Bay NWR for waterfowl hunting will add limited opportunity for expansion of waterfowl hunting opportunities on Siletz Bay. Given the low waterfowl harvest rates relative to the large wintering duck population, the refuge hunt program will not significantly contribute to waterfowl population changes, and the area should support a sustainable harvest.

In addition, the Siletz Bay NWR waterfowl hunt has been designed with measures and restrictions to ensure it does not negatively affect other refuge priority objectives. For example:

- The hunt areas are limited in size and location, to ensure that sufficient sanctuary for waterfowl is available.

- Waterfowl hunting on the east side of the highway will be allowed only three days per week to limit wildlife disturbance.
- Hunter outreach and education will be part of the waterfowl hunt program, to reduce wildlife disturbance and the potential for conflict among visitors.

4.3. Is there competition for habitat between target species and other wildlife?

A wide variety of other migratory and resident birds use the estuary and refuge tidal marsh. Great blue herons and other wading birds use the bay as a foraging area, and there is a small breeding colony of great blue herons on the Refuge. Thousands of shorebirds use the estuary as stop-over habitat. Marsh-nesting birds such as marsh wren, savannah sparrow, and common yellowthroat are abundant. A diversity of raptors are commonly observed hunting prey within the marshes and mudflats. California brown pelicans use the lower bay for foraging and the Salishan Spit as a roost site. At Siletz Bay NWR, waterfowl hunting will occur outside of the breeding season for these non-target species. The portions of Siletz Bay NWR that remain closed to waterfowl hunting will provide sanctuary to waterfowl and other wildlife. Limiting waterfowl hunting on the east side of the highway to three days per week will also help reduce human disturbance to wintering migratory birds. See the Siletz Bay NWR CCP/EA (USFWS 2012a) and the Waterfowl Hunting Compatibility Determination (CCP Appendix B) for additional description of effects on wildlife and habitat. Competition between species targeted by the waterfowl hunt program and other wildlife or their habitats is not considered a limiting factor.

4.4. Are there unacceptable levels of predation by target species on other wildlife species?

Not applicable.

5. Description of Waterfowl Hunt Program

5.1. Areas of the Refuge That Support Populations of the Target Species

Siletz Bay NWR provides important wintering and migration (stop-over) habitat for a variety of ducks and geese. Surveys and observations have indicated waterfowl make significant use of the open bay, mudflats, and tidal marsh with heaviest use occurring from September through November and again during spring migration. The southern portions of the bay from the mouth of Drift Creek to Salishan Spit receive the most use. Key habitats where waterfowl concentrate in the estuary include both refuge hunt and non-hunt areas as well as State tidelands. Some of the important resting and feeding habitats on the Refuge will remain closed to waterfowl hunting in order to provide undisturbed (sanctuary) areas for waterfowl and other birds.

5.2. Areas to Be Opened to Public Hunting

The Service will establish a waterfowl hunting program on 87 acres of refuge-owned lands that are west of U.S. Highway 101, and on 112 acres of refuge lands that are east of U.S. Highway 101 and south of Millport Slough (Figure 1). There is a demand for more public hunting around Siletz Bay, especially in areas that will allow for walk-in access. Opening the Refuge to waterfowl hunting and providing walk-in opportunities, at both Millport Slough and on refuge lands west of U.S. Highway 101, will enhance and slightly increase waterfowl hunting opportunities in the area. Lands west of

U.S. Highway 101 get the most use by waterfowl, and since the State tidelands adjacent to the Refuge are already hunted, opening the Refuge will effectively expand this hunting area and therefore will likely provide the highest-quality waterfowl hunting opportunity on the Refuge.

The 87 acres of refuge-owned lands that are west of U.S. Highway 101 lands consist of tidal salt marsh where the Siletz River and Millport Slough empty into the bay near the development of Siletz Keys and at the mouth of Drift Creek. Boundary posting along the tidal marsh and mudflat interface near Siletz Keys is difficult to maintain due to the difficulty in keeping posts upright and intact in the marsh, which is inundated by tides twice daily. Consequently, there is often confusion among hunters as to where the refuge boundary ends and the State-owned tidelands begin. The Refuge has maintained that as long as hunters were in the mudflats and not east of the vegetation line they were most likely on State tidelands; however, this boundary has been difficult to legally enforce. Opening refuge lands west of U.S. Highway 101 will not only enhance waterfowl hunting in Siletz Bay, but it will also decrease the uncertainty of legal hunt boundaries and eliminate the issue of hunters trespassing over refuge lands to access the State hunting area. The Service will also establish a 100-yard no-hunting zone to prohibit waterfowl hunting on refuge property that extends westward from the refuge boundary line on the west side of the housing development of Siletz Keys.

The 112 acres of refuge lands that are east of U.S. Highway 101 and south of Millport Slough (Millport Slough South Unit) are being opened for waterfowl hunting to provide an additional option for walk-in waterfowl hunting, especially during moderate tides. Lands south of Millport Slough that are open to waterfowl hunting will remain closed to other public uses during hunting season.

5.3. Species to Be Taken, Hunting Periods, Hunting Access

Waterfowl hunters will be allowed to hunt geese, ducks, and coots seven days per week on refuge-owned lands that are west of U.S. Highway 101, and three days per week on refuge lands east of U.S. Highway 101 and south of Millport Slough. The established days for waterfowl hunting on the Millport Slough South Unit will be Wednesday, Saturday, and Sunday. Waterfowl will be taken in accordance with State, Federal, and refuge-specific regulations. Waterfowl hunters must only possess federally approved nontoxic shotshells while in the field.

Hunter access to refuge lands will only be allowed from one hour before sunrise to one hour after sunset. Refuge waterfowl hunting hours will be in accordance with State regulations listed in the Game Bird Shooting Hour Table (ODFW 2012). Construction of permanent blinds will not be allowed; however, hunters will be allowed to use portable blinds or blinds constructed of on-site dead vegetation or driftwood under the condition that they either be removed or disassembled at the end of each day. Bag limits and hunting seasons on Siletz Bay NWR will conform to ODFW regulations.

Hunters using boats will be able to reach refuge lands on both the east and west side of U.S. Highway 101 during high tides from a private boat launch on the Siletz River. The Millport Slough South Unit can be accessed by boat or by using a short trail and a small gravel parking area located on South Millport Slough Road. Over time the existing parking area and trail will be improved by the USFWS to support the waterfowl hunting program.

Although dogs are prohibited on the Refuge away from parking lots, they are a vital part of the waterfowl hunting tradition and can reduce the loss of waterfowl to the hunter's bag and hence prevent waste and reduce the overall impact to the resource. Because of their role, both as part of the waterfowl hunting tradition and their contribution to increasing the likelihood of retrieval of birds that have been shot, dogs used in the act of waterfowl hunting will be allowed on the Siletz Bay NWR per Service Policy in 50 CFR 32.26.21. Hunters are encouraged to use dogs as an aid to retrieving waterfowl during the hunting season; however, dogs must remain under control of the handler at all times. Dogs must be in a vehicle or on a leash until being used for hunting.

5.4. Justification for the Permit, If One Is Required

No refuge-issued permit is required. However, hunters must comply with all State and Federal regulations regarding waterfowl hunting, including provisions outlined in 50 CFR 32.2, which states:

- Each person shall secure and possess the required State license and waterfowl validation.
- Each person 16 years of age and older shall secure and possess a Federal Migratory Bird Hunting Stamp while hunting migratory waterfowl.
- Each person shall comply with the terms and conditions authorizing access or use of wildlife refuges.

5.5. Procedures for Consultation and Coordination with the State

ODFW was involved in the needs assessment and design of the waterfowl hunt during the preparation of the Siletz Bay NWR CCP/EA. ODFW supported the preferred alternative described in the CCP/EA and approved by the Regional Director. Waterfowl hunting will continue on State tidelands adjacent to refuge lands, and the USFWS will manage the waterfowl hunt program on refuge lands. Refuge law enforcement officers will coordinate regularly with OSP officers to conduct law enforcement, outreach, and education, and to enforce bag limits, species limits, and the requirement for federally approved nontoxic shot.

5.6. Methods of Control and Enforcement

The following methods will be used to control and enforce hunting regulations:

- Refuge and waterfowl hunting area boundaries will be clearly posted.
- The Refuge will develop an informational sheet on the rules and regulations of waterfowl hunting at Siletz Bay NWR.
- Access to the Refuge will be prohibited from one hour after sunset to one hour before sunrise.
- The USFWS will conduct law enforcement patrols on a regular basis to ensure compliance with State and Federal waterfowl hunting regulations as well as refuge-specific regulations pertinent to the hunt, including compatibility stipulations (see Compatibility Determination, CCP Appendix B).
- USFWS law enforcement staff will coordinate with OSP officers and other law enforcement agencies. OSP officers will patrol State lands when available to help ensure compliance with laws and hunting regulations. Concurrent jurisdiction will allow OSP officers as well as Lincoln County Sheriff Department officers authority on refuge lands as well.
- Information and hunting area maps will be made available on the refuge website, at the refuge headquarters in Newport, at ODFW offices, and eventually at the Millport Slough South parking area.

- USFWS will work with ODFW to include a description of the Siletz Bay Refuge hunting program and pertinent regulations in the annual State of Oregon Game Bird Regulations publications.

5.7. Funding and Staffing Requirements

Administering the waterfowl hunt will require refuge staff time to coordinate with ODFW and the local community, develop an informational "tear sheet" with regulations for the waterfowl hunt, produce news releases, respond to hunter inquiries, conduct hunter and visitor outreach, minimize conflicts among users, coordinate with OSP, conduct law enforcement, maintain boundary posting and hunter information sites, monitor impacts to wildlife and habitat and visitor use, and ensure public safety (see CCP Appendix B). Additional funds will be required to improve a small gravel parking area at Millport Slough Road.

This new hunt program was described in the Siletz Bay NWR CCP, specifically in the Compatibility Determination and the Implementation Appendix (CCP Appendices B and C). Full implementation will become possible only with increased funding and staffing to assist in enforcement, outreach, and monitoring. Implementation during at least the first few years of the program will be done with existing staffing, so it will redirect some effort from other high-priority habitat and public use programs. Because of the proximity of State tidelands, close coordination will be needed between Oregon Coast NWR Complex staff and ODFW and OSP personnel. This coordination will be necessary to effectively conduct outreach and enforcement and to implement regulations.

Surveying and posting Siletz Bay NWR waterfowl hunting boundaries will be accomplished prior to the start of the 2013-2014 waterfowl hunting season. Law enforcement and outreach efforts to educate waterfowl hunters about the boundaries and regulations involving waterfowl hunting on Siletz Bay NWR will commence following publication of the final CCP and Waterfowl Hunt Plan.

6. Measures Taken to Avoid Conflicts with Other Management Objectives

The Siletz Bay NWR waterfowl hunt program was designed to provide a quality waterfowl hunting opportunity, while minimizing or eliminating conflicts with refuge purposes, goals, and management objectives. These objectives include a focus on estuarine and other habitat restoration and reduction in human disturbance to fish and wildlife. Refuge objectives also include providing the public with safe, compatible, and accessible wildlife viewing opportunities that reduce conflicts between refuge users (see the Siletz Bay NWR CCP [USFWS 2012a] and the Waterfowl Hunting Compatibility Determination [CCP Appendix B]).

6.1. Biological Conflicts

Human disturbance to wintering birds and other wildlife using the tidal marshes of Siletz Bay NWR will occur as a result of waterfowl hunting activity. Migratory and wintering waterfowl require access to areas with adequate food reserves and areas where they can loaf and roost undisturbed. They generally minimize time in flight and maximize foraging time because flight requires considerably more energy than any other activity, except egg laying. In addition to direct mortality of individual hunted birds, human disturbance associated with waterfowl hunting includes loud noises such as those produced by shotguns and boat motors. This disturbance, especially when repeated over a period of time, can cause waterfowl to change feeding habits, feed only at night, lose weight, or abandon feeding areas. Prolonged and extensive disturbances may cause large numbers of waterfowl to temporarily or permanently leave disturbed areas (Madsen 1985).

Spatial regulation of hunting activity in the form of providing sanctuaries, or non-hunted areas, is the most common strategy to reduce disturbance caused by hunting. In tidal areas, high-tide roosts present an obvious first choice for sanctuary areas, although night-time roosts may differ from those used by day. Bregnballe and Madsen (2004) found that to increase species diversity in hunted areas, a sanctuary area with quality feeding and resting habitat should be located adjacent to the hunt area. The number of migratory birds that a site can support can be increased if birds can escape a short distance to sanctuary. Thus, sanctuary areas are very important to minimize disturbance to waterfowl populations to ensure their continued use of Siletz Bay. Sanctuary areas also maintain waterfowl in juxtaposition to hunting areas, which may increase harvest opportunities. The North Millport Slough Unit, which is separated from the South Millport Slough hunt area by Millport Slough, will remain closed to waterfowl hunting and all other public uses, providing an area of sanctuary throughout the entire waterfowl hunting season. The 200-yard no-hunting zone around the west side of the hunted State tidelands provides a frequently used sanctuary resting area for ducks (D. Cottam, ODFW, pers. comm.) and is immediately adjacent to the area open for waterfowl hunting, although hunting in these open tideflats is difficult.

Other management strategies to reduce biological conflicts include temporal restrictions such as hunting only certain days per week, or only allowing hunting part of the day. By itself, intermittent hunting is generally not found to be the most effective way to minimize hunting disturbance effects (Fox and Madsen 1997). When birds move from a disturbed site, the frequency of disruption affects the probability of their return, and introduces a lag in recovery time to levels of abundance experienced in the absence of hunting. However, an intermittent hunt program can minimize disturbance, especially if the interval of non-hunting time is measured in weeks rather than days (Fox and Madsen 1997). Even if the non-hunted period is shorter, it can improve the ability of a site to sustain waterfowl use in an area that is hunted all season long (Bregnballe and Madsen 2004). Because minimizing disturbance to wintering waterfowl and providing waterfowl hunting opportunities on refuges are both priorities for the USFWS, it is common for refuges to manage hunt programs with intermittent hunting in the form of non-hunt days.

The refuge hunting area west of the highway will be contiguous with the State tidelands open for waterfowl hunting. Based on the confusion that would be caused by closing the refuge area to hunting several days per week while the adjacent State lands are open daily, the waterfowl hunting program on the west of the highway will not be intermittent. However, on the Millport Slough South Unit, the period of non-hunting disturbance will be measured in days rather than instituting a diurnal time restriction closure (e.g., hunting only from sunrise to noon). Waterfowl hunting will be allowed three days per week (Saturday, Sunday, and Wednesdays). Refuge waterfowl hunting hours will be in accordance with State regulations listed in the Game Bird Shooting Hour Table, and access into refuge waterfowl hunting areas will be allowed one hour before sunrise through one hour after sunset.

Boating activity associated with waterfowl hunting during the fall and winter can alter distribution, reduce use of particular habitats or entire areas by waterfowl and other birds, alter feeding behavior and nutritional status, and cause premature departure from areas (Knight and Cole 1995). Because of the potential safety hazard posed by boating in an area with strong tidal influence, waterfowl hunters may use either motorized or non-motorized boats to engage in waterfowl hunting on State tidelands west of U.S. Highway 101. Disturbance from motorized boats can occur even when waterfowl densities are low, depending upon boats' noise, speed, and capability to cover extensive areas in a short amount of time. However, boat use by waterfowl hunters is expected to be minimal since boat access into Siletz Bay is limited and challenging due to the availability of correct weather conditions (e.g., winds <15 mph) and higher tide levels to fill tidal channels or cover the mudflats.

The waterfowl hunt program on Siletz Bay NWR will also include the following restrictions to reduce biological impacts: (1) hunting of geese, ducks and coots only; (2) limited waterfowl hunting areas, which will be posted and enforced; (3) a requirement to use only federally approved nontoxic shot; (4) sufficient feeding and resting habitat for waterfowl in areas closed to waterfowl hunting (i.e., sanctuary); and (5) periodic biological and social monitoring and evaluation of the waterfowl hunt program, including feedback from users to determine if objectives are being met.

6.1.1. Impacts to Non-target Species

The refuge hunt program indirectly impacts species other than those targeted by hunters. The presence of hunters and dogs, sounds of gunfire, and the sight of hunters traveling to and from hunt areas can disturb other wildlife species such as great blue heron, bald eagle, great egret, and northern harrier which forage in refuge wetlands and waterbodies. This disturbance, especially when repeated over a period of time, may result in some wildlife species altering feeding habits or moving to other areas during the active waterfowl hunting season. Waterfowl hunting will occur outside of the breeding season for these avian species. Accidental shootings of non-game birds are believed to be negligible. Hunters' foot trails and temporary blinds in the Millport Slough South Unit salt marsh could slightly alter wetland vegetation; however, these impacts and those to refuge fish populations and other wildlife are expected to be negligible (see the Waterfowl Hunting Compatibility Determination [CCP Appendix B] for additional discussion of impacts to non-target species).

6.2. Public Use Conflicts

Conflicts between waterfowl hunters and other refuge visitors during the waterfowl hunting season (October through January) are expected to be minor, since the hunt period occurs during the time of year when the activities of wildlife observation, photography, and interpretation receive the lowest amount of use by visitors due to rainy and windy weather. To minimize the potential for conflict between refuge users and reduce associated safety issues, lands south of Millport Slough that are open to waterfowl hunting will remain closed to wildlife observation, photography, and interpretation. Refuge lands west of U.S. Highway 101 will be open to wildlife observation and photography year-round, so there is a potential for conflict to arise between these users and waterfowl hunters. However, the Service anticipates very few, if any, visitors will spend time observing or photographing wildlife via foot in this area due to the lack of an access point for parking and entry into the site and the extreme difficulty involved in walking through mudflats. It is likely that visitors will engage in wildlife observation and photography from boats, but most recreational boating from canoes and kayaks occurs from May to September, thus reducing the likelihood of conflicts between hunters and people observing or photographing wildlife from boats.

It is possible that refuge visitors using Alder Island (Figure 1), once it is developed and opened, could be impacted by hunting on both Millport Slough and refuge lands west of U.S. Highway 101 though the impact is expected to be minor due to the distance of hunters from Alder Island. The Refuge also offers interpreter-led paddle trips in Millport Slough but only during the summer and thus will not overlap with the hunt period. There is very little recreational non-motorized boating occurring in the bay or along the river in the fall and winter due to inclement weather, so impact from hunting on visitors at this time of year is expected to be minor.

No public entry, for hunting or any other use, will be permitted into the Millport Slough South Unit during the other four days of the week during the waterfowl hunting season. Because the Millport Slough South Unit is easily distinguishable and spatially separated from the waterfowl hunt area on the west side of the highway, the intermittent waterfowl hunting program should be clear to waterfowl hunters.

To ensure safety and minimize conflict between hunters and people engaged in wildlife observation and photography, the USFWS will provide information about the waterfowl hunt program's boundaries and seasons to the general public and those utilizing other refuge programs. Information will be provided at a future information board at the Millport Slough South Unit parking lot, on the refuge website, in the refuge office, and in the ODFW game bird regulations handbook. In addition, law enforcement patrols will be conducted on a regular basis to contact the public and ensure compliance with State, Federal, and refuge regulations. The refuge law enforcement staff will also monitor and collect data on the hunt program's participation and activities to ensure it does not interfere with other wildlife-dependent uses. If necessary, using the best available science and data, the program will be modified accordingly to ensure the program meets the goals and objectives of the Refuge.

6.3. Administrative Conflicts

There are no administrative conflicts at this time.

7. Conduct of the Hunt

7.1. Refuge-specific Hunting Regulations

- Hunting of geese, ducks and coots is allowed on refuge lands west of U.S. Highway 101 seven days per week.
- Hunting of geese, ducks, and coots is allowed on the Millport Slough South Unit of the Refuge three days per week. The established days for waterfowl hunting on the Millport Slough South Unit will be Wednesday, Saturday, and Sunday.
- Only federally approved nontoxic shot may be used or be in hunters' possession while hunting on the Refuge.
- Only portable blinds or blinds constructed of on-site dead vegetation or driftwood may be used. All blinds, decoys, shotshell hulls, and other personal equipment and refuse must be removed from the Refuge at the end of each day.
- Access to the Refuge will be prohibited from one hour after sunset to one hour before sunrise.
- The use or possession of alcoholic beverages while hunting is prohibited.
- Hunters are encouraged to use dogs as an aid to retrieving waterfowl during the hunting season; however, dogs must remain under control of the handler at all times. Dogs must be in a vehicle or on a leash until they are in the marsh as a part of the hunt.
- Hunters may enter closed areas of the Refuge only to retrieve downed birds.

7.2. Anticipated Public Reaction to the Hunt

Waterfowl hunting was discussed at two public meetings held in conjunction with the CCP process. Comments were solicited on waterfowl hunting through a variety of methods, including the public meetings, presentations, planning updates, and the release of the draft CCP/EA. The USFWS received comments regarding opening Siletz Bay NWR to waterfowl hunting. Some commenters supported opening the Refuge on both sides of the highway to waterfowl hunting seven days per week while others supported limiting hunting to three days per week or keeping the Refuge closed to hunting. A few others offered specific concerns regarding public safety or the appropriateness of allowing hunting on a refuge. Offering compatible wildlife-dependent recreation opportunities such as hunting, fishing, wildlife observation, and interpretation is a refuge priority. Public input was considered and efforts were made to design the hunt program to meet the NWRS and refuge-specific goals and objectives, provide a safe and high-quality experience, minimize wildlife disturbance, provide improved wildlife sanctuary, reduce or avoid conflicts with other refuge users, and minimize confusion for hunters. A summary of public comments and the USFWS's responses can be found in Appendix K (Summary of Public Comment and the Service's Responses) in the CCP (USFWS 2012a).

7.2.1. Adjacent Landowners and Economy

The planned opening of 199 acres of refuge tidal marsh within Siletz Bay NWR to waterfowl hunting will complement existing waterfowl hunting in the bay. The economic benefits from expanding waterfowl hunting on Siletz Bay NWR are associated with the money hunters spend on a variety of goods and services for trip-related and equipment-related purchases. Trip-related expenditures include food, lodging, transportation, and other incidental expenses. Equipment expenditures consist of guns, ammunition, decoys, hunting dogs, and special hunting clothing. Waterfowl hunters that hunt both ducks and geese spend an average of $854 annually (Carver 2008) on the activity. Because Siletz Bay NWR has been closed to public use since it was established there is no baseline on which to formulate the current economic benefits of waterfowl hunting on the Refuge. Noting current trends in waterfowl hunting on adjacent State lands, a significant increase or decrease in hunting levels is not anticipated by opening refuge lands to waterfowl hunting. Consequently it is not anticipated that opening refuge lands to waterfowl hunting will have a significant impact on the local community or its economy.

7.3. Hunter Application and Registration Procedures (if applicable)

Not applicable. This will be a free-roam hunt waterfowl hunt area, which will require no applications or registrations to hunt.

7.4. Media Selection for Announcing and Publicizing the Hunt

The Refuge has a standard list of local and regional media contacts for news releases. A news release announcing the waterfowl hunting opportunities will be sent out prior to the first waterfowl hunting season and annually thereafter. Notices will also be posted on the refuge website and at other appropriate locations. This new hunting opportunity will also be defined in the ODFW game bird hunting regulations handbook (ODFW 2012).

7.5. Hunter Requirements

Hunters are required to be familiar with all State, Federal, and refuge-specific regulations. Refuge-specific regulations will be available on the refuge website and refuge waterfowl hunting tear sheet, at the designated access points for waterfowl hunters, and in the ODFW game bird hunting regulations (ODFW 2012).

1. **Age (if restrictions are imposed by the State)**

   Age requirements will be in accordance with ODFW requirements.

2. **Allowable equipment (dogs, vehicles, blinds, sporting arms, ammunition)**

   Requirements will be in accordance with ODFW and refuge regulations.

3. **License and permits**

   a. All goose, duck, and merganser hunters must have a valid Oregon hunting license, State Harvest Information Program validation and a signed Federal Waterfowl (Duck) Stamp. Residents and nonresidents must possess a Resident Waterfowl Validation or Nonresident Game Bird Validation, respectively.

   b. If hunting coots: hunters are required to be in possession of the above permits (a) except that a Federal Duck Stamp is not required.

   c. If hunting sea ducks (harlequin duck, scoter, long-tailed duck, and eider): hunters are required to be in possession of the above permits (a) and a Sea Duck Permit.

   d. If hunting black brant: hunters must be in possession of the above (a) and a Black Brant Permit.

4. **Reporting harvest**

   Hunters must fulfill all ODFW reporting requirements.

5. **Hunter training and safety (if required by State)**

   Hunters must fulfill all ODFW requirements for training and hunter safety classes.

8. References

Bregnballe, T. and J. Madsen. 2004. Tools in waterfowl reserve management: effects of intermittent hunting adjacent to a shooting-free core area. Wildlife Biology 10:261-268.

Carver, E. 2008. Economic impact of waterfowl hunting in the United States: Addendum to the 2006 national survey of fishing, hunting, and wildlife-associated recreation report 2006. U.S. Fish and Wildlife Service. 13 pp. Available at: http://digitalmedia.fws.gov/cdm/ref/collection/document/id/61.

Flyways.us. 2012. Regulations and harvest. Available at: http://www.flyways.us/regulations-and-harvest.

Fox, A.D. and J. Madsen. 1997. Behavioral and distributional effects of hunting disturbance on waterbirds in Europe: implications for refuge design. Journal of Applied Ecology 34:1-13.

Knight, R.L. and D.N. Cole. 1995. Wildlife responses to recreationists. Pages 51-70 in: R.L. Knight and K.J. Gutzwiller, eds. Wildlife and recreationists: coexistence through management and research. Washington, D.C.: Island Press.

Madsen, J. 1985. Impact of disturbance on field utilization of pink-footed geese in West Jutland, Denmark. Biological Conservation 33:53-63.

ODFW (Oregon Department of Fish and Wildlife). 2012. 2012-2013 Oregon game bird regulations. Available at: http://www.dfw.state.or.us/resources/hunting/upland_bird/docs/oregon_game_bird_regs.pdf.

Raftovich, R.V., K.A. Wilkins, S.S. Williams, and H.L. Spriggs. 2012. Migratory bird hunting activity and harvest during the 2010 and 2011 hunting seasons. U.S. Fish and Wildlife Service. Laurel, MD. 68 pp.

USFWS. 1990. Environmental assessment proposed Siletz Bay National Wildlife Refuge. U.S. Fish and Wildlife Service, Region 1. Portland, Oregon. 31 pp. + appendices.

USFWS. 2012a. Draft comprehensive conservation plan and environmental assessment, Siletz Bay National Wildlife Refuge, Lincoln County, OR. U.S. Department of the Interior, Fish and Wildlife Service, Region 1. Portland, OR. 417 pp.

USFWS. 2012b. Waterfowl population status, 2012. U.S. Department of the Interior, Fish and Wildlife Service. Washington, D.C. 79 pp.

USFWS. 2012c. Adaptive harvest management: 2012 hunting season. U.S. Department of Interior, Fish and Wildlife Service. Washington, D.C. 58 pp. Available at http://www.fws.gov/migratorybirds/mgmt/AHM/AHM-intro.htm.

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Appendix M. References Cited

Adamus, P.R., J. Larsen, and R. Scranton. 2005. Wetland profiles of Oregon's coastal watersheds and estuaries. Part 3 in: Hydrogeomorphic Guidebook for Tidal Wetlands of the Oregon Coast. Prepared for Coos Watershed Association, Oregon Department of State Lands, and U.S. Environmental Protection Agency, Region 10. Available at: http://www.oregon.gov /DSL/WETLAND/docs/tidal_HGM_pt3.pdf.

AgDRIFT. 2001. A user's guide for AgDRIFT 2.04: a tiered approach for the assessment of spray drift of pesticides. Spray Drift Task Force. Macon, MO.

Apfelbaum, S.I. and C.E. Sams. 1987. Ecology and control of reed canarygrass (*Phalaris arundinacea L.*). Natural Areas Journal 7:69-74.

ANS (Aquatic Nuisance Species) Task Force. 2011. Dedicated to the prevention and control of aquatic nuisance species. Available at: http://www.anstaskforce.gov/spoc/nzms.php. Accessed March 2011.

ATSDR (Agency for Toxic Substances and Disease Registry) U.S. Department of Health and Human Services. 2004. Guidance manual for the assessment of joint toxic action of chemical mixtures. U.S. Department of Health and Human Services, Public Health Service, ATSDR, Division of Toxicology. 62 pp. (+ appendices).

Atwater, B.F., S. Musumi-Rokkaku, K. Satake, Y. Tsuji, K. Ueda, and D.K. Yamaguchi. 2005. The orphan tsunami of 1700—Japanese clues to a parent earthquake in North America. U.S. Geological Survey Professional Paper 1707. U.S. Geological Survey and University of Washington Press, Seattle. 133 pp.

Audubon Society of Portland. 2011. Important bird areas. Available at: http://audubonportland.org /local-birding/iba. Accessed June 13, 2012.

Baehr, C.H. and C. Habig. 2000. Statistical evaluation of the UTAB database for use in terrestrial nontarget organism risk assessment. Presentation at the American Society for Testing and Materials (ASTM) Tenth Symposium on Environmental Toxicology and Risk Assessment, April 2000, Toronto, Canada.

Bailey, E.P. and J.L. Trapp. 1984. A second wild breeding population of the Aleutian Canada goose. American Birds 38(3)284-286.

Baker, J. and G. Miller. 1999. Understanding and reducing pesticide losses. Extension Publication PM 1495. Iowa State University Extension. Ames, IA. 6 pp.

Barry, T. 2004. Characterization of propanil prune foliage residues as related to propanil use patterns in the Sacramento Valley, CA. Proceedings of the International Conference on Pesticide Application for Drift Management. Waikoloa, HI. 15 pp.

Bartlett, G.A. 1987. Effects of disturbance and hunting on the behavior of Canada goose family groups in east central Wisconsin. Journal of Wildlife Management 51:517-522.

Battaglin, W.A., E.M. Thurman, S.J. Kalkhoff, and S.D. Porter. 2003. Herbicides and transformation products in surface waters of the midwestern United States. Journal of the American Water Resources Association (JAWRA) 39(4):743-756.

Bayer, R., ed. 1977. Birds of Lincoln County, Oregon. Sea Grant Marine Advisory Program, Oregon State University. Newport, OR. 19 pp.

Behnke, R.J. 1979. Monograph of the native trouts of the genus *Salmo* of western North America. Prepared for U.S. Fish and Wildlife Service. U.S. Forest Service, Rocky Mountain Region, Lakewood, CO.

Bell, D.V. and L.W. Austin. 1985. The game-fishing season and its effects on overwintering wildfowl. Biological Conservation 33:65-80.

Bellrose, F.C. 1986. Ducks, geese, and swans of North America. Harrisburg, PA: Stackpole Books.

Bent, A.C. 1927. Life histories of North American shorebirds (part 1). Bulletin of the United States National Museum. No. 142. 420 pp.

Beyer, W.N., E.E. Connor, and S. Gerould. 1994. Estimates of soil ingestion by wildlife. Journal of Wildlife Management 58:375-382.

Bishop, M. A. and N. Warnock. 1998. Migration of western sandpipers: links between their Alaskan stop-over areas and breeding grounds. Wilson Bulletin 110:457-462.

Bishop, M. A., N. Warnock, and J.Y. Takekawa. 2004. Differential spring migration by male and female western sandpipers at interior and coastal sites. Ardea 92:185-196.

Bishop, M.A., P.M. Meyers, and P.F. McNeley. 2000. A method to estimate migrant shorebird numbers on the Copper River Delta, Alaska. Journal of Field Ornithology 71:627-637.

BLM (Bureau of Land Management). 2007. Vegetation treatments using herbicides on Bureau of Land Management Lands in 17 western states Programmatic EIS (PEIS). Bureau of Land Management. Washington, D.C. 539 pp.

Bouffard, S.H. 1982. Wildlife values versus human recreation: Ruby Lake National Wildlife Refuge. Transactions of the North American Wildlife and Natural Resources Conference 47:553-556.

Boyle, S.A. and F.B. Samson. 1985. Effects of non-consumptive recreation on wildlife: a review. Wildlife Society Bulletin 13:110-116.

Bratton, S.P. 1990. Boat disturbance of ciconiiformes in Georgia estuaries. Colonial Waterbirds 13:124-128.

Bregnballe, T. and J. Madsen. 2004. Tools in waterfowl reserve management: effects of intermittent hunting adjacent to a shooting-free core area. Wildlife Biology 10:261-268.

Bromirski, P.D., A.J. Miller, R.E. Flick, and G. Auad. 2011. Dynamical suppression of sea level rise along the Pacific coast of North America: indications for imminent acceleration. Journal of Geophysical Research 116: C07005. doi: 10.1029/2010JC006759.

Brooks, M.L., C.M. D'Antonio, D.M. Richardson, J.B. Grace, J.E. Keeley, J.M. DiTomaso, R.J. Hobbs, M. Pellant, and D. Pyke. 2004. Effects of invasive alien plants on fire regimes. BioScience 54:77-88.

Brophy, L.S. 2001. Siletz estuary plant community mapping. Prepared for the Confederated Tribes of Siletz Indians. Green Point Consulting. Corvallis, OR. 44 pp.

Brophy, L.S. 2002. Siletz Bay NWR and Nestucca Bay NWR tidal marsh restoration and reference sites: baseline plant community monitoring and mapping. Green Point Consulting. Corvallis, OR. 98 pp.

Brophy, L.S. 2009. Effectiveness monitoring at tidal wetland restoration and reference sites in the Siuslaw River estuary: a tidal swamp focus. Prepared for Ecotrust. Green Point Consulting. Corvallis, OR. 125 pp.

Brophy, L.S. 2011. Addressing climate change in tidal wetland restoration and conservation planning: new tools and approaches. Workshop on modeling for estuaries, climate change, and restoration and conservation planning [conference]. February 1, 2011. Hatfield Marine Science Center. Newport, OR. 43 pp.

Brophy, L.S. and S. van de Wetering. 2012. Ni-les'tun tidal wetland restoration effectiveness monitoring: baseline: 2010-2011. Green Point Consulting, the Institute for Applied Ecology, and the Confederated Tribes of Siletz Indians. Corvallis, OR. 114 pp.

Brophy, L.S., C.E. Cornu, P.R. Adamus, J.A. Christy, A. Gray, L. Huang, M.A. MacClellan, J.A. Doumbia, and R.L. Tully. 2011. New tools for tidal wetland restoration: development of a reference conditions database and a temperature sensor method for detecting tidal inundation in least-disturbed tidal wetlands of Oregon, USA. Prepared for the Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET). Green Point Consulting, South Slough National Estuarine Research Reserve. Corvallis, OR and Charleston, OR. 199 pp.

Brown, L.R. and P.B. Moyle. 1991. Status of coho salmon in California. Submitted to the National Marine Fisheries Service. University of California Department of Wildlife and Fisheries Biology. Davis, CA. 114 pp. + appendices.

Brown, S., C. Hickey, B. Harrington, R. Gill, eds. 2001. The U.S. Shorebird Conservation Plan. 2nd edition. Manomet Center for Conservation Sciences. Manomet, MA. 60 pp.

Buchanan, D.V., J.E. Sanders, J.L. Zinn, and J.L. Fryer. 1983. Relative susceptibility of four strains of summer steelhead to infection by *Ceratomyxa shasta*. Transactions of the American Fisheries Society 112:541-543.

Buchanan, J.B. 2005. Priorities for implementation of the Northern Pacific Coast Regional Shorebird Management Plan. General Technical Report PSW-GTR-191. USDA Forest Service. 112-114 pp.

Burger, J. 1986. The effect of human activity on shorebirds in two coastal bays in northeastern United States. Biological Conservation 13:123-130.

Burger, J. and M. Gochfeld. 1991. Human activity influence and diurnal and nocturnal foraging of sanderlings (*Calidris alba*). Condor 93:259-265.

Butler, R.W., G.W. Kaiser, and G.E.J. Smith. 1987. Migration chronology, length of stay, sex ratio, and weight of western sandpipers (*Calidris mauri*) on the south coast of British Columbia. Journal of Field Ornithology 58:103-111.

Butler, T., W. Martinkovic, and O.N. Nesheim. 1998. Factors influencing pesticide movement to ground water. Extension Publication PI-2, University of Florida, Cooperative Extension Service, Gainesville, FL. 4 pp.

Byram, S. 2002. Brush fences and basket traps: the archaeology and ethnohistory of tidewater weir fishing on the Oregon coast. Ph.D. dissertation. University of Oregon, Eugene.

Calabrese, E.J. and L.A. Baldwin. 1993. Performing ecological risk assessments. Chelsea, MI: Lewis Publishers.

Carver, E. 2008. Economic impact of waterfowl hunting in the United States: Addendum to the 2006 national survey of fishing, hunting, and wildlife-associated recreation report 2006. U.S. Fish and Wildlife Service. 13 pp. Available at: http://digitalmedia.fws.gov/cdm/ref/collection/document/id/61.

Cassirer, E.F. 1990. Responses of elk to disturbance by cross-country skiers in northern Yellowstone National Park. M.S. thesis. University of Idaho, Moscow.

Cederholm, C.J., D.H. Johnson, R.E. Bilby, L.G. Dominguez, A.M. Garrett, W.H. Graeber, E.L. Greda, M.D. Kinze, B.D. Marcot, J.F. Palisano, R.W. Plotnikoff, W.G. Pearcy, C.A. Simenstad, and P.C. Trotter. 2000. Pacific salmon and wildlife ecological contexts, relationships, and implications for management. Special Edition Technical Report, Wildlife Habitat Relationships in Oregon and Washington. Washington Department of Fish and Wildlife. Olympia, WA. 127 pp. + appendices.

Center, T.D., J.H. Frank, and F.A. Dray, Jr. 1997. Biological control. Pages 245-263 in: D. Simberloff, D.C. Schmitz, and T.C. Brown, eds. Strangers in paradise: impact and management of nonindigenous species in Florida. Washington, D.C.: Island Press.

Chen, J.L., C.R. Wilson, and B.D. Tapley. 2006. Satellite gravity measurements confirm accelerated melting of Greenland Ice Sheet. Science 313(5795):1958-1960.

CIG (Climate Impacts Group). 2004. Overview of climate change impacts in the U.S. Pacific Northwest. Background paper prepared for the West Coast Governors' Climate Change Initiative. Available at: http://cses.washington.edu/db/pdf/cigoverview353.pdf. Accessed May 4, 1010.

CIG. 2011. About El Niño/La Niña. Available at: http://cses.washington.edu/cig/pnwc/aboutenso .shtml. Accessed April 8, 2011.

Cleaver, F.C. 1951. Fishery statistics of Oregon. Oregon Fish Commission, Oregon Contribution No. 16. 176 pp.

Clough, J.S. and E.C. Larson. 2010. Application of the sea-level affecting marshes model (SLAMM 6) to Siletz Bay NWR. Prepared for the U.S. Fish and Wildlife Service. Warren Pinnacle Consulting, Inc. Warren, VT. 69 pp.

Clough, J.S., Park, R.A. and R. Fuller. 2010. SLAMM technical documentation, release 6.0 beta, draft, January 2010. Available at: http://warrenpinnacle.com/prof/SLAMM/index.html.

Cole, D.N. and R.L. Knight. 1990. Impacts of recreation on biodiversity in wilderness. Logan, UT: Utah State University.

Comer, P., D. Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S. Menard, M. Pyne, M. Reid, K. Schulz, K. Snow, and J. Teague. 2003. Ecological systems of the United States: a working classification of U.S. terrestrial systems. NatureServe. Arlington, VA. 75 pp.

Conlan, R. and R. Service. 2000. El Niño and La Niña: tracing the dance of ocean and atmosphere. Available at: http://www7.nationalacademies.org/opus/elnino_PDF.pdf. Accessed December 20, 2006.

Connolly, P.J., T.H. Williams, and R.E. Gresswell, eds. 2008. The 2005 coastal cutthroat trout symposium: status, management, biology, and conservation. Oregon Chapter, American Fisheries Society. Portland, OR. 171 pp.

Cooke, A.S. 1987. Disturbance by anglers of birds at Grafham Water. Pages 15-22 in: P.S. Maitland and A.K. Turner, eds. Angling and wildlife in fresh waters. ITE Symposium 19:15-22.

Coombs, E.M., J.K. Clark, G.L. Piper, and A.F. Cofrancesco, Jr. 2004. Biological control of invasive plants in the United States. Corvallis, OR: Oregon State University Press.

Cooper, R. and T.H. Johnson. 1992. Trends in steelhead (*Oncorhynchus mykiss*) abundance in Washington and along the Pacific coast of North America. Report number 92-20. Washington Department of Wildlife, Fisheries Management Division. 90 pp.

Cox, R.D. and V.J. Anderson. 2004. Increasing native diversity of cheatgrass-dominated rangeland through assisted succession. Journal of Range Management 57:203-210.

Cullinan, T. 2001. Important bird areas of Washington. Audubon Washington. Olympia, WA. 170 pp.

Dahl, T.E. 1990. Wetlands—losses in the United States, 1780s to 1980s. U.S. Fish and Wildlife Service Report to Congress. Washington, D.C. 13 pp.

Defenders of Wildlife v. Andrus (Ruby Lake Refuge I). Case 2098 (D.D.C. 1978). Environmental Reporter 11:873.

DeLong, A. 2002. Managing visitor use and disturbance of waterbirds. A literature review of impacts and mitigation measures. Appendix L in: Stillwater National Wildlife Refuge Complex final environmental impact statement for the comprehensive conservation plan and boundary revision, volume 2. U.S. Department of the Interior, Fish and Wildlife Service, Region 1. Portland, OR. 114 pp.

Dicken, S.N., C.L. Johannessen, and B. Hanneson. 1961. Some recent physical changes of the Oregon coast. Department of Geography, University of Oregon. Eugene, OR. 140 pp.

Dobb, E. 1998. Reality check: the debate behind the lens. Audubon 100(1):44-51, 98-99.

DOE (U.S. Department of Energy). 2012. Carbon dioxide information analysis center. Available at: http://cdiac.ornl.gov/whatsnew.html. Accessed May 7, 2012.

Dominguez, F., E. Rivera, D.P. Lettenmaier, and C.L. Castro. 2012. Changes in winter precipitation extremes for the western United States under a warmer climate as simulated by regional climate models. Geophysical Research Letters 39(L05803). doi:10.1029/2011GL050762.

Doney, S.C., Fabry, V.J., Feely, R.A. 2009. Ocean acidification: the other CO_2 problem. Annual Review of Marine Science 2009 1:169-192. Available at: http://www.annualreviews.org /doi/pdf/10.1146/annurev.marine.010908.163834.

Douglas, B.C. 1991. Global sea level rise. Journal of Geophysical Research 96(C4):6981-6992.

Draper, J.A. 1988. A proposed model of late prehistoric settlement systems on the southern Northwest Coast, Coos and Curry Counties, Oregon. Ph.D. dissertation. Washington State University, Pullman.

Driver, C.J., M.W. Ligotke, P. Van Voris, B.D. McVeety, B.J. Greenspan, and D.B. Brown. 1991. Routes of uptake and their relative contribution to the toxicologic response of northern bobwhite (*Colinus virginianus*) to an organophosphate pesticide. Environmental Toxicology and Chemistry 10:21-33.

Drut, M. and J.B. Buchanan. 2000. U.S. shorebird conservation plan: northern Pacific Coast regional shorebird management plan. Portland, OR: Fish and Wildlife Service, U.S. Department of the Interior. 31 pp.

Dunning, J.B. 1984. Body weights of 686 species of North American birds. Western Bird Banding Association. Monograph No. 1. Cave Creek, AZ: Eldon Publishing.

Dwyer, N.C. and G.W. Tanner. 1992. Nesting success in Florida sandhill cranes. Wilson Bulletin 104:22-31.

Eddy, S. and J.C. Underhill. 1978. How to know the freshwater fishes. Dubuque, IA: Wm. C. Brown Company Publishers.

Edwards, R.W. and D.V. Bell. 1985. Fishing in troubled waters. New Science 1446(7 March):19-21.

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

Evans, P.R. and M.W. Pienkowski. 1984. Population dynamics of shorebirds. Behavior of Marine Animals 5: 83-123.

EXTOXNET. 1993. Movement of pesticides in the environment. Pesticide Information Project of Cooperative Extension Offices of Cornell University, Oregon State University, University of

Idaho, University of California – Davis, and the Institute for Environmental Toxicology, Michigan State University. 4 pp.

Fairbanks, W.S. and R. Tullous. 2002. Distribution of pronghorn (*Antilocapra americana* Ord) on Antelope Island State Park, USA, before and after establishment of recreational trails. Natural Areas Journal 22:277-282.

Farmer, A.H. and A.H. Parent. 1997. Effects of the landscape on shorebird movements at spring migration stop-overs. Condor 99: 698-707.

FEMA (Federal Emergency Management Agency). 2009a. Flood Insurance Rate Map ID 41041C0117D. Effective date December 18, 2009.

FEMA (Federal Emergency Management Agency). 2009b. Flood Insurance Rate Map ID 41041C0136D. Effective date December 18, 2009.

FEMA (Federal Emergency Management Agency). 2009c. Flood Insurance Rate Map ID 41041C0120D. Effective date December 18, 2009.

Fernández, G., N. Warnock, D.L. Lank, and J.B. Buchanan. 2006. Conservation plan for the western sandpiper, version 1.0. Manomet Center for Conservation Science. Manomet, MA.

Fitzpatrick, M. 1999. Coastal cutthroat trout: life in the watershed. Oregon Sea Grant ORESU-G-99-012. Oregon State University. Corvallis, OR. 10 pp.

Fletcher, J.S., J.E. Nellessen, and T.G. Pfleeger. 1994. Literature review and evaluation of the EPA food-chain (Kanaga) nomogram, and instrument for estimating pesticide residue on plants. Environmental Toxicology and Chemistry 13:1381-1391.

Flyways.us. 2012. Regulations and harvest. Available at: http://www.flyways.us/regulations-and-harvest.

Foott, S.J., R.L. Walker, J.D. Williamson and K.C. True. 1994. Health and physiology monitoring of Chinook and steelhead smolts in the Trinity and Klamath rivers. Unpublished report. U.S. Fish and Wildlife Service, California-Nevada Fish Health Center. Anderson, CA. 12 pp.

Fox, A.D. and J. Madsen. 1997. Behavioral and distributional effects of hunting disturbance on waterbirds in Europe: implications for refuge design. Journal of Applied Ecology 34:1-13.

Franklin, J.F. and C.T. Dyrness. 1988. Natural vegetation of Oregon and Washington. Corvallis, OR: Oregon State University Press.

Fraser, A.I. and J.B.H. Gardiner. 1967. Rooting and stability in Sitka spruce. Great Britain Forestry Commission Bulletin 40. 27 pp.

Fraser, J.D., L.D. Frenzel, and J.E. Mathisen. 1985. The impact of human activities on breeding bald eagles in north-central Minnesota. Journal of Wildlife Management 49:585-592.

Freddy, D.J. 1986. Responses of adult mule deer to human harassment during winter. Page 286 in: R.D. Comer, T.G. Baumann, P. Davis, J.W. Monarch, J. Todd, S. Van Gytenbeek, D. Wills, and J. Woodling, eds. Proceedings II. Issues and technology in the management of impacted western wildlife: Proceedings of a national symposium. Thorne Ecological Institute. Boulder, CO.

Frissell, C.A. 1993. Topography of extinction and decline of native fishes in the Pacific Northwest and California (USA). Conservation Biology 7:342-354.

Ganguly, A., K. Steinhaeuser, D. Erickson, M. Branstetter, E. Parish, N. Singh, J. Drake, and L. Buja. 2009. Higher trends but larger uncertainty and geographic variability in 21st century temperature and heat waves. Proceedings of the National Academy of Sciences of the United States of America 106:15555-15559.

Gill, R.E., Jr. and C.M. Handel. 1990. The importance of subarctic intertidal habitats to shorebirds: a study of the central Yukon-Kuskokwim Delta, Alaska. Condor 92:709-725.

Glick, P., J. Clough, and B. Nunley. 2007. Sea-level rise and coastal habitats in the Pacific Northwest: an analysis for Puget Sound, Southwestern Washington, and Northwestern Oregon. Prepared for the National Wildlife Federation. Available at: http://www.nwf.org /Global-Warming/Effects-on-Wildlife-and-Habitat/Estuaries-and-Coastal-Wetlands/~/media/PDFs/Global%20Warming/Reports/PacificNWSeaLevelRise.ashx.

Goldfinger, C., C.H. Nelson, A. Morey, J.E. Johnson, J. Gutierrez-Pastor, A.T. Eriksson, E. Karabanov, J. Patton, E. Gràcia, R. Enkin, A. Dallimore, G. Dunhill, and T. Vallier. 2010. Turbidite event history: methods and implications for Holocene paleoseismicity of the Cascadia Subduction Zone. USGS Professional Paper 1661-F. U.S. Geological Survey. Reston, VA. 178 pp.

Good, J.W. 2000. Summary and current status of Oregon’s estuarine ecosystems. Section 3.3 in: Oregon state of the environment report 2000. Oregon Progress Board. Salem, OR. Available at: http://egov.oregon.gov/DAS/OPB/docs/SOER2000/Ch3_3a.pdf.

Good, T.P., R.S. Waples, and P. Adams, eds. 2005. Updated status of federally listed ESUs of West Coast salmon and steelhead. NOAA Technical Memorandum NMFS-NWFSC-66. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northwest Fisheries Science Center and Southwest Fisheries Science Center. Seattle, WA, and Santa Cruz, CA. 598 pp.

Gould, R.W. and G.A. Wedemeyer. Undated. The role of diseases in the decline of Columbia River anadromous fish populations. U.S. Fish and Wildlife Service and National Marine Fisheries Service. 81 pp.

Grubb, T.G. and R.M. King, 1991. Assessing human disturbance of breeding bald eagles with classification tree models. Journal of Wildlife Management 55:500-511.

Guntenspergen, G., H. Neckles, and G. Shriver. 2009. Development of a salt marsh assessment tool to monitor system integrity and provide management priorities for wildlife conservation in response to a hierarchy of threats: global change, invasive species and local stressors. U.S. Geological Survey. Patuxent, MD.

Haig, S.M., C.L. Gratto-Trevor, T.D. Mullins, and M.A. Colwell. 1997. Population identification of western hemisphere shorebirds throughout the annual cycle. Molecular Ecology 6:413-427.

Hall, A. 2007. Cutler City: Wild Rhododendron Capital of the Oregon Coast. Available at: http://www.historiccutler.org/PDF%20Files/FINAL%20-%20Context%20Statement.pdf.

Hall, A. 2011. Lincoln City History. Available at: http://www.oregoncoast.org/heritage-culture/.

Hamilton, S.F. 1984. Oregon estuary salinity data and maps. Pages 25-46 in: Estuarine mitigation: the Oregon process (O.A.R. 141-85-264). Oregon Division of State Lands. Salem, OR. 62 pp. Available at: http://oregon.gov/DSL/WETLAND/docs/salinity_maps.pdf.

Hamlet, A.F., E.P. Salathé, and P. Carrasco. 2010. Statistical downscaling techniques for global climate model simulations of temperature and precipitation with application to water resources planning studies. Chapter 4 in: A.F. Hamlet, P. Carrasco, J. Deems, M.M. Elsner, T. Kamstra, C. Lee, S. Lee, G.S. Mauger, E.P. Salathé, I. Tohver, and L.W. Binder, eds. Final report for the Columbia Basin Climate Change Scenarios Project. Climate Impacts Group, Center for Science in the Earth System, Joint Institute for the Study of the Atmosphere and Ocean. University of Washington, Seattle. 27 pp.

Hasan, S. and P.G. Ayres. 1990. The control of weeds through fungi: principles and prospects. Tansley Review 23:201-222.

Hawes, S.M., J.A. Hiebler, E.M. Nielsen, C.W. Alton, J.A. Christy, and P. Benner. 2008. Historical vegetation of the Pacific Coast, Oregon, 1855-1910. ArcMap shapefile, Version 2008_03. Oregon Natural Heritage Information Center, Oregon State University.

Heinz, J. 1971. Salmon and Siletz bays—conflicts in estuarine uses. Oregon State Game Commission.

Hitchcock, C.L., A. Cronquist, and M. Ownbey. 1969. Vascular plants of the Pacific Northwest. Part 1: vascular cryptogams, gymnosperms, and monocotyledons. Seattle, WA: University of Washington Press.

Hoffman, D.J. 1989. Embryotoxicity and teratogenicity of environmental contaminants to bird eggs. Review of Environmental Contamination and Toxicology 115:41-50.

Holmes, R. T. 1971. Density, habitat, and the mating system of the Western Sandpiper (*Calidris mauri*). Oecologia 7:191-208.

Hönisch, B., A. Ridgwell, D.N. Schmidt, E. Thomas, S.J. Gibbs, A. Sluijs, R. Zeebe, L. Kump, R.C. Martindale, S.E. Greene, W. Kiessling, J. Ries, J.C. Zachos, D.L. Royer, S. Barker, T.M. Marchitto, Jr., R. Moyer, C. Pelejero, P. Ziveri, G. Foster, and B. Williams. 2012. The geological record of ocean acidification. Science 335 (2 March 2012):1058-1063.

House of Representatives. 1997. Report 105-106 on National Wildlife Refuge System Improvement Act. Available at: http://www.fws.gov/Refuges/policiesandbudget/HR1420_part1.html.

Huber, M. and R. Knutti. 2011. Anthropogenic and natural warming inferred from changes in Earth's energy balance. Nature Geoscience 5:31-36. doi: 10.1038/ngeo1327.

Huddleston, J.H. 1996. How soil properties affect groundwater vulnerability to pesticide contamination. EM 8559. Oregon State University Extension Service. Corvallis, OR. 4 pp.

Huffman, K. 1999. San Diego South Bay survey report-effects of human activity and water craft on wintering birds in South San Diego Bay. USFWS. 45 pp.

Hulting, A., K. Neff, E. Coombs, R. Parker, G. Miller, and L.C. Burrill. 2008. Scotch broom, biology and management in the Pacific Northwest. Oregon State University Extension Service, University of Idaho Extension Service, Washington State University Extension Service. 8 pp.

ICWDM (Internet Center for Wildlife Damage Management). 2011. Nutria. Available at: http://icwdm.org/handbook/rodents/Nutria.asp. Accessed March 2011.

IPCC (Intergovernmental Panel on Climate Change). 1996. Climate change 1995: synthesis report. Cambridge University Press. Cambridge, United Kingdom, and New York, NY. 572 pp.

IPCC. 2001. Climate change 2001: the scientific basis. J.T. Houghton, Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell, and C.A. Johnson, eds. Contribution of Working Group I to the third assessment report of the Intergovernmental Panel on Climate Change. Cambridge University Press. Cambridge, United Kingdom and New York, NY. 881 pp.

IPCC. 2007a. Climate change 2007: the physical science basis. S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller, eds. Contribution of Working Group I to the fourth assessment report of the Intergovernmental Panel on Climate Change. Cambridge University Press. Cambridge, United Kingdom and New York, NY. 996 pp.

IPCC. 2007b. Climate change 2007: synthesis report. Core Writing Team, R.K. Pachauri, and A. Reisinger, eds. Contribution of Working Groups I, II, and III to the fourth assessment report of the Intergovernmental Panel on Climate Change. IPCC. Geneva, Switzerland. 104 pp.

IPCC. 2007c, Summary for policymakers. Pages 1-18 in: S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller, eds. Climate change 2007: the physical science basis. Contribution of Working Group I to the fourth assessment report of the Intergovernmental Panel on Climate Change. Cambridge University Press. Cambridge, UK, and New York, NY. 996 pp.

Jacob, T., J. Wahr, T.W. Pfeffer, and S. Swenson. 2012. Recent contributions of glaciers and ice caps to sea level rise. Nature 482(23 February 2012):514-518. doi: 10.1038/nature10847.

Jahn, L.R. and R.A. Hunt. 1964. Duck and coot ecology and management in Wisconsin. Technical Bulletin No. 33. Wisconsin Conservation Department. Madison, WI. 212 pp.

Jefferson, C.A. 1975. Plant communities and succession in Oregon coastal salt marshes. Ph.D. dissertation. Oregon State University, Corvallis.

Johnston, J.M. 1981. Life history of anadromous cutthroat trout with emphasis on migratory behavior. Pages 123-127 in: E.L. Brannon and E.O. Salo, eds. Proceedings of the salmon and trout migratory behavior symposium. University of Washington, School of Fisheries, Seattle, Washington.

Kaiser, M.S. and E.K. Fritzell. 1984. Effects of river recreationists on green-backed heron behavior. Journal of Wildlife Management 48:561-567.

Kerle, E.A., J.J. Jenkins, and P.A. Vogue. 1996. Understanding pesticide persistence and mobility for groundwater and surface water protection. EM 8561. Oregon State University Extension Service. Corvallis, OR. 8 pp.

Klein, M.L. 1989. Effects of high levels of human visitation on foraging waterbirds at J.N. “Ding” Darling National Wildlife Refuge, Sanibel, Florida. Final report to the U.S. Fish and Wildlife Service. Gainesville, FL. 103 pp.

Klein, M.L. 1993. Waterbird behavioral responses to human disturbances. Wildlife Society Bulletin 21:31-39.

Knight, R.L. and D.N. Cole. 1995. Wildlife responses to recreationists. Pages 51-70 in: R.L. Knight and K.J. Gutzwiller, eds. Wildlife and recreationists: coexistence through management and research. Washington, D.C.: Island Press.

Knight, R.L. and S.K. Knight. 1984. Responses of wintering bald eagles to boating activity. Journal of Wildlife Management 48:999-1004.

Knight, R.L., D.P. Anderson, and N.V. Marr. 1991. Responses of an avian scavenging guild to anglers. Biological Conservation 56:195-205.

Kushlan, J.A., M.J. Steinkamp, K.C. Parsons, J. Capp, M.A. Cruz, M. Coulter, I. Davidson, L. Dickson, N. Edelson, R. Elliot, R.M. Erwin, S. Hatch, S. Kress, R. Milko, S. Miller, K. Mills, R. Paul, R. Phillips, J.E. Saliva, B. Sydeman, J. Trapp, J. Wheeler, and K. Wohl. 2002. Waterbird conservation for the Americas: the North American waterbird conservation plan, version 1. Waterbird Conservation for the Americas. Washington, D.C. 78 pp. Available at: http://www.waterbirdconservation.org/nawcp.html.

Lawson, P.W., E.P. Bjorkstedt, M.W. Chilcote, C.W. Huntington, J.S. Mills, K.M.S. Moore, T.E. Nickelson, G.H. Reeves, H.A. Stout, T.C. Wainwright, and L.A. Weitkamp. 2007. Identification of historical populations of coho salmon (*Oncorhynchus kisutch*) in the Oregon coast evolutionary significant unit. NOAA Technical Memorandum NMFS-NWFSC-79. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Springfield, VA. 129 pp.

Lee, H., II, and C.A. Brown, eds. 2009. Classification of regional patterns of environmental drivers and benthic habitats in Pacific Northwest estuaries. EPA/600/R-09/140. U.S. Environmental Protection Agency, Office of Research and Development, National Health and Environmental Effects Research Laboratory, Western Ecology Division. Corvallis, OR. 298 pp.

Leek, S.L. 1987. Viral erythrocytic inclusion body syndrome (EIBS) occurring in juvenile spring Chinook salmon (*Oncorhynchus tshawytscha*) reared in freshwater. Canadian Journal of Fisheries and Aquatic Sciences 44:685-688.

Lertzman, K., D. Gavin, D. Hallett, L. Brubaker, D. Leposfsky, and R. Mathewes. 2002. Long-term fire regime estimate from soil charcoal in coastal temperate rainforests. Conservation Ecology 6:5.

Leung, L.R. and Y. Qian. 2003. Changes in seasonal and extreme hydrologic conditions of the Georgia Basin/Puget Sound in an ensemble regional climate simulation for the mid-century. Canadian Water Resource Journal 28(4):605-631.

Leung, L.R., Y. Qian, X. Bin, W.M. Washington, J. Han, and J.O. Roads. 2004. Mid-century ensemble regional climate change scenarios for the western United States. Climatic Change 62:75-11.

Liddle, M.J. and H.R.A. Scorgie. 1980. The effects of recreation on freshwater plants and animals: a review. Biological Conservation 17:183-206.

Long, L.L. and C.J. Ralph. 2001. Dynamics of habitat use by shorebirds in estuarine and agricultural habitats in Northwestern California. Wilson Bulletin 113(1):41-52.

Lyman, R.L. 1991. Prehistory of the Oregon coast: the effects of excavation strategies and assemblage size on archaeological inquiry. San Diego, CA: Academic Press.

MacArthur, R.A., V. Geist, and R.H. Johnston. 1982. Cardiac and behavioral responses of mountain sheep to human disturbance. Journal of Wildlife Management 46:351-358.

Madsen, J. 1985. Impact of disturbance on field utilization of pink-footed geese in West Jutland, Denmark. Biological Conservation 33:53-63.

Maia, E. 1994. Noxious weeds: a guide to invasive non-native plants. King County Department of Public Works, Surface Water Management Division. Seattle, WA.

Marten, G.C. and M.E. Heath. 1973. Reed canarygrass. Pages 263-276 in: M.E. Heath, D.S. Metcalfe, and R.F. Barnes, eds. Forages: the science of grassland agriculture. Ames, IA: Iowa State University Press.

Masters, R.A. and R.L. Sheley. 2001. Invited synthesis paper: principles and practices for managing rangeland invasive plants. Journal of Range Management 54:502-517.

Masters, R.A., S.J. Nissen, R.E. Gaussoin, D.D. Beran, and R.N. Stougaard. 1996. Imidazolinone herbicides improve restoration of Great Plains grasslands. Weed Technology 10:392-403.

Mathot, K.J., D.R. Lund, and R.W. Elner. 2010. Sediment in stomach contents of western sandpipers and dunlin provide evidence of biofilm feeding. Waterbirds 33 (3): 300-306.

Maxwell, B.D., E. Lehnhoff, and L.J. Rew. 2009. The rationale for monitoring invasive plant populations as a crucial step for management. Invasive Plant Science and Management 2:1-9.

McKay, N.P., J.T. Overpeck, and B.L. Otto-Bliesner. 2011. The role of ocean thermal expansion in Last Interglacial sea level rise. Geophysical Research Letters 38:L14605. doi: 10.1029/2011GL048280.

Meehl, G.A., T.F. Stocker, W.D. Collins, P. Friedlingstein, A.T. Gaye, J.M. Gregory, A. Kitoh, R. Knutti, J.M. Murphy, A. Noda, S.C.B. Raper, I.G. Watterson, A.J. Weaver, and Z.C. Zhao. 2007. Global climate projections. Pages 747-845 in: S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller, eds. Climate change 2007: the physical science basis. Contribution of Working Group I to the fourth assessment report of the Intergovernmental Panel on Climate Change. Cambridge University Press. Cambridge, UK, and New York, NY. 996 pp.

Miller, R.E. and P.D. Blair. 1985. Input-output analysis: foundations and extensions. Englewood Cliffs, NJ: Prentice-Hall.

Miller, S.G., R.L. Knight, and C.K. Miller. 2001. Wildlife responses to pedestrians and dogs. Wildlife Society Bulletin 29:124-132.

Mineau, P., B.T. Collins, and A. Baril. 1996. On the use of scaling factors to improve interspecies extrapolation to acute toxicity in birds. Regulatory Toxicology and Pharmacology 24:24-29.

Minnesota IMPLAN Group, Inc. 2008. IMPLAN system (2008 data and software). Stillwater, MN: Minnesota IMPLAN Group.

Minor, R. and K.A. Toepel. 1983. Patterns of aboriginal land use in the southern Oregon coastal region. Pages 225-253 in: R.E. Greengo, ed. Prehistoric places on the southern Northwest Coast. Seattle, WA: Thomas Burke Memorial Washington State Museum.

Monaghan, A.J., D.H. Bromwich, R.L. Fogt, S-H. Wang, P.A. Mayewski, D.A. Dixon, A.A. Ekaykin, M. Frezzotti, I.D. Goodwin, E. Isaksson, S.D. Kaspari, V.I. Morgan, H. Oerter, T.D. van Ommen, C.J. van der Veen, and J. Wen. 2006. Insignificant change in Antarctic snowfall since the International Geophysical Year. Science 313:827-831.

Moody, M.E. and R.N. Mack. 1988. Controlling the spread of plant invasions: the importance of nascent foci. Journal of Applied Ecology 25:1009-1021.

Moore, C.T., E.V. Lonsdorf, M.G. Knutson, H.P. Laskowski, and S.K. Lor. 2011. Adaptive management in the U.S. National Wildlife Refuge System: science-management partnerships for conservation delivery. Journal of Environmental Management 92:1395-1402.

Moorhead, K.K. and M.M. Brinson. 1995. Response of wetlands to rising sea level in the lower coastal plain of North Carolina. Ecological Applications 5:261-271.

Morrison, R.I.G., R.E. Gill, Jr., B.A. Harrington, S. Skagen, G.W. Page, C.L. Gratto-Trevor, and S.M. Haig. 2001. Estimates of shorebird populations in North America. Occasional Paper, no. 104. Canadian Wildlife Service. Ottawa, Ontario. 64 pp.

Morse, L.E., J.M. Randall, N. Benton, R. Hiebert, and S. Lu. 2004. An invasive species assessment protocol: evaluating non-native plants for their impact on biodiversity. Version 1. NatureServe, Arlington, VA. 40 pp.

Morton, J.M. 1995. Management of human disturbance and its effects on waterfowl. Pages F59-F86 in: W.R. Whitman, T. Strange, L. Widjeskog, R. Whittemore, P. Kehoe, and L. Roberts, eds. Waterfowl habitat restoration, enhancement and management in the Atlantic flyway. 3rd edition. Dover, DE: Environmental Management Committee, Atlantic Flyway Council Technical Section, and the Delaware Division of Fish and Wildlife.

Mote, P.W. 2003. Trends in temperature and precipitation in the Pacific Northwest during the twentieth century. Northwest Science 77:271-282.

Mote, P.W. and E.P. Salathé. 2009. Future climate in the Pacific Northwest. Chapter 1 in: J. Littell, M.M. Elsner, L.W. Binder, and A. Snover, eds. The Washington Climate change impacts assessment. Climate Impacts Group, University of Washington. Seattle, WA. 407 pp.

Mote, P.W. and E.P. Salathé. 2010. Future climate in the Pacific Northwest. Climatic Change 102(1-2):29-50.

Mote, P.W., A.F. Hamlet, M.P. Clark, and D.P. Lettenmaier. 2005. Declining mountain snowpack in western North America. Bulletin of the American Meteorological Society 86(1):39-49.

Mote, P., A. Petersen, S. Reeder, H. Shipman, and L. Whitely-Binder. 2008. Sea level rise in the coastal waters of Washington State. University of Washington Climate Impacts Group and the Washington Department of Ecology. 11 pp.

Moyle, P.B. 1976. Inland fishes of California. Berkeley, CA: University of California Press.

Moyle, P.B., R.M. Yoshiyama, J.E. Williams, and E.D. Wikramanayake. 1995. Fish species of special concern in California. 2nd edition. Final report to California Department of Fish and Game, contract 2128IF. University of California Department of Wildlife and Fisheries Biology. Davis, CA. 272 pp. Available at: http://web.biologicaldiversity.org/species/fish /North_American_green_sturgeon/pdfs/fish_ssc.pdf. Accessed July 31, 2012.

Mullin, B.H., L.W. Anderson, J.M. DiTomaso, R.E. Eplee, and K.D. Getsinger. 2000. Invasive plant species. Council for Agricultural Science and Technology Issue Paper (13):1-18.

NAS (National Academy of Sciences). 2008. Understanding and Responding to Climate Change: Highlights of National Academies Reports. 2008 Edition. Board on Atmospheric Sciences and Climate, National Academy of Sciences. Washington, D.C.

NASA (National Aeronautics and Space Administration). 2012. NASA mission takes stock of Earth's melting land ice. Available at: http://www.jpl.nasa.gov/news/news.cfm?release =2012-036#4. Accessed March 2012.

NatureServe. 2010. NatureServe explorer: an online encyclopedia of life [web application]. Version 7.1. Online at: http://www.natureserve.org/explorer. Accessed March 2011.

NatureServe. 2012. International ecological classification standard: terrestrial ecological classifications. NatureServe Central Databases. Arlington, VA. Data current as of April 24, 2012.

NAWMP (North American Waterfowl Management Plan) Plan Committee. 2004. North American waterfowl management plan 2004. Strategic guidance: strengthening the biological foundation. Canadian Wildlife Service, U.S. Fish and Wildlife Service, Secretaria de Medio Ambiente y Recursos Naturales. 22 pp.

NCDC (National Climatic Data Center). 2011. NCDC storm events—Oregon. Available at: http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms. Accessed March 16, 2011.

Nehlsen, W., J.E. Williams, and J.A. Lichatowich. 1991. Pacific salmon at the crossroads. Stocks at risk from California, Oregon, Idaho, and Washington. Fisheries 16:4-21.

Nelson, A.R., B.F. Atwater, P.T. Bobrowsky, L.A. Bradley, J.J. Clague, G.A. Carver, M.E. Darienzo, W.C. Grant, H.W. Krueger, R. Sparks, T.W. Stafford, Jr., and M. Stuiver. 1995. Radiocarbon evidence for extensive plate-boundary rupture about 300 years ago at the Cascadia subduction zone. Nature 378:371-374.

Nickelson, T. 2001. Population assessment: Oregon coast coho salmon ESU. Northwest Region Research and Monitoring Program, Oregon Department Fish and Wildlife. Clackamas, OR. 47 pp. Available at: http://library.state.or.us/repository/2011/201108291146451/index.pdf. Accessed July 31, 2012.

Nickelson, T. and P. Lawson. 1998. Population viability of coho salmon *Oncorhynchus kisutch* in Oregon coastal basins: Application of a habitat-based life cycle model. Canadian Journal of Fisheries and Aquatic Sciences 55:2383-2392.

NMFS (National Marine Fisheries Service). 1997a. Status review update for coho salmon from the Oregon and Northern California coasts. March 28, 1997. West Coast Coho Salmon Biological Review Team. Seattle, WA. 100 pp.

NMFS. 1997b. Coastal coho habitat factors for decline and protective efforts in Oregon. April 24, 1997. NMFS Habitat Conservation Division. Portland, OR.

NMFS. 2009. Letter from Barry Thom, NMFS, to Ed Bowles, ODFW, dated September 1, 2009, concurring with ODFW's "Oregon Coastal Coho, Coastal Rivers Coho Sports Fishery" Fisheries Management and Evaluation Plan under limit 4 of the 4(d) rule. Northwest Region, Salmon Management Division, Roseburg, OR.

NMFS. 2010. Status review update for eulachon in Washington, Oregon, and California. Prepared by the Eulachon Biological Review Team. 443 pp.

NOAA (National Oceanic and Atmospheric Administration). 1999. Status review of coastal cutthroat trout from Washington, Oregon, and California. NOAA Technical Memorandum NMFS-NWFSC-37. National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Springfield, VA. 292 pp.

NOAA. 2000. West coast salmon and the Endangered Species Act. Listing status: coho. Protected resources NOAA Fisheries and National Marine Fisheries Service: the Endangered Species Act. Available at: http://www.nwr.noaa.gov/1salmon/salmesa/cohoswit.html. Accessed July 6, 2000.

NOAA. 2008. Endangered and threatened species: final threatened listing determination, final protective regulations, and final designation of critical habitat for the Oregon coast evolutionarily significant unit of coho salmon. Federal Register 73(28):7816-7873.

NOAA. 2010. Coho salmon (*Oncorhynchus kisutch*). Available at: http://nmfs.noaa.gov/pr/species/fish/cohosalmon.htm. Accessed March 2011.

NOAA. 2011a. Tidal benchmark data sheet—Depoe Bay, Oregon (9435827). Available at: http://tidesandcurrents.noaa.gov/data_menu.shtml?stn=9435827%20DEPOE%20BAY,%20OR&type=Bench%20Mark%20Data%20Sheets. Accessed April 8, 2011.

NOAA. 2011b. Station information—Depoe Bay, Oregon (9435827). Available at: http://tidesandcurrents.noaa.gov/station_info.shtml?stn=9435827%20Depoe%20Bay,%20OR. Accessed April 8, 2011.

NOAA. 2011c. Tidal station locations and ranges. Available at: http://tidesandcurrents.noaa.gov/tides06/tab2wc1b.html. Accessed April 8, 2011.

NOAA. 2011d. Sea level trends. Available at: http://tidesandcurrents.noaa.gov/sltrends/sltrends.shtml. Accessed April 8, 2011.

NOAA. 2012a. Pacific eulachon/smelt (*Thaleichthys pacificus*). Available at: http://www.nmfs.noaa.gov/pr/species/fish/pacificeulachon.htm. Accessed May 2012.

NOAA. 2012b. Green sturgeon (*Acipenser medirostris*). Available at: http://www.nmfs.noaa.gov/pr/species/fish/greensturgeon.htm. Accessed May 2012.

NOAA. 2012c. Global climate change indicators. Available at: http://www.ncdc.noaa.gov/indicators/. Accessed on May 7, 2012.

Nolin, A.W. and C. Daly. 2006. Mapping “at risk” snow in the Pacific Northwest. Journal of Hydrometeorology 7:1164-1171.

NPS (National Park Service). 2011. Plant Conservation Alliance’s alien plant working group. Available at: http://www.nps.gov/plants/alien/fact/hehe1.htm. Accessed March 2011.

Nyman, J.A., R.J. Walters, R.D. Delaune, and W.H. Patrick, Jr. 2006. Marsh vertical accretion via vegetative growth. Estuarine, Coastal and Shelf Science 69(3-4):370-380.

O’Brien, M., R. Crossley, and K. Karlson. 2006. The shorebird guide. New York, NY: Houghton Mifflin Co.

Oberrecht, K. 1997. Oregon’s salt marshes. South Slough National Estuarine Research Reserve. Charleston, OR. 8 pp.

Ocean Carbon and Biogeochemistry Program. 2008. Ocean acidification- recommended strategy for a U.S. national research program. Available at: http://www.us-ocb.org/publications/OCB_OA_Whitepaper.pdf. Accessed July 31, 2012.

ODEQ (Oregon Department of Environmental Quality). 2011. Oregon Department of Environmental Quality water quality assessment 2010 integrated report database. Submitted to EPA for review and approval (January, 31, 2011). Available at: http://www.deq.state.or.us/wq/assessment/rpt2010/search.asp. Accessed April 8, 2011.

ODFW (Oregon Department of Fish and Wildlife). 1979. Natural resources of Siletz Estuary. Estuary Inventory Report. Prepared by Research and Development Section Oregon Department of Fish and Wildlife for Oregon Land Conservation and Development Commission, Vol. 2, No. 4. 44 pp.

ODFW. 1995. Oregon coho salmon biological status assessment and staff conclusions for listing under the Oregon Endangered Species Act. February 22, 1995. Oregon Department of Fish and Wildlife, Portland, OR. Attachment to II-B-I to the Draft OCSRI Plan dated August 20, 1996.

ODFW. 2006. Oregon conservation strategy. Oregon Department of Fish and Wildlife. Salem, OR. Available at: http://www.dfw.state.or.us/conservationstrategy/read_the_strategy.asp. Accessed July 31, 2012.

ODFW. 2009. Fisheries management and evaluation plan: Oregon coastal coho, coastal rivers coho sports fishery. Available at: http://www.nwr.noaa.gov/Salmon-Harvest-Hatcheries/State-Tribal-Management/upload/FMEP-OCC-coastal-rivers-final.pdf. Accessed March 2, 2012.

ODFW. 2011a. Living with nutria. Available at: http://www.dfw.state.or.us/wildlife/living_with /nutria.asp. Accessed March 2011.

ODFW. 2011b. 2011-2012 Oregon game bird regulations. Available at: http://www.dfw.state.or.us /resources/hunting/upland_bird/docs/oregon_game_bird_regs.pdf. Accessed June 13, 2012.

ODFW. 2012a. Threatened, endangered, and candidate fish and wildlife species in Oregon. Available at: http://www.dfw.state.or.us/wildlife/diversity/species/docs/Threatened_and_Endangered _Species.pdf. Accessed May 23, 2012.

ODFW. 2012b. 2012-2013 Oregon game bird regulations. Available at: http://www.dfw.state.or.us /resources/hunting/upland_bird/docs/oregon_game_bird_regs.pdf.

OLC (Oregon LiDAR Consortium). 2010. LiDAR bare earth digital elevation model—South Coast, Oregon. Available at: http://www.oregongeology.org/sub/projects/olc/default.htm. Accessed July 31, 2012.

Olson, B.E. 1999. Grazing and weeds. Chapter 8 in: R.L. Sheley and J.K. Petroff, eds. Biology and management of noxious rangeland weeds. Corvallis, OR: Oregon State University Press.

OPRD (Oregon Parks and Recreation Department). 2005. Oregon State Parks regional interpretive framework. Oregon State Park and Recreation Department. Salem, OR.

OPRD. 2008. 2008-2012 Oregon statewide comprehensive outdoor recreation plan (SCORP). Outdoor recreation in Oregon: the changing face of the future. Available at: http://egov.oregon.gov/OPRD/PLANS/docs/scorp/2008_Scorp_Final_Web.pdf. Accessed July 31, 2012.

ORBIC (Oregon Biodiversity Information Center). 2010. Rare, threatened, and endangered species of Oregon. Institute for Natural Resources, Portland State University. Portland, OR. 105 pp.

Oregon DSL (Department of State Lands). 1989. Heads of tide for coastal streams in Oregon. Available at: http://www.oregon.gov/DSL/PERMITS/docs/heads_of_tide_1989.pdf. Accessed July 31, 2012.

Oregon State University. 1996. EXTOXNET-Extension Toxicology Network, Pesticide Information Profiles. Oregon State University. Corvallis, OR.

Orr, E.L., W.N. Orr, and E.M. Baldwin. 1992. Geology of Oregon. Dubuque, IA: Kendall/Hunt Publishing Company.

Owens, N.W. 1977. Responses of wintering brant geese to human disturbance. Wildfowl 28:5-14.

Page, G.W. and R.E. Gill, Jr. 1994. Shorebirds in western North America: late 1800s to late 1900s. Studies in Avian Biology 15:147-160.

Park, R.A., J.K. Lee, P.W. Mausel, and R.C. Howe. 1991. Using remote sensing for modeling the impacts of sea level rise. World Resources Review 3:184-220.

Park, R.A., M.S. Trehan, P.W. Mausel, and R.C. Howe. 1989. The effects of sea level rise on U.S. coastal wetlands. Pages 1-1 to 1-55 in: J.B. Smith and D.A. Tirpak, eds. The potential effects of global climate change on the United States: Appendix B - Sea Level Rise. EPA-230-05-89-052. U.S. Environmental Protection Agency. Washington, D.C.

Pfeffer, W.T., Harper, J.T., and S. O'Neel. 2008. Kinematic constraints on glacier contributions to 21st-century sea-level rise. Science 321(5894):1340-1343.

Pfister, C., B.A. Harrington, and M. Lavine. 1992. The impact of human disturbance on shorebirds at a migration staging area. Biological Conservation 60:115-126.

Pfleeger, T.G., A. Fong, R. Hayes, H. Ratsch, and C. Wickliff. 1996. Field evaluation of the EPA (Kanaga) nomogram, a method for estimating wildlife exposure to pesticide residues on plants. Environmental Toxicology and Chemistry 15:535-543.

PFMC (Pacific Fisheries Management Council). 1999. Final amendment 13 to the Pacific Coast salmon plan. National Oceanic and Atmospheric Administration Award Number NA97FC0031. Available at: http://www.pcouncil.org/wp-content/uploads/finala13.pdf. Accessed March 2, 2012.

PIF (Partners in Flight). 2010. Species assessment database. Available at: http://www.rmbo.org/pif /scores/scores.html. Accessed March 23, 2010.

Pollock, M.M., G.R. Pess, T.J. Beechie, and D.R. Montgomery. 2004. The importance of beaver ponds to coho salmon production in the Stillaguamish River Basin, Washington, USA. North American Journal of Fisheries Management 24:749-760.

Pope, R., J. DeWitt, and J. Ellerhoff. 1999. Pesticide movement: what farmers need to know. Extension Publication PAT 36. Iowa State University Extension, Ames, IA, and Iowa Department of Agriculture and Land Stewardship, Des Moines, IA. 6 pp.

Prinn, R., S. Paltsev, A. Sokolov, M. Sarofim, J. Reilly, and H. Jacoby. 2011. Scenarios with MIT integrated global systems model: significant global warming regardless of different approaches. Climatic Change 104:515-537.

Raftovich, R.V., K.A. Wilkins, S.S. Williams, H.L. Spriggs, and K.D. Richkus. 2011. Migratory bird hunting activity and harvest during the 2009 and 2010 hunting seasons. U.S. Fish and Wildlife Service. Laurel, MD. 68 pp.

Raftovich, R.V., K.A. Wilkins, S.S. Williams, and H.L. Spriggs. 2012. Migratory bird hunting activity and harvest during the 2010 and 2011 hunting seasons. U.S. Fish and Wildlife Service. Laurel, MD. 68 pp.

Ramsay, C.A., G.C. Craig, and C.B. McConnell. 1995. Clean water for Washington—protecting groundwater from pesticide contamination. Extension Publication EB1644. Washington State University Extension. Pullman, WA. 12 pp.

Ratti, J.T. and K.P. Reese. 1988. Preliminary test of the ecological trap hypothesis. Journal of Wildlife Management 52: 484-491.

Raveling, D.G. 1979. The annual cycle of body composition of Canada geese with special reference to control of reproduction. Auk 96:234-252.

Rea, C.C. 1975. The causes of erosion to Siletz spit, Oregon. M.S. thesis. Oregon State University, Corvallis, OR. 105 pp.

Read, W. 2008. The great coastal gale of December 1-3, 2007. Available at: http://www.climate .washington.edu/stormking/December2007.html. Accessed March 25, 2011.

Ross, R. 1990. Prehistory of the Oregon coast. Pages 554-559 in: W. Suttles, volume ed. Handbook of North American Indians, Volume 7: Northwest Coast. Washington, D.C.: Smithsonian Institution.

Rucker, E. and E.J. Ordall. 1953. Infectious diseases of Pacific salmon. Transactions of the American Fisheries Society 83:297-312.

Ruggiero, P., C.A. Brown, P.D. Komar, J.C. Allan, D.A. Reusser, and H. Lee, II. 2010. Chapter 6. Impacts of climate change on Oregon’s coasts and estuaries. Pages 211-268 in: K.D. Dello and P.W. Mote, eds. Oregon climate assessment report. Oregon Climate Change Research Institute, College of Oceanic and Atmospheric Sciences, Oregon State University. Corvallis, OR. 412 pp.

Salathé, E.P., Y. Zhang, L.R. Leung, and Y. Qian, 2010: Regional climate model projections for the state of Washington. Climatic Change 102(1-2):51-75.

Sanders, J.E., J.J. Long, C.K. Arakawa, J.L. Bartholomew, and J.S. Rohovec. 1992. Prevalence of *Renibacterium salmoninarum* among downstream-migrating salmonids in the Columbia River. Journal of Aquatic Animal Health 4:72-75.

Schiewe, M.H. 1997. Memorandum from M.H. Schiewe, Northwest Fisheries Science Center, to William Stelle and William Hogarth, National Oceanic and Atmospheric Administration, regarding status review update for coho salmon from the Oregon and Northern California coasts, April 3, 1997.

Schlicker, H.G., R.J. Deacon, J.D. Beaulieu, and G.W. Olcott. 1972. Environmental geology of the coastal region of Tillamook and Clatsop Counties, Oregon. Bulletin 74. Oregon Department of Geology and Mineral Industries. Salem, OR. 164 pp.

Schroeder, R.L., J. Holler, and J.P. Taylor. 2004. Managing national wildlife refuges for historic or non-historic conditions: determining the role of the refuge in the ecosystem. in: managing biological integrity, diversity, and environmental health in the national wildlife refuges. Natural Resources Journal 44(4):1041-1066.

Scranton, R. 2004. The application of geographic information systems for delineation and classification of tidal wetlands for resource management of Oregon's coastal watersheds. Master's thesis. Oregon State University, Corvallis, OR.

SDTF 2003 (Spray Drift Task Force 2003). 2003. A summary of chemigation application studies. Spray Drift Task Force. Macon, MO.

Seliskar, D.M. and J.L. Gallagher. 1983. The ecology of tidal marshes of the Pacific Northwest coast: a community profile. FWS/OBS-82/32. U.S. Fish and Wildlife Service, Division of Biological Services. Washington, D.C. 65 pp.

Simenstad, C.A. 1983. The ecology of estuarine tidal channels of the Pacific Northwest coast: a community profile. FWS/OBS-83/05. U.S. Fish and Wildlife Service. Washington, D.C. 181 pp.

Skagen, S.S. 1980. Behavioral responses of wintering bald eagles to human activity on the Skagit River, Washington. Pages 231-241 in: R.L. Knight, G.T. Allen, M.V. Stalmaster, and C.W. Servheen, eds. Proceedings of the Washington bald eagle symposium. Seattle, WA. 254 pp.

Skagen, S.K. and H.D. Oman. 1996. Dietary flexibility of shorebirds in the western hemisphere. Canadian Field-Naturalist 110(3): 419-444.

Skagen, S.K., R.L. Knight, and G.H. Orians. 1991. Human disturbances of an avian scavenging guild. Ecological Applications 1:215-225.

Smerling, T., M. Steil, B. Stygar, and M.H. Surridge. 2005. Predicting the impact of sea level rise on national wildlife refuges: a manual for coastal managers. U.S. Fish and Wildlife Service, National Wildlife Refuge System, Division of Natural Resources. Washington, D.C.

Smith, E. and J. Baker. 2008. Pacific island ecosystem complex. Pages 76-84 in: K.E. Osgood, ed. Climate impacts on U.S. Living marine resources: National Marine Fisheries Service concerns, activities and needs. NOAA Technical Memorandum NMFS-F/SPO-89, U.S. Department of Commerce. Silver Spring, MD. 118 pp.

Smith, S.H., J.F. Bell, F.R. Herman, and T. See. 1984. Growth and yield of Sitka spruce and western hemlock at Cascade Head Experimental Forest, Oregon. Research Paper PNW-325. U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. Portland, OR. 30 pp.

Snavely, P.D., A. Niem, F.L. Wong, N.S. MacLeod, T.K. Calhoun, D.L. Minasian, and W. Niem. 1976. Geologic map of the Cape Foulweather and Euchre Mountain quadrangles. Scale 1:62500. Miscellaneous Investigations Series Map I-868. U.S. Geological Survey. Reston, VA.

Snow, C.D. 1973. Clams eye history of Siletz bay. Unpublished Report, Fish Commission Oregon.

So, K.J., J.S. Clough, and E.C. Larson. 2011. Application of the sea-level affecting marshes model (SLAMM 6) without dikes to Nestucca Bay NWR. USFWS unpublished report. On file at the Oregon Coast National Wildlife Refuge Complex office, U.S. Fish and Wildlife Service, Region 1. Newport, OR.

Solomon, S., D. Qin, M. Manning, R.B. Alley, T. Berntsen, N.L. Bindoff, Z. Chen, A. Chidthaisong, J.M. Gregory, G.C. Hegerl, M. Heimann, B. Hewitson, B.J. Hoskins, F. Joos, J. Jouzel, V. Kattsov, U. Lohmann, T. Matsuno, M. Molina, N. Nicholls, J. Overpeck, G. Raga, V. Ramaswamy, J. Ren, M. Rusticucci, R. Somerville, T.F. Stocker, P. Whetton, R.A. Wood, and D. Wratt. 2007. Technical summary. Pages 19-91 in: S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller, eds. Climate change 2007: the physical science basis. Contribution of Working Group I to the fourth assessment report of the Intergovernmental Panel on Climate Change. Cambridge University Press. Cambridge, UK, and New York, NY. 996 pp.

Speight, M.C.D. 1973. Outdoor recreation and its ecological effects: a bibliography and review. Discussion Papers in Conservation 4. University College. London, United Kingdom. 35 pp.

Stenzel, L.E. and G.W. Page. 1988. Results of the first comprehensive shorebird census of San Francisco and San Pablo Bays. Wader Study Group Bulletin 54:43-48.

Strauss, E.G. 1990. Reproductive success, life history patterns, and behavioral variation in a population of piping plovers subjected to human disturbances. Ph.D. dissertation. Tufts University, Medford, MA.

Taylor, G.H. 2008. Appendix A: climatological report: an analysis of storm characteristics and long-term storm variability along the Oregon-Washington coast. 26 pp. in: OWEB Coastal Storm Assessment Project. Prepared by Oregon State University Institute for Natural Resources. Oregon State University. Corvallis, OR.

Taylor, G.H. and C. Hannan. 1999. The climate of Oregon: from rain forest to desert. Corvallis, OR: Oregon State University Press.

Taylor, A.R. and R.L. Knight. 2003. Wildlife responses to recreation and associated visitor perceptions. Ecological Applications 13:951-963. doi:10.1890/1051-0761(2003)13 [951:WRTRAA]2.0.CO;2.

Tebaldi, C., B.H. Strauss, and C.E. Zervas. 2012. Modelling sea level rise impacts on storm surges along U.S. coasts. Environmental Research Letters 7(2012):014032. doi: 10.1088/1748-9326/7/1/014032.

Teske, M.E., S.L. Bird, D.M. Esterly, S.L. Ray, and S.G. Perry. 1997. A user's guide for AgDRIFT™ 1.0: a tiered approach for the assessment of spray drift of pesticides. Technical Note No. 95-10. CDI. Princeton, NJ.

Teske, M.E., S.L. Bird, D.M. Esterly, T.B. Curbishley, S.L. Ray, and S.G. Perry. 2002. AgDRIFT®: a model for estimating near-field spray drift from aerial applications. Environmental Toxicology and Chemistry 21:659-671.

Thom, R.M. 1992. Accretion rates of low intertidal salt marshes in the Pacific Northwest. Wetlands 12(3):147-156

Thomas, D.W. 1983a. Changes in the Columbia River Estuary habitat types over the past century. Columbia River Estuary Data Development Program. Columbia River Estuary Study Taskforce, Astoria, OR. 51 pp. + appendices.

Thomas, V.G. 1983b. Spring migration: The prelude to goose reproduction and a review of its implication. Pages 73-81 in: H. Boyd, ed. Fourth Western Hemispheric Waterfowl and Waterbird Symposium. Canadian Wildlife Service. Ottawa, Canada.

Tjarnlund, U., G. Ericson, E. Landesjoo, I. Petterson, and L. Balk. 1995. Investigation of the biological effects of two-cycle outboard engines' exhaust on fish. Marine Environmental Research 39:313-316.

Tomohiro, K., P.G. Beninger, P. Decottignies, K.J. Mathot, D.R. Lund, and R.W. Elner. 2008. Biofilm grazing in a higher vertebrate: the western sandpiper, *Calidris mauri*. Ecology 89(3):599-606.

Trotter, P.C. 1989. Coastal cutthroat trout: a life history compendium. Transactions of the American Fisheries Society 118:463-473.

Tuite, C.H., M. Owen, and D. Paynther. 1983. Interaction between wildfowl and recreation at Llangorse Lake and Talybont Reservoir, South Wales. Wildfowl 34:48-63.

Tydeman, C.F. 1977. The importance of the close fishing season to breeding bird communities. Journal of Environmental Management 5:289-296.

Urban, D.J. and N.J. Cook. 1986. Ecological risk assessment. EPA 540/9-85-001. U.S. Environmental Protection Agency, Office of Pesticide Programs. Washington, D.C. 94 pp.

USACE (U.S. Army Corps of Engineers). 1976. Siletz wetlands review. Portland, Oregon. 273 pp.

U.S. Department of Commerce. Bureau of Economic Analysis. 2011. Regional economic accounts. Available at: www.bea.doc.gov/bea/regional/data.htmw. Accessed January 2011.

USDA (U.S. Department of Agriculture), Natural Resource Conservation Service. 1997. Soil survey of Lincoln County, Oregon. Available at: http://soildatamart.nrcs.usda.gov/manuscripts /OR638/0/or638_text.pdf. Accessed April 8, 2011.

USDA. 2008. Smooth cordgrass Spartina alterniflora plant fact sheet. Natural Resources Conservation Service. Washington, D.C. 3 pp.

USEPA (U.S. Environmental Protection Agency). 1990. Laboratory test methods of exposure to microbial pest control agents by the respiratory route to nontarget avian species. EPA/600/3-90/070. Environmental Research Laboratory. Corvallis, OR. 82 pp

USEPA. 1998. A comparative analysis of ecological risks from pesticides and their uses: background, methodology and case study. Environmental Fate and Effects Division, Office of Pesticide Programs, U.S. Environmental Protection Agency. Washington, D.C. 105 pp.

USEPA. 2004. Overview of the ecological risk assessment process in the Office of Pesticide Programs, U.S. Environmental Protection Agency: endangered and threatened species effects determinations. Office of Pesticide Programs. Washington, D.C. 101 pp.

USEPA. 2005a. Technical overview of ecological risk assessment risk characterization: approaches for evaluating exposure; Granular, bait, and treated seed applications. U.S. Environmental Protection Agency, Office of Pesticide Programs. Washington, D.C. Available at: http://www.epa.gov/oppefed1/ecorisk_ders/toera_analysis_exp.htm.

USEPA. 2005b. User’s Guide TREX v1.2.3. U.S. Environmental Protection Agency, Office of Pesticide Programs, Washington, D.C. 22 pp. Available at: http://www.epa.gov/oppefed1 /models/terrestrial/trex_usersguide.htm.

USFS (U.S. Forest Service). 2005. Pacific Northwest Region invasive plant program preventing and managing invasive plants final environmental impact statement. U.S. Forest Service. Portland, OR. 359 pp.

USGS (U.S. Geological Survey). 2000. Pesticides in stream sediment and aquatic biota – current understanding of distribution and major influences. USGS Fact Sheet 092-00. U.S. Geological Survey. Sacramento, California. 4 pp.

USFWS (U.S. Fish and Wildlife Service). 1980. Important fish and wildlife habitats in Oregon. U.S. Department of the Interior, Fish and Wildlife Service, Region 1. Portland, OR. Available at: http://www.fws.gov/oregoncoast/bandonmarsh/EA.htm.

USFWS. 1989. Concept plan for waterfowl habitat protection, an update, middle upper Pacific Coast: North American waterfowl management plan, category 29. U.S. Department of the Interior, Fish and Wildlife Service, Region 1. Portland, OR.

USFWS. 1990. Environmental assessment proposed Siletz Bay National Wildlife Refuge. U.S. Fish and Wildlife Service, Region 1. Portland, Oregon. 31 pp. + appendices.

USFWS. 1993. Introduction of foxes to Alaskan Islands: history, effects on avifauna, and eradication. Resource Publication 193. U.S. Fish and Wildlife Service. Washington, D.C. 53 pp.

USFWS. 1994. The Native American policy of the U.S. Fish and Wildlife Service. U.S. Department of the Interior, Fish and Wildlife Service. Washington, D.C. 9 pp. Available at: http://www.fws.gov/nativeamerican/graphics/Native_Amer_Policy.pdf.

USFWS. 1997. Control of smooth cordgrass (*Spartina alterniflora*) on Willapa National Wildlife Refuge. Environmental assessment. Willapa Bay National Wildlife Refuge. Ilwaco, WA. 125 pp.

USFWS. 2000. Compatibility regulations. Available at: http://Refuges.fws.gov/policymakers /nwrpolicies.html.

USFWS. 2001. Final rule to remove the Aleutian Canada goose from the list of endangered and threatened wildlife. Federal Register 66(54):15643-15656.

USFWS. 2004. Wildland fire management plan, Oregon Coast National Wildlife Refuge Complex, Bandon Marsh NWR, Nestucca Bay NWR, Siletz Bay NWR. U.S. Department of Interior, Fish and Wildlife Service, Region 1. Portland, OR. 108 pp.

USFWS. 2005. Birds of management concern - Region 1 and Region 8 (CNO). U.S. Fish and Wildlife Service, Region 1. Portland, OR. 16 pp.

USFWS. 2006. Little Nestucca River restoration project, Nestucca Bay National Wildlife Refuge, Tillamook County, Oregon. Oregon Coast National Wildlife Refuge Complex. Newport, OR. 66 pp.

USFWS. 2008a. Birds of conservation concern 2008. U.S. Fish and Wildlife Service, Division of Migratory Bird Management. Arlington, VA. 85 pp. Available at: http://www.fws.gov /migratorybirds/.

USFWS. 2008b. Identifying resources of concern and management priorities for a refuge: a handbook. United States Department of the Interior, U.S. Fish and Wildlife Service, National Wildlife Refuge System. 61 pp.

USFWS. 2010a. Rising to the urgent challenge, strategic plan for responding to accelerating climate change. U.S. Department of the Interior, Fish and Wildlife Service. Washington, D.C. 32 pp.

USFWS. 2010b. Strategic plan for inventories and monitoring on national wildlife refuges: adapting to environmental change. U.S. Department of the Interior, Fish and Wildlife Service, Division of Refuges. Washington, D.C. 56 pp.

USFWS. 2011. Waterfowl population status, 2011. U.S. Department of the Interior. Washington, D.C. 80 pp.

USFWS. 2012a. Draft comprehensive conservation plan and environmental assessment, Siletz Bay National Wildlife Refuge, Lincoln County, OR. U.S. Department of the Interior, Fish and Wildlife Service, Region 1. Portland, OR. 417 pp.

USFWS. 2012b. Waterfowl population status, 2012. U.S. Department of the Interior, Fish and Wildlife Service. Washington, D.C. 79 pp.

USFWS. 2012c. Adaptive harvest management: 2012 hunting season. U.S. Department of Interior, Fish and Wildlife Service. Washington, D.C. 58 pp. Available at: http://www.fws.gov /migratorybirds/mgmt/AHM/AHM-intro.htm.

USFWS. 2012d. Marbled murrelet (*Brachyramphus marmoratus*). Available at: http://www.fws.gov/oregonfwo/Species/Data/MarbledMurrelet/. Accessed May 2012.

USFWS. 2012e. Draft guidance on selecting species for design of landscape-scale conservation. U.S. Department of the Interior, Fish and Wildlife Service. Washington, D.C. 40 pp. Available at: http://www.fws.gov/landscape-conservation/pdf/DraftTechnicalGuidanceJuly2012.pdf. Accessed January 30, 2013.

USGCRP (U.S. Global Change Research Program). 2009. Global climate change impacts in the United States. T.R. Karl, J.M. Melillo, and T.C. Peterson, eds. Cambridge, United Kingdom: Cambridge University Press.

USGS (U.S. Geological Survey). 2011. USGS surface-water monthly statistics—Siletz River, Siletz, OR (14305500). Available at: http://waterdata.usgs.gov/usa/nwis/uv?site_no=14305500. Accessed April 13, 2011.

USHCN (U.S. Historical Climatology Network). 2012. Newport, Oregon (356032) monthly data. Available at: http://cdiac.ornl.gov/cgi-bin/broker?_PROGRAM=prog.climsite_monthly.sas&_SERVICE=default&id=356032. Accessed May 7, 2012.

Vermeer, M. and S. Rahmstorf. 2009. Global sea level linked to global temperature. Proceedings of the National Academy of Sciences 106:21527-21532.

Vos, D.K., R.A. Ryder, and W.D. Graul. 1985. Response of breeding great blue herons to human disturbance in northcentral Colorado. Colonial Waterbirds 8:13-22.

Wantz, J.W. and R.E. Sinclair. 1981. Distribution of extreme winds in the Bonneville Power Administration Service Area. Journal of Applied Meteorology 20:1400-1411.

Waring, R.H. and J.F. Franklin. 1979. Evergreen coniferous forests of the Pacific Northwest. Science 204:1380-1386.

Wauchope, R.D., T.M. Buttler, A.G. Hornsby, P.M. Augustijn-Beckers, and J.P. Burt. 1992. The SCS/ARS/CES pesticide properties database for environmental decision making. Reviews of Environmental Contamination and Toxicology 123:1-155.

Weinmann, F., M. Boule’, K. Brunner, J. Malek, and V. Yoshino. 1984. Wetland plants of the Pacific Northwest. U.S. Army Corps of Engineers, Seattle. 85 pp.

White-Robinson, R. 1982. Inland and saltmarsh feeding of wintering brent geese in Essex. Wildfowl 33:113-118.

Wilson, W.H. 1994. Western sandpiper (Calidris mauri). In The Birds of North America Online. A. Poole, ed. Ithaca: Cornell Lab of Ornithology. Retrieved from the Birds of North America Online. Available at: http://bna.birds.cornell.edu/bna/species/090.

Wood, J.W. 1979. Diseases of Pacific salmon—their prevention and treatment. State of Washington Department of Fisheries, Hatchery Division. 82 pp.

Woods, N. 2004. Australian developments in spray drift management. Proceedings of the International Conference on Pesticide Application for Drift Management. Waikoloa, HI. 8 pp.

WRCC (Western Regional Climate Center). 2011a. Climate of Oregon. Available at: http://www.wrcc.dri.edu/narratives/OREGON.htm. Accessed March 16, 2011.

WRCC. 2011b. Period of record general climate summary—temperature, Otis, Oregon (356366). Available at: http://www.wrcc.dri.edu/cgi-bin/cliGCStT.pl?or6366. Accessed March 16, 2011.

WRCC. 2011c. Period of record general climate summary—temperature, Newport, Oregon (356032). Available at: http://www.wrcc.dri.edu/cgi-bin/cliGCStT.pl?or6032. Accessed March 16, 2011.

WRCC. 2011d. Period of record general climate summary—precipitation, Otis, Oregon (356366). Available at: http://www.wrcc.dri.edu/cgi-bin/cliGCStP.pl?or6366. Accessed March 16, 2011.

WRCC. 2011e. Period of record general climate summary—precipitation, Newport, Oregon (356032). Available at: http://www.wrcc.dri.edu/cgi-bin/cliGCStP.pl?or6032. Accessed March 16, 2011.

WRCC. 2011f. Climate data summary—Astoria, Oregon normals, means and extremes. Available at: http://www.wrcc.dri.edu/cgi-bin/clilcd.pl?or94224. Accessed March 16, 2011.

WRCC. 2011g. Climate of Washington. Available at: http://www.wrcc.dri.edu/narratives /WASHINGTON.htm. Accessed on March 16, 2011.

WRCC. 2011h. Average wind speeds by state: Oregon. Available at: http://www.wrcc.dri.edu /htmlfiles/westwind.final.html#OREGON. Accessed March 16, 2011.

WRCC. 2011i. Average wind direction by state: Oregon. Available at: http://www.wrcc.dri.edu /htmlfiles/westwind.final.html#OREGON. Accessed March 16, 2011.

Zinn, J.A. 1973. Analysis of resident property owner perception of resources and the management system of Siletz Bay estuary, Oregon. Ph.D. Thesis, Oregon State University. Corvallis, Oregon. 230 pp.

U.S. Department of the Interior
U.S. Fish & Wildlife Service
Oregon Coast
National Wildlife Refuge Complex
2127 SE Marine Science Drive
Newport, Oregon 97365-5258

Phone: 541/867 4550
Fax: 541/867 4551

http://www.fws.gov

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April 2013

The mission of the U.S. Fish & 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.

Cover Photo
Siletz Bay from the east

Inset Photos
Bufflehead
Bald eagle with lamprey
Great blue heron

All photos Roy W. Lowe/USFWS