Chapter 4
Biological Environment

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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.

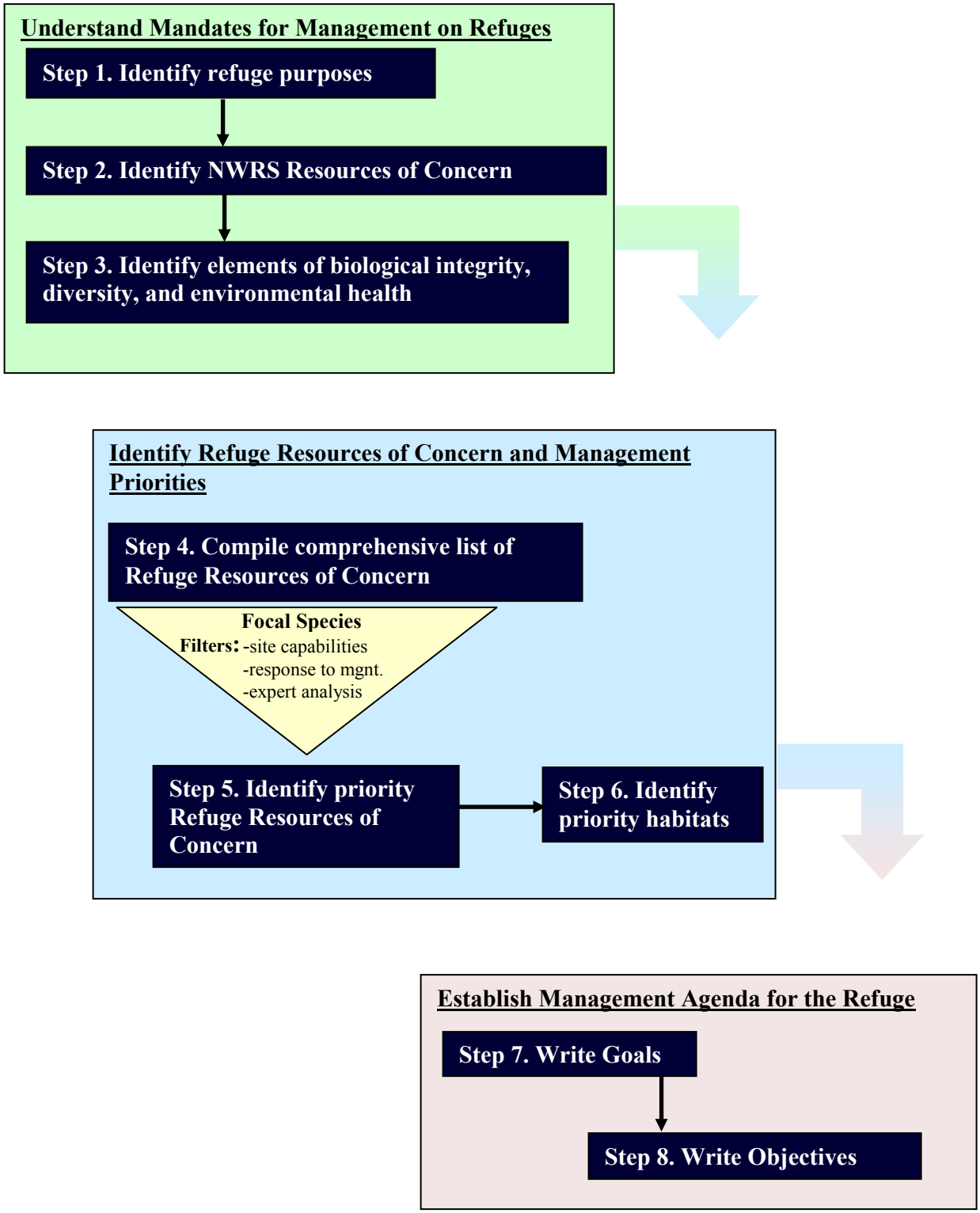
The main criteria for selecting priority ROCs included the following requirements:

- 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.

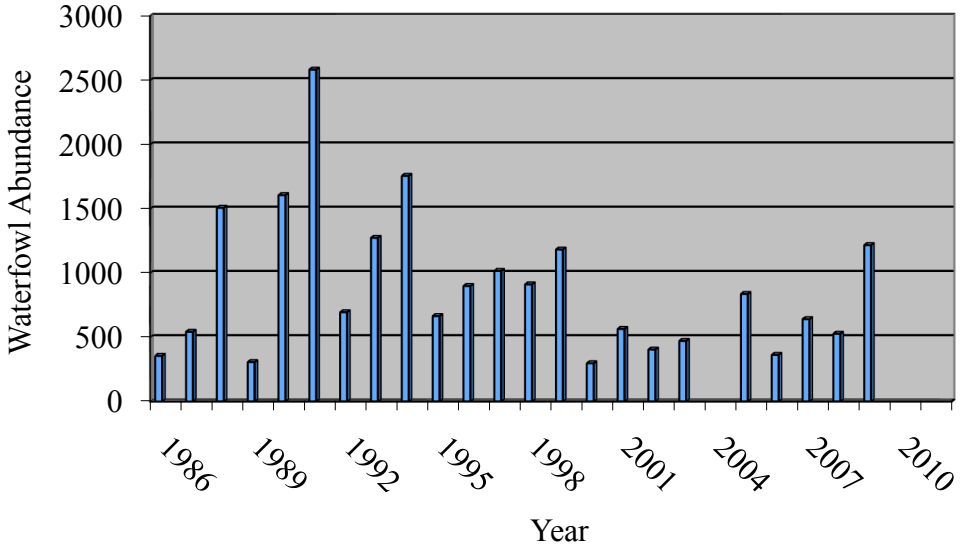
4.8.4 Waterfowl Population Trends

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.