Chapter 3 Affected Environment

3.1 Introduction

This chapter identifies the current environmental conditions on the Washington Islands NWRs that could be affected by the alternatives presented in Chapter 2. To the extent possible, the descriptions of environmental topics are commensurate with the importance of the impact. The environmental consequences of the alternative on the affected environment presented below are described in Chapter 4.

3.2 Climate and Ocean Conditions

The climate in the vicinity of the Washington Islands NWRs study area is characterized by wet and mild conditions. Summer weather systems come from the North Pacific, leading to foggy, cool summers with limited rainfall. Winter weather comes from the southwest, bringing abundant rainfall and mild temperatures. Annual rainfall fluctuates between 72 and 132 inches (182 to 335 cm), with an average of 105 inches (267 cm). Windy conditions are quite common, with highest wind speed for the region clocked at 94 mph (151 kph) at Tatoosh Island (November 1942) (NOAA 1993).

Ocean surface water temperatures average between 48^{o}F and 57^{o}F (9^{o}C and 14^{o}C) near the coast (NOAA 1993). Sea surface temperature anomalies are common in this region, which can raise or lower water temperature by as much as 2 to 3 degrees (Brueggeman 1992). The Washington Islands NWRs are located near the northern extent of the California Current System (CCS). The CCS extends from British Columbia to Baja California and is one of the most ecologically diverse and productive marine ecosystems in the world. Water currents generally follow a northward direction up the coastline during the winter and shift to a southward flow during summer months. Wind, ocean floor bathimetry, shoreline configuration, and freshwater inflow all contribute to fluctuations in seasonal current flow patterns (NOAA 1993). Under certain northerly wind conditions, coastal upwelling can occur, which is most frequent during the summer and fall months (Brueggeman 1992). Upwelling is the wind-driven transportation of cold, dense, nutrient-rich water up toward the ocean surface, and it has been found to be critical to biological productivity (Hickey 1996). The upwelling season reaches its maximum levels during July and August (Short 1992). Tidal fluctuations within the islands and coastal areas are large, averaging 11.5 feet (3.5 m). This large tidal difference allows for an extensive intertidal zone, with associated rich intertidal habitats.

The Columbia River Plume also influences the outer coast's waters and is considered a unique feature of the refuge area (Hickey 1996). This freshwater incursion affects currents, water

properties, nutrients, and productivity, as the water pours north during the winter months, although variable winds can drive the plume north at anytime of year (Hickey 1996).

The Strait of Juan de Fuca, submarine canyons, coastal promontories, and plumes from coastal estuaries are also potential influencing forces on waters surrounding the Refuges. These forces are not well understood along the coast, and their degree of influence remains uncertain (Hickey 1996).

The current understanding of the phytoplankton and zooplankton is also limited along the outer coast. They both vary with upwelling fluctuations but are considered to be relatively highly productive systems (Horner 1996).

3.3 Geology and Soils

The islands and rock formations that make up the Washington Islands NWRs are the basalt and granite bedrock remnants of areas once covered by glacial till. These areas were once contiguous with the Olympic Peninsula mainland but were eroded away by rising ocean levels and subsequent wave and current action (USFWS 1989). Other geological processes, such as submergence and uplift, have also influenced the shapes and locations of the islands. Glacial materials still crown the flat tops of many of these rocky islands. The island and rock formations of this region are very steep table formations, with many rising up to several hundred feet above the water surface. Island size varies from small sea stacks less than one acre (0.4 ha) to the largest island (Destruction Island) at 34.5 acres (14 ha).

3.4 Biological Resources

The Washington Islands NWRs are located within the Sitka Spruce (*Picea sitchensis*) vegetation zone, which covers the coastal regions from northern California to Alaska (Cassidy et al. 1997). This vegetation type is described as a “fog belt” that runs in a narrow band along the coastline and onto larger islands. Precipitation, wind, and mild temperatures combine to provide for rapid growth rates of spruce and other adapted vegetation (Cassidy et al. 1997). Not all the islands support spruce, and many do not support any vegetation at all. These rocks and islands are generally considered part of the coastal beaches and rocky habitat zone (Cassidy et al. 1997). Freshwater habitat is limited to seeps on a few of the larger islands.

Due to the remote nature of this area and the difficulty of getting onto the islands, rocks, and sea stacks, the habitat is generally unaffected by direct human impacts. Some direct human impacts have, however, occurred on a few islands and sea stacks due to: USCG grounds keeping activities on Destruction Island; historic military bombing practice drills; trespassing by recreational boaters; wildlife research activities; and tribal subsistence harvesting activities. Destruction Island is an example of the influence of human-induced habitat disturbance as shown

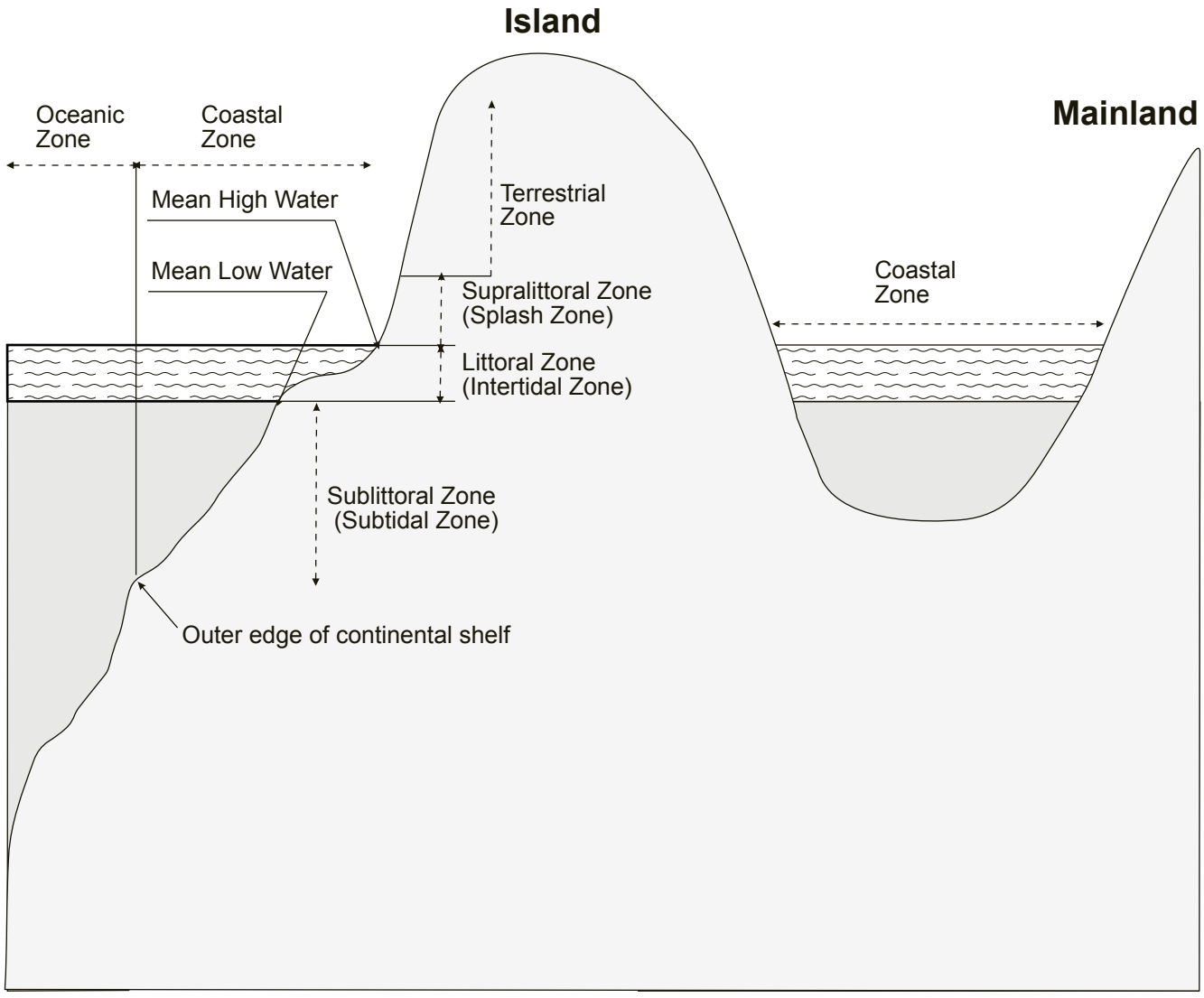
by reduced herbaceous vegetation in some areas caused by introduced rabbits (Aubry and West 1984). Biological resources on the Washington Islands NWRs are also indirectly affected by humans through impacts such as over-fishing, global warming, and pollution (Ainley et al. 1994). However, these impacts disrupt natural ecosystems and species populations in more subtle ways and are, therefore, difficult but critical to assess (Boersma and Parrish 1999).

As shown in Figure 3-1, the diverse and abundant biological resources of these rocks and islands are organized by zones. The terrestrial zone is the land above the higher, high water mark—this land is not covered by water even at the highest spring tides, except during severe winter storm events. Below the terrestrial zone is the supralittoral zone or splash zone. This area is the land between the spring highest tides and the high water mark of the rest of the year. The splash zone typically receives ocean water by wave spray. Below this zone is the littoral or intertidal zone, which is covered and exposed by seawater twice each day by the high and low tides. Farther into the water is the sublittoral or subtidal zone. This zone begins at the low water mark of low tide and extends out over the continental shelf to the edge of the shelf. Beyond this zone are the bathyal, abyssal, and hadal zones; they all represent deeper waters and will be grouped for the purposes of this document as open ocean.

3.4.1 Vegetation

The rocky intertidal zones around the base of many of the islands and sea stacks contain an estimated 130 nonvascular plant species (two vascular, five or more lichens, and more than 120 algae) (Dethier 1988). Additional marine vegetation can be found among kelp forests in the subtidal zone, which are generally located in water depths of 7 to 66 feet (2 to 20 m) (NOAA 1993). These habitats are thought to be "one of the world's most productive" marine habitats in terms of abundance and diversity of dependent flora and fauna (NOAA 1993). Bull kelp (*Nereocystis luetkeana*) is the dominant plant within this marine habitat. The outer coast represents 12 percent of the total population of this plant in Washington (WDNR 1999). Bull kelp is currently facing many threats, such as commercial harvests, sedimentation caused by mainland run-off, and boat sewage discharge (Edwards and Foster 2000). Bull kelp is consumed by sea urchins. The presence of a healthy sea otter (*Enhydra lutris*) population prevents the urchin population from growing too high and depleting the valuable kelp resources. Kelp forests support many species, including: many fish species, especially during early life stages; a variety of algae species, many used by commercial industries; a variety of invertebrate species; and larger predators such as sea otters, seals and sea lions.

Vascular plants grow on only a few of the islands, rocks, and sea stacks. Plant species vary among the islands and are only well documented on the larger, more accessible islands (Aubry and West 1984; Barrett 1979; Cornelius 1982; NOAA 1993; Wilson and Manual 1986; Wilson 1991). Most of the islands contain grasses, forbs, and some shrub species. Salmonberry (*Rubus spectabilis*) and salal (*Gaultheria shallon*) are common dominant plants on the islands. A few of the islands have a Sitka spruce (*Picea sitchensis*) tree layer. Known shrub layer plants include



Source: Adapted from Duxbury et al. 2000.

Biological Zones of Washington Offshore Islands NWRs and Vicinity

FIGURE 3-1

salmonberry, salal, Hooker's willow (*Salix hookeriana*), red elderberry (*Sambucus racemosa*), and bearberry honeysuckle (*Lonicera involucrata*). Forb communities are known to incorporate Suksdorf mugwort (*Artemisia suksdorfii*), common cowparsnip (*Heracleum lanatum*), Bird's-eye pearlwort (*Sagina procumbens*), and California figwort (*Scrophularia californica*). Grass associations often include spike bentgrass (*Agrostis exarata*), slough sedge (*Carex obnupta*), common velvetgrass (*Holcus lanatus*), orchardgrass (*Dactylis glomerata*), dune wildrye (*Elymus mollis*), annual bluegrass (*Poa annua*), and red fescue (*Festuca rubra*). Orchardgrass, velvetgrass, and bird's-eye pearlwort are nonnative plant species.

3.4.2 Wildlife

Like the vegetation of the islands and rocks, the fauna that utilize the area are arranged within the different habitat zones of the marine and terrestrial systems. Marine fishes are found in the open water surrounding the Washington Islands NWRs. Marine mammals can generally be found in the open waters; however, breeding and resting bring them up into the subtidal and intertidal zones. The subtidal and intertidal habitats also hold many species of marine invertebrates. Avian species are found in the open ocean, intertidal, and upland habitats. Terrestrial fauna are restricted to the upland habitats on the tops of the islands. Species accounts for known refuge wildlife species are described below.

Fish

Commercially valuable species found in this region include spiny dogfish (*Squalus acanthias*), Pacific herring (*Clupea pallasi*), pink salmon (*Oncorhynchus gorbuscha*), chum salmon (*O. keta*), coho salmon (*O. kisutch*), sockeye salmon (*O. nerka*), chinook salmon (*O. tshawytscha*), steelhead (*O. mykiss*), coastal cutthroat (*O. clarki clarki*), Pacific hake (*Theragra chalcogramma*), widows rockfish (*Sebastes entomelis*), Pacific halibut (*Hippoglossus stenolepis*), Petrale sole (*Eopsetta jordani*), starry flounder (*Platichthys stellatus*), arrowtooth flounder (*Atheresthes stomias*), Pacific ocean perch (*Sebastes alutus*), lingcod (*Ophiodon elongatus*), English sole (*Parophrys vetulus*), Dover sole (*Microstomus pacificus*), Pacific cod (*Gadus macrocephalus*), and sablefish (*Anoplopoma fimbria*) (WDFW 2000a).

Groundfish species have experienced a decline in recent years, enough so that the State of Washington has issued a Strategic Plan and Federal agencies are considering listing these species for certain regions. The State's Strategic Plan outlines steps that will be taken in Washington to promote healthy groundfish populations (Palsson et al. 1998). This plan highlights the importance of marine reserves in allowing for groundfish population regrowth areas, the benefits of scientific research, and reduction of bycatch (Palsson et al. 1998).

Forage fish are those fish species that make up a critical part of the diet of marine mammals, larger predatory fish, and seabirds. The health of the populations of these fish species is often used as an indicator of the health and productivity of the larger marine system. As forage fish populations fluctuate, so do the species that eat them. Fish species that are known prey items for Washington coastal seabirds and marine mammals include Pacific herring, surf smelt

(*Hypomesus pretiosus*), Pacific sand lance (*Ammodytes hexapterus*), northern anchovy (*Engraulis mordax*), and a few other smelt (*Hypomesus* sp.) species that are grouped for management practices by the WDFW (2000b). Though most forage fish generally spawn and are harvested in Puget Sound, they travel and forage in the Washington Islands NWRs area and are the main prey items for seabirds, sea lions, seals, and salmon. There have been a few documented spawning areas on the outer coast, including surf smelt around Kalaloch Rocks and north along the coast to the Hoh River (WDFW 2000b). Forage fish are impacted by many non-natural impacts such as commercial and recreational fishing, water pollution, and sedimentation. Basic population assessments have not been carried out for these fish species (except herring, which has been documented as declining) and, therefore, population trends remain uncertain (Bargmann 1998; USFWS 1997). However, the importance of these fish to the entire health of the marine ecosystem is known; therefore, management plans, such as the State's Forage Fish Management Plan, have been enacted (Bargmann 1998). The management plan outlines an ecosystem approach for protecting forage fish species, which includes the protection of spawning grounds (Bargmann 1998). Surf smelt spawning habitat has been documented along the Washington coast on a few intertidal sand-gravel beaches (Bargmann 1998). Spawning habitats for other forage fish need to be assessed for the Washington coast. There is growing concern over Pacific hake and sardine populations due to suspected declines and the relative importance of these two species in seabird and marine mammal diets (pers. comm., Pat Gearin).

Marine Mammals

Marine mammals regularly use the islands and rocks in and above the intertidal zone for haul-out and breeding habitat and the surrounding waters for foraging. Haul-out habitat includes offshore rocks, anchored floats, and sand spits that marine mammals rest on during calm, sunny weather (Jeffries et al. 2003; Chapman and Feldhamer 1982; Johnson and Jefferies 1977). Haul-out habitat is characterized by adjacent deep water and some protection from disturbance (Johnson and Jefferies 1977). Marine mammal foraging habitat is found in marine waters around the islands and rocks. Marine mammals using the Washington Islands NWRs area directly include sea otter, harbor seal (*Phoca vitulina*), Steller sea lion (*Eumetopias jubatus*), California sea lion (*Zalophus californianus*), northern elephant seal (*Mirounga angustirostris*), and rarely, northern fur seal (*Callorhinus ursinus*). Under the Marine Mammal Protection Act of 1972 all marine mammals are federally protected.

Sea otter populations, listed by the State as an endangered species, have been increasing from reintroduction efforts in 1969 and 1970; after they were extirpated in the early 1900s (Brueggeman 1992). In 2004, 743 sea otters were counted between Point Grenville at Grenville Bay and Pillar Point in the Strait of Juan de Fuca (Jameson and Jeffries 2004). In 2001, two sea otters were reported using habitat in the Puget Sound. While WDFW has not surveyed inland waters in recent years, there have been credible sightings of scattered individuals in the San Juan Islands and Puget Sound (Jameson and Jeffries 2004). No groups were noted, however, and the number of sea otters in inland waters would not significantly add to the total (Jameson and Jeffries 2004).

Most of the State's sea otters are within or near the Washington Islands Refuges. Refuge islands where sea otters have been documented breeding include Sandy Island, Hand Rock, Destruction Island, and Ozette Island (WDFW 2000c). Sea otters utilize kelp beds and protected bays, especially around Ozette and Bodelteh Islands (Flattery Rocks NWR), and Destruction Island (Quillayute Needles NWR) for foraging (Bowlby et al. 1988).

Sea otters are considered a key species in terms of the ecological influence they have on kelp communities through reducing herbivore abundance (Kvitek et al. 1989; Lance et al. 2004). Sea otters have also been reported to influence the rocky intertidal zones near Cape Alava, Washington, through their foraging methods of turning over rocks (Kvitek et al. 1989).

Sea otters along the Washington coast are at risk from drowning in fish nets and oil spills (Gerber and Van Blaricom 1999; Kvitek et al. 1989; Riedman and Estes 1990; Lance et al. 2004). Sea otters have been documented to get caught in commercial nets in Washington and California (P. Gearin as cited in Gerber and Van Blaricom 1999; Wendell et al. 1985). Major oil spills, such as the Exxon Valdez spill in Prince William Sound, are the greatest threat to sea otters especially when they occur within a limited range, and their population numbers are low as they currently are in Washington (Geraci and Williams 1990; Gerber and VanBlaricom 1999). Even minor oil spills are believed to cause major impacts to sea otter populations (Bonnell et al. 1996).

Competition between sea otters and commercial harvest of sea urchins may become a more prominent issue as the otter population increases and expands along the coast (Kvitek et al. 1989). Olympic Coast Tribes have an interest in developing a sea otter subsistence harvest program (NMFS 1995; pers. comm. Greig Arnold).

Harbor seals are generally found in harbors and bays along the coast (Chapman and Feldhamer 1982; Ingles 1965). The State's harbor seal populations have been increasing since the 1970s with the 1999 Washington coastal stock population estimated at 15,958 (Jeffries et al. 2003). Many of these animals use the rocks, reefs, and beaches associated with the Washington Islands NWRs for pupping and haul-out sites (NMFS 2003a; USFWS 1989). During surveys conducted in 1989 and 1990, Destruction Island, Hoh Head, Alexander Island, the reef near Rounded Island, Giants Graveyard, Sea Lion Rock, the reef near Jagged Island, inshore of Hand Rock, and Ozette Island reef, were all concentration sites for harbor seals (Brueggemann 1992). There are over 90 known haul-out sites that are used regularly along the Washington coast (Brueggeman 1992). Breeding occurs from April though July in Washington (Jefferies 1986). Breeding has been observed at Destruction Island, the Giants Graveyard area, Cape Johnson area, and the Hand Rock area (Brueggeman 1992). Harbor seals are susceptible to disturbance and are easily scared from haul-out areas (Brueggeman 1992; Chapman and Feldhamer 1982). Human disturbance is one of the major causes of pup mortality due to desertion by the mother (Boulva and McLaren 1979). Seals are also impacted by declines in forage fish species, pollution, shooting, propeller wounds, underwater blasting, oil spills, fishing operation entrapment, and other human-related incidents (Barlow et al. 1996; Chapman and Feldhamer 1982). Certain

northwest tribes have reserved treaty rights to hunt harbor seals; however, this hunt does not extend onto refuge lands. Tribes develop harvest regulations for tribal members and report back to NOAA Fisheries with data on harvested seals. (NMFS 2003a; pers. comm. Russell Woodruff, Chairman of the Quileute Tribal Council, December 13, 2001). This subsistence use is not considered to be a large impact on the populations (pers. comm., Pat Gearin).

Steller sea lions, a federally listed threatened species, are found from the North Pacific Ocean Rim (Northern Japan through the Aleutian Islands of Alaska) south to California (NOAA 1993). They breed throughout this range and were once considered the most abundant sea lion in the northern hemisphere (Kenyon and Rice 1961). Their dramatic decline has been blamed on disease, entanglement, and prey availability (Merrick et al. 1987; Wooster 1993). Steller sea lions do not migrate but disperse widely outside of the breeding season (NOAA 1993). Pat Gearin of the National Marine Mammal Laboratory believes that 99 percent of all of Washington's Steller sea lions use the refuge areas (pers. comm., Pat Gearin). The estimate for refuge area use by this species is over 1,000 individuals (Gearin 1996). Forage species include mostly fish species (especially bottom-dwelling fish) and invertebrates, and occasionally marine mammals (Chapman and Feldhamer 1982; Gerber 1993; NOAA 1993). In Washington, breeding may occur on the Refuges' Carroll Island. Refuge islands are also used by Steller sea lions for hauling out (WDFW 1993; Speich et al. 1987). Sea lions often return to favorable haul-out sites year after year (NOAA 1993). Carroll Island and Split Rock have been documented as particularly active Steller sea lion haul-out sites (Brueggeman 1992). Human activity around haul-out sites has been documented to influence site tenacity in a negative matter (Johnson et al. 1989). Humans, boats, and aircraft have been documented to disturb hauled-out animals (NOAA 1993). Areas that are repeatedly disturbed can be abandoned permanently (Kenyon 1962). There is no commercial harvest of Steller sea lions. Other human-induced threats to Steller sea lions include fishery-related entrapment, fishery-related prey decline, oil spills and other water pollution, debris entanglement, and disturbance (Barlow et al. 1996; NOAA 1993).

California sea lions range from the Vancouver Islands, in British Columbia south to Acapulco, Mexico (Brueggeman 1992). They breed in Southern California and southward into Mexico (Ingles 1965; Brueggeman 1992). The northern wandering of this species is primarily carried out by males, which come up into the Washington Island NWRs and utilize haul-out and foraging habitats (Speich et al. 1987). Though haul-out sites do shift for this species, Carroll Island (located in Quillayute Needles NWR), Sea Lion Rock (south of Carroll Island in Quillayute Needles NWR), and the Bodelteh Islands (located in Flattery Rocks NWR) have been identified as important areas (pers. comm., Pat Gearin; Brueggeman 1992). California sea lions eat the same prey species as Steller sea lions and thus compete for food resources (Mate 1976, as quoted in Chapman and Feldhamer 1982). Human-induced threats include oil spills, commercial fisheries-caused prey decline and entrapment (especially the Pacific hake and sardine fisheries and bottom-dragging fishing operations), and disturbance at haul-out areas (pers. comm., Pat Gearin; Barlow et al. 1996). Certain northwest tribes have reserved treaty rights to hunt California sea lions; however, this hunt does not extend onto refuge lands. Tribes develop

harvest regulations for tribal members and report back to NOAA Fisheries with data on harvested sea lions (NMFS 2003b; pers. comm. Russell Woodruff). This subsistence use is not considered to be a large impact on the populations (pers. comm., Pat Gearin).

The core breeding range for the northern elephant seal is Baja California, Mexico, to Point Reyes, California (Chapman and Feldhamer 1982). However, elephant seals have been documented to pup on Destruction Island within the Washington Islands NWRs. They use refuge haul-out areas, such as Destruction Island, during molting. Molting is a vulnerable period when seals shed and regrow their outer coats of fur. Sightings of this species within the refuge area have been increasing over the last decade (Gearin 1996). After breeding and molting periods end, elephant seals travel north as far as the Aleutian Islands to forage in productive northern waters (Chapman and Feldhamer 1982).

Northern fur seals are occasional visitors to the open waters surrounding the Washington Islands NWRs (Brueggeman 1992). The Washington Islands NWRs are well within the range of the species, which extends from the Arctic south to Baja California, Mexico (Brueggeman 1992). An estimated 80,000 to 90,000 animals migrate past refuge islands along the 100 fathom isobath during March and April (Gearin 1996). The majority of fur seal sightings in Oregon and Washington have been females and juveniles (Brueggeman 1992). The forage prey for this species includes bottom fish such as Pacific hake, squid (order Decapoda), ratfish (*Hydrolagus colliei*), and small sharks (order Chlamydoselachiformes) (Chapman and Feldhamer 1982). Entanglement in commercial fishing operations has been documented to impact populations of this marine mammal (Brueggeman 1992; Chapman and Feldhamer 1982).

Additional marine mammals documented in the waters around the Washington Islands NWRs include many whale and dolphin species (NOAA 1993). The gray whale (*Eschrichtius robustus*) and Pacific harbor porpoise (*Phocoena phocoena*) are considered common species in the nearshore waters of the region (Brueggeman 1992; Speich et al. 1987). Gray whale use of the region generally peaks in the spring and fall migration periods. In addition to migrational use of the area, the Pacific Coast Feeding Aggregation of gray whales can be observed utilizing the waters along the Washington coast during the summer (NMFS 2002). The Makah Tribe is the only Native American tribe that has harvested gray whales under a harvest quota approved by the International Whaling Commission and NOAA Fisheries (NMFS 2001).

The Pacific harbor porpoise is the smallest, and one of the most common cetaceans along the Pacific coastline, within 24 miles (38.5 km) of shore (Leatherwood et al. 1982). There is growing concern over harbor porpoise population declines in Oregon and Washington, which has lead to an increase in research (Brueggemen 1992). Human-induced disturbances and entanglement in fishing nets are believed to highly impact this marine mammal (Chapman and Feldhamer 1982; Speich et al. 1987).

Marine Invertebrates

The rocky intertidal zones of the Washington Islands NWRs are estimated to contain roughly 180 invertebrate species (Dethier 1988). Intertidal invertebrate species important to the Tribes as well as those of commercial importance include the following: California mussel (*Mytilus californianus*), native (Olympia) oyster (*Ostrea lurida*), Dungeness crab (*Cancer magister*), limpets (family Fissurellidae), chitons (class *Amphineura*), ocean pink shrimp (*Pandalus borealis* and *P. jordani*), and many crustacean species. The sandy beaches of the mainland coastline of this region provide the majority of the Pacific razor clam (*Siliqua patula*) harvest area for the entire west coast (NOAA 1993). Local Tribes, including the Quinault, Quileute, and Hoh, and recreational and commercial fisheries, harvest razor clams along the outer coast of Washington (Gerber and VanBlaricom 1999). Outer coast populations of Dungeness crab are considered to be important to the statewide population of this highly valuable commercial species (D. Armstrong, as cited in Gerber and VanBlaricom 1999). Washington State has identified the refuge areas as known Dungeness crab habitat (WDFW 2000e). Other invertebrate species possible in the intertidal zones of the Washington Islands NWRs include the introduced Pacific oyster (*Crassostrea gigas*), blue mussel (*Mytilus galloprovincialis*, *M. trossulus*, and hybrids), weathervane scallop (*Patinopecten caurinus*), market squid (*Loligo opalescens*), North Pacific octopus (*Octopus doefleini*), black turbans (*Tegula funebralis*), limpets (*Tectura scutum* and *Lottia pelta*), black chitons (*Katherina tunicata*), and giant chiton (*Cryptochiton stelleri*). Crustaceans likely on and around the islands of the Washington Islands NWRs include red rock crab (*Cancer productus*), spot shrimp (*Pandalus platyceros*), pink shrimp (*Pandalus jordani* and *P. borealis*), sidestripe shrimp (*Pandalopsis dispar*), gooseneck barnacle (*Pollicipes polymerus*), and acorn barnacles (*Semibalanus cariosus* and *Balanus nubilus*). The State has identified hardshell subtidal clam habitat around Anderson Point, Bahobohosh Point, on the southern side of Cape Flattery, and just north of Cape Alava (WDFW 2000d).

Other invertebrates, known collectively as enchinoderms, located in the intertidal and subtidal areas of the islands and rocks of the Washington Islands NWRs are green sea urchin *(Strongylocentrotus droebachiensis*), red sea urchin (*S. franciscanus*), purple sea urchin (*S. purpuratus*), and sea anemone (*Anthopleura elegantissima* and *A. xanthogrammica*). The WDFW has identified sea urchin habitat around Fuca Pillar off the coast of the Makah Indian Reservation (WDFW 2000e). The Makah Tribe operates a commercial sea urchin fishery in the Strait of Juan de Fuca (pers. comm. Greig Arnold). Human-induced threats to marine invertebrates in Washington State include oil spills and harvest exploitation (pers. comm., Megan Dethier; Gerber and VanBlaricom 1999).

Birds

Breeding Seabirds

The Washington Islands NWRs are well known for their avian resources, supporting breeding populations of landbirds and seabirds. The habitat continuum between the terrestrial and marine systems has led to rich and highly productive avian populations (NOAA 1993). The interaction

and dependency between the landbird and seabird populations on Washington's outer coast is complex and closely tied to marine resources.

The area's importance for breeding seabirds has been recognized since 1907, when the reservations (which later became the Washington Islands NWRs) were established for colony protection. A survey of seabird abundance along the Oregon and Washington coast found Olympic Peninsula seabird colonies to be important sites for regional seabird populations (Brueggeman 1992). The islands and rocks in this area provide habitat for over 72 percent of Washington's nesting seabirds and are among the largest colonies in the continental U.S. (Speich and Wahl 1989; NOAA 1993). Fourteen species make up the approximate 200,000 breeding seabird population. A number of these species only breed on the outer coast, likely due to a loss of nesting habitat elsewhere (Speich and Wahl 1989). Refuge nesting seabirds include seven burrow/crevice nesters and seven surface nesters. Names, nesting habitats, and legal status of these nesting seabird species are listed in Table 3-1.

The fork-tailed storm-petrel (*Oceanodroma furcata*) is a refuge breeding seabird that ranges across most of the world's northern oceans (Speich and Wahl 1989). They are found off the coast of Washington year round, though their numbers decline in winter months (Wahl 1984). The Washington Islands NWRs hold more than 50 percent of the west coast's breeding populations of fork-tailed storm petrels within the contiguous U.S. (NOAA 1993). Nesting habitat includes rocky crevices and burrows in the island soil (Speich and Wahl 1989). Nesting habitat typically includes islands with good vegetation cover (Kaufman 1996). Known nesting islands within the Washington Islands NWRs are Carroll, Bodelteh, and Alexander Islands (Speich and Wahl 1989). Nesting population estimates for the Washington coast are around 6,700 birds (Speich and Wahl 1989). A wide ranging forager, this species has been known to travel an average of 186 miles (300 km) from their nesting sites during the night to find food (Brueggeman 1992). This species generally feeds on fish and floating debris in waters over the continental shelf and farther out to sea, and occasionally close to land (Kaufman 1996). Storm-petrels have been documented concentrating around fishing vessels to take advantage of offal (Brueggeman 1992). This seabird species is particularly sensitive to disturbances at their nesting sites, introduced rats, and oil spills (Kaufman 1996, Speich and Wahl 1989).

Leach's storm-petrel (*Oceanodroma leucorhoa*) is a common species, whose range includes the northern Pacific Rim from Baja California, to the Gulf of Alaska (Brueggeman 1992; Speich and Wahl 1989). This species is known to be highly philopatric, returning to nesting colonies year after year (Huntington et al. 1996). This long-lived species lays one egg per year, which is cared for at the colony by both the male and female (Huntington et al. 1996). This species is difficult to observe as the majority of breeding activity occurs at night and non-breeding periods are spent off-shore. Along the Washington Coast this species nests in burrows and crevices (Speich and Wahl 1989). The Leach's storm-petrel is believed to outnumber the fork-tailed storm-petrel at a ratio of approximately 10 to 1 as a breeder in Washington (Brueggeman 1992). Nesting locations are known on 11 islands off the Washington Coast, though as many as 25 locations

Table 3-1. Breeding seabirds of the Washington Islands NWRs, outer coast of Washington State.

Common Name	Scientific Name	Nesting Habitat
Fork-tailed Storm-Petrel	*Oceanodroma furcata*	Burrows, cavities, and crevices - mostly between rocks
Leach's Storm-Petrel	*Oceanodroma leucorhoa*	Burrows - in turf
Double-crested Cormorant	*Phalacrocorax auritus*	Surface - builds nest of marine debris and sticks
Brandt's Cormorant	*Phalacrocorax penicillatus*	Surface - builds nests on broad ledges
Pelagic Cormorant	*Phalacrocorax pelagicus*	Surface - builds nests on narrow ledges
Black Oystercatcher	*Haematopus bachmani*	Surface - builds pebble nest at water's edge in rocks
Glaucous-winged Gull	*Larus glaucescens*	Surface - nests on rocky ledges and grassy tops of islands
Western Gull	*Larus occidentalis*	Surface - nests on rocky ledges and grassy tops of islands
hybrid Glaucous-winged Western Gull	_____	same as above
Common Murre	*Uria aalge*	Surface - high rocky ledges and non-vegetated flat top areas. Does not build nest
Pigeon Guillemot	*Cepphus columba*	Burrows, crevices, and among driftwood - rocky ledges or cliff burrows
Ancient Murrelet	*Synthliboramphus antiquus*	Burrows - tunnels or natural cavities
Cassin's Auklet	*Ptychoramphus aleutica*	Burrow - tunnels or natural cavities, generally with over opening vegetation or structure
Rhinoceros Auklet	*Cerorhinca monocerata*	Burrows- in steep hillsides and cliffs
Tufted Puffin	*Fratercula cirrhata*	Burrows - tunnels in steep grassy hillsides, cliffs, and sometimes in natural cavities

Source: Harrison 1979; WDFW 2000

have been reported (Speich and Wahl 1989). Speich and Wahl (1989) speculate that more nest locations are probable in the region. The largest colony is on Jagged Island, but they are also found on Carroll Island, Petrel Rock, Alexander Island, Kohcaa(uh) Island, Cake Island, and Round Island (Speich and Wahl 1989). Population estimates for Washington State are 50,000 or more (Speich and Wahl 1989). Storm-petrels forage on microorganisms at the sea surface and often only return to land during the breeding season (Huntington et al. 1996). Leach's storm-petrel is known to be impacted by a variety of pollutants, but most significantly by introduced predators (Huntington et al. 1996).

On the outer coast, double-crested cormorants (*Phalacrocorax auritus*) nest on islands, sea stacks, and mainlands. The birds nest as single pairs, or in colonies of a few to several hundred pairs, and often share colonies with pelagic cormorants. This species builds conspicuous stick nests on the tops of relatively flat islands, on broad, wide cliff benches, and in trees. The only tree-nesting colony on the Olympic Coast is on Tunnel Island. Other favorite nesting islands are Willoughby Rock, Split Rock, Little Hogsback, Hoh Head, Jagged Island, Point of the Arches, and White Rock. Double-crested cormorants frequently change their colony locations, so their year-to-year occurrence is unpredictable. Brood sizes range from 1 to 8 young, with the majority of pairs producing two or three chicks. Small young can be seen from early June, and fledging occurs until late September. Birds are present on the rocks and islands year round. El Niño events reduce the number of breeding pairs as well as reproductive success according to their severity. During unfavorable years, double-crested cormorants suffer almost total breeding failures with very few pairs attempting to breed. The Washington outer coast breeding population has varied between 47 and 805 pairs in the last decade, with about one fourth of the population frequently breeding off-refuge on mainland headlands. Since 1978, the population has slightly increased, although numbers have declined since 1995 due to a string of El Niño years. While oil spills and fish nets certainly are a threat to the species, double-crested cormorants are also prone to suffer from human and bald eagle disturbances. The Service has aerially surveyed the total number of breeding pairs annually since 1979 (pers. obs. U.W. Wilson).

In Washington, Brandt's cormorants (*Phalacrocorax penicillatus*) currently breed only on the outer coast where the species is the least abundant of the cormorants. The birds nest only on bare rock portions of islands and sea stacks, where broad ledges, rocky slopes, and ridges—frequently close to the water—are the preferred habitat. Nests are not found on precipitous cliff ledges. The nests are almost completely constructed of seaweed and surf grass. Brandt's cormorant colonies seem to attract small numbers of murres. The outer coast population is centered in Copalis NWR where the birds use Willoughby Rock, Split Rock, Destruction Island, and Middle Rock, frequently. Farther north, Carroll and Jagged Islands sometimes support a few breeding pairs. As with other cormorants, colony shifts occur frequently. Brood sizes range from one to six young, with most of the successful breeders raising two or three chicks. Small young can be seen as early as mid June, and fledging occurs as late as mid October. Birds are present on the rocks and islands year round. El Niño events reduce the number of breeding pairs as well as reproductive success according to their severity. During unfavorable years, Brandt's

cormorants suffer almost total breeding failures with very few pairs attempting to breed. The Washington outer coast population has varied between 46 and 578 breeding pairs in the last decade, but has declined since 1995 due to a string of El Niño years. While oil spills and fish nets certainly are a threat to the species, Brandt's cormorants are very sensitive to human disturbance and often also suffer from bald eagle (*Haliaeetus leucocephalus*) harassment and predation. The Service has aerially surveyed the total number of breeding pairs annually since 1979 (Wilson 1991; pers. obs., U.W. Wilson).

The pelagic cormorant (*Phalacrocorax pelagicus*) is the most abundant and widespread of the cormorants on the outer coast. Colonies are located on island cliffs, sea stacks, and the mainland. Nests of seaweed, grasses, feathers, and a variety of flotsam are built on cliff ledges, and inside cliff and sea caves. The nests are constructed more compactly than double-crested cormorant nests, which are sometimes found with pelagic cormorants nesting on the wider ledges. The pelagic cormorant can be found on any island and mainland with suitable cliff habitat, and the total known breeding locations are too numerous to list here. The largest colonies are frequently on Willoughby Rock, Tunnel Island, Hoh Head, Teahwhit Head, Crying Lady Rock, Carroll Island, Jagged Island, Point of the Arches, and Cape Flattery. Cormorants frequently shift colony sites, so their year-to-year occurrence is unpredictable. Successful breeding pairs raise two to three young per season, with broods up to seven not unusual. The breeding chronology of the species is protracted, with small young as early as mid June and fledging as late as mid November. Birds are present on the rocks and islands year round. El Niño events reduce the number of breeding pairs as well as reproductive success according to their severity. During unfavorable years, pelagic cormorants suffer almost total breeding failures with very few pairs attempting to breed. The Washington outer coast population has varied between 834 and 2,248 breeding pairs in the last decade, with about one third of the population breeding off-refuge on mainland cliffs. Numbers have declined since 1995, due to a string of El Niño years. While oil spills and fish nets certainly are a threat to the species, pelagics are also prone to suffer from human and bald eagle disturbances. The Service has aerially surveyed the total number of breeding pairs annually since 1979 (pers. obs., U.W. Wilson).

The glaucous-winged gull (*Larus glaucescens*) is one of the most wide-ranging gulls in the Pacific, with their breeding range stretching along the west coast from the northern Oregon Coast across to Japan (Verbeek 1993). This gull species is the most widespread and abundant in Washington (Speich and Wahl 1989). The glaucous-winged gull hybridizes widely with the western gull (Verbeek 1993). The nesting habitat is variable from rocky islands to building tops in downtown Seattle (Speich and Wahl 1989). Speich and Wahl (1989) write that "some of the largest seabird colonies in Washington are those of the glaucous-winged gull," the largest of which are located on the islands of the Washington Islands NWRs. Prey items are as variable as their nesting habitat, but on the outer Washington coast the diet includes fish offal, marine invertebrates, and eggs of oystercatchers and alcids (Speich and Wahl 1989). Gull populations in general suffer fewer human-induced threats due to their wide array of prey items and ability to take advantage of human environments (Speich and Wahl 1989). Some human activities that

threaten other wildlife actually benefit gulls, such as offal disposal and open dumps (Verbeek 1993; Sherrod et al. 1976). Mainland human activities may benefit gull populations, whose ranges extend over off-shore islands. However, human disturbance of nesting gulls can cause egg or chick mortality directly, or by exposing them to other predators such as crows.

The western gull's (*Larus occidentalis*) range is the southern counterpart to the glaucous-winged gull, with the northern extent of its range just reaching Destruction Island in Quillayute Needles NWR and the southern edge ending in Baja California (Speich and Wahl 1989). The range of the hybrid of this species with the glaucous-winged gull parallels the western gull's distribution northward to Destruction Island (Hoffman et al. 1978). In Washington, the western gull and its glaucous-winged/western hybrid species, nest on rocky cliffs and islets, especially on islands and offshore rocks (Smith at al. 1997; Speich and Wahl 1989). The prey items of this gull overlap extensively with that of the glaucous-winged gull and include fish, offal, seabird eggs and young, garbage dumps, and invertebrates (Speich and Wahl 1989). The recent move by Washington State to cap dump sites may displace foraging gulls. The population threats and issues are the same as those of the glaucous-winged gull above.

In Washington, the common murre (*Uria aalge*) breeds only on the outer coast. Within the three Refuges, the major colonies are Point Grenville, Split Rock, Willoughby Island, Quillayute Needles, Carroll Island, and Jagged Island. The majority of refuge colonies are located on the tops of partially vegetated or bare rock sea stacks and flat-topped islands. Only a small portion of refuge murres use cliffs. Generally, the birds arrive in April and may be on the colonies into September. A single egg is laid on bare rock or soil. Young leave the colonies at an age of 18 to 25 days and are cared for at sea by the male of the pair for several weeks. Although evidence of breeding exists, no detailed studies of breeding success have been conducted at refuge colonies, mainly due to their inaccessibility and difficulty in observing the tops of the islands and sea stacks where they occur. Prior to 1983, the refuge population was around 30,000 birds, with most of the birds using colonies in Copalis NWR. With the 1983 El Niño event, the population crashed to less than 3,000 birds. While some of the colonies in Quillayute Needles NWR eventually recovered, some even exceeding pre-1983 levels, the large southern colonies, comprising most of the pre-1983 Washington population, remain almost deserted to this date. As a result, the refuge murre population during favorable years is now only about one third of pre-1983 levels and is centered at the Quillayute Needles and Carroll Island colonies compared to colonies in Copalis NWR prior to 1983. El Niño events are a major factor determining murre colony attendance on outer coast refuge islands. Colonies are deserted during severe El Niños and one or two years thereafter. Even moderate El Niños depress numbers significantly. In addition to these natural factors, Washington murres have also been severely impacted by: U.S. Navy practice bombing activities at Sea Lion Rock in Copalis NWR; several large oil spills; and by entanglement and drowning in fish nets. In what combination these factors were responsible for causing the Washington murre decline, is unknown. This species has been annually surveyed by refuge personnel using aerial photography since 1979, with multiple surveys each year since 1995 (Wilson 1991; pers. obs. U.W. Wilson).

The pigeon guillemot (*Cepphus columba*) is a small alcid that ranges from southern California north across the North Pacific Rim (Speich and Wahl 1989). The foraging habitat for this species is the shallow reach of the nearshore zone, where they hunt for forage fish (Speich and Wahl 1989). Nesting habitat is variable, incorporating rock crevices, talus, boulder beaches, burrows in dirt cliffs, and artificial burrow sites such as pipe and wharf structures (Speich and Wahl 1989). Nesting occurs on most of Washington's marine coastline and is considered to be one of the most widespread seabirds in the State (Smith et al. 1997; Speich and Wahl 1989). Though population estimates are difficult for this species due to the fact that they nest in scattered small groups, published statewide population numbers are around 6,000 birds, and refuge population estimates are around 500 birds (Speich and Wahl 1989). Disturbance is not as great a threat to this seabird population due to their widespread distribution as well as inaccessibility of nest sites and low nesting densities (Speich and Wahl 1989). They are locally vulnerable to oil spills, mammalian predators, and gill netting (Ewins 1993).

The ancient murrelet (*Synthliboramphus antiquus*) is a northern Pacific breeder whose range may dip into the Washington Islands NWRs. This seabird can be found foraging in offshore waters, generally over the continental shelf and occasionally close to shore (Gaston 1994). During the breeding season, this species makes its annual pilgrimage to terrestrial habitats, where it uses burrows for nest sites (Gaston 1994). Nests are natural and/or dug holes under tree roots, under vegetation, or in rocky crevices (Harrison 1979). Along Washington's outer coast, the presence of this species is well known for foraging, especially during winter months (Gaston 1994). Breeding evidence is limited to one documented nest in the 1920s (Hoffman 1924) and general breeding behavior observations made by refuge biologists, of small rafts of birds near Carroll and Jagged Islands. Regional population estimates and trends for this species are poor due to the lack and difficulty of research in the Pacific Northwest (Gaston 1994). Across its range, this species is suspected to be declining due to disturbances and introduced predators at nests (Gaston 1994). This species is also known to be vulnerable to oil spills and other water toxins (Gaston 1994).

The Cassin's auklet (*Ptychoramphus aleutica*) ranges from the western Aleutians to central Baja California. This burrow nester rears chicks in self-dug burrows, in rocky crevices, or under logs and trees (Manuwal and Thoresen 1993). The majority of nesting activity is performed at night. Diet consists of crustaceans, squid, and fish, which they gather beyond the continental shelf (Manuwal and Thoresen 1993). In Washington, this species is locally abundant on rocky islands along the outer coast, where they are the most abundant seabird in the State, other than gulls (Smith et al. 1997; Speich and Wahl 1989). The Washington Coast is believed to hold more than 50 percent of the west coast's breeding populations of Cassin's auklets in the contiguous U.S. (NOAA 1993). Population estimates for Washington are at least 88,000 birds with more thought to be present (Speich and Wahl 1989). The refuge area and west entrance of the Strait of Juan de Fuca are considered to be important winter areas for this species (Environment Canada 2000). Cassin's auklets are particularly vulnerable to disturbances, especially during the nesting season (Speich and Wahl 1989). Oil spills, introduced predators and mammals, pollution, and gill-net

entanglement have also been documented as threats to this species (Manuwal and Thoresen 1993).

The rhinoceros auklet (*Cerorhinca monocerata*) is actually a misnamed puffin. The species' morphology and breeding biology are very similar to those of the tufted puffin. The major difference between these two puffins is that the rhinoceros auklet is smaller and nocturnal (active at night) with respect to its activities on the colonies, while the tufted puffin is larger and diurnal (active during the day). Rhinoceros auklets arrive on their colonies after dark and depart around sunrise. The birds excavate burrows on islands with sufficient soil depth. In Washington, they prefer steep, grassy slopes and grassy areas on the tops of cliffs as well as salmonberry and willow covered areas on or near steep slopes where the birds can launch themselves into flight easily. Breeding pairs produce only one chick per year. The species' prolonged incubation period and slow chick growth rate are adaptations to patchy, unpredictable marine prey resources. Chicks are fed a diet primarily of fish. On Washington's outer coast, primary prey species include rockfish, Pacific sandlance, northern anchovy, herring, and smelt. Birds arrive on the colony as early as February, and the last breeding pairs and chicks leave the colony in mid September. In contrast to common murres and cormorants, rhinoceros auklets are less affected by El Niño events, with many pairs producing chicks. With an estimated 12,000 breeding pairs, Destruction Island hosts most of the outer coast breeding population and about half of the entire Washington population. Protection Island in the Strait of Juan de Fuca is the other large rhinoceros auklet colony in Washington. Together these two colonies comprise over 90 percent of the lower 48 states' population. Small numbers of breeding pairs are also thought to breed on Alexander and Carroll Islands on the outer coast. The current major threats to this species are oil spills and entanglement in fish nets. Refuge and State biologists have developed an extensive database on major breeding biology aspects of this species. The Destruction Island population needs to be estimated again in the near future (Wilson and Manuwal 1986; pers. obs. U.W. Wilson).

Tufted puffins (*Fratercula cirrhata*) are an icon for the Washington coast and one of the better-known seabirds among the general public. Their range extends from Japan around the northern Pacific Rim south to California (Speich and Wahl 1989). The Washington Coast contains one of the two major colonies, as well as more than 50 percent of the tufted puffins found in the contiguous U.S. (NOAA 1993). Washington State population estimates are 23,300 (Speich and Wahl 1989). The two largest colonies in Washington are on Jagged Rock and on Alexander Island, which are both within the Washington Islands NWRs boundaries (Speich and Wahl 1989). This species nests in sod burrows or rock crevices of islands (Burrell 1980). On Destruction Island, puffins have been documented to nest within 10 feet (3 m) of the "top of the steepest and least vegetated cliff faces" (Burrell 1980). The prey species for puffins include fish and marine invertebrates (Baird 1991). Gill-net fishery entrapments, coupled with ocean water temperature fluctuations, are suspected to have caused population declines (Smith et al. 1997). Other threats include oil spills and nest site disturbance (Tenyo Maru Oil Spill Natural Resources Trustees 2000; Speich and Wahl 1989). In a 1991 oil spill off Cape Flattery,

Washington, about 10 percent of the tufted puffins' statewide population was eliminated (Tenyo Maru Oil Spill Natural Resources Trustees 2000).

Though oceanic islands can be isolated sanctuaries for breeding seabird populations, where they can enjoy an absence of human induced changes to their populations, island bird populations are some of the most threatened in the world (Kress 1999). The threat is mostly due to the proximity of humans to the islands and their respective impacts to the island habitats and natural resources (Furness and Monaghan 1987; Kress 1999). Human threats, along the Washington Coast, to seabird populations include fisheries bycatch, oil pollution, boat disturbance, nest trampling, military operation disturbance, and prey decline (Speich and Wahl 1989; Wooster 1993). Because many of the breeding seabird populations breed on only a few of the islands, their populations are more at risk to impacts (Furness and Monaghan 1987).

Non-breeding Seabirds and Waterbirds

A large number of seabird species use the area around the Washington Islands NWRs during fall and spring migration and overwinter while breeding elsewhere (USFWS 1989). During migration periods, the total count for seabirds alone can exceed one million birds (Brueggeman 1992). Quality habitat for migrating birds in which to forage and rest during their difficult, long distance passages has been shown to be extremely important to the health of migratory avian populations (Moore et al. 1995). Some waterbird species such as the western grebe (*Aechmorphorus occidentalis*), use the waters around the Refuges for wintering habitat (Speich et al. 1987).

Documented, non-breeding seabird and waterbird presence in the area includes, the red-throated loon (*Gavia stellata*), Pacific loon (*G. pacifica*), common loon (*G. immer*), western grebe, brown pelican (*Pelecanus occidentalis*), sooty shearwater (*Puffinus griseus*), white winged scoter (*Melanitta fusca*), surf scoter (*M. perspicillata*), black scoter (*M. nigra*), Caspian tern (*Sterna caspia*), common tern (*S. hirundo*), parasitic jaeger (*Stercorarius parasiticus*), Heermann's gull (*Larus heermanni*), and California gull (*Larus californicus*) (Speich et al. 1987). Loon species use the waters surrounding the Refuges for migration period foraging and resting (Speich et al. 1987). Western grebes use the waters surrounding the Refuges for both post-breeding dispersal and over-wintering habitat (Speich et al. 1987).

Brown pelicans do not breed in Washington. Birds from California and Mexico arrive up at Willapa Bay, Grays Harbor, and the outer coast of the Olympic Peninsula in June. Pelican numbers peak in September, when several thousand individuals may be present on the Washington coast. By early November, most of these pelicans have migrated back south. In Washington, the highest numbers are usually encountered during El Niño years when food becomes scarce around their breeding colonies in the south and many birds fail to breed. During such years, a few individuals may even move into the Strait of Juan de Fuca. Islands and sea stacks of the outer coast refuges are used by the birds for roosting. Sand bars at the mouths of rivers and creeks are also favorite places for pelicans. During most years, numbers are highest in

Copalis NWR as pelican numbers decline farther north. The most favored sites in Copalis NWR are Grenville Arch, Willoughby Rock, and Split Rock. It is common to see several hundred birds roosting on any one of these rocks. Farther north, the Quillayute Needles and Carroll Island are favorite roosts. The primary disturbance to roosting birds is low-flying aircraft. The Service has aerially surveyed pelicans in recent years when funds for flights were available (pers. obs. U.W. Wilson).

Of the five shearwater species seen off the Washington coast, the sooty shearwater is the most abundant (Speich et al. 1987). Sooty shearwaters can be seen in Washington waters year round but are more abundant in the summer when numbers can reach hundreds of thousands. Scoter species are also seen year round, but fewer are observed in spring and summer when they are breeding in Canada and Alaska (Speich et al. 1987). Scoters often forage close to the rocks and islands of the Washington Islands NWRs (Speich et al. 1987). Common and Caspian terns utilize the Washington Islands NWRs area for post breeding dispersal and migration (Brueggeman 1992; Wahl 1975). Both of the non-breeding gull species, the Heermann's and California gulls, are southern or interior breeders that use the Washington coast during post-breeding periods (Speich et al. 1987). The parasitic jaeger is common over the continental shelf from April through November in Washington (Wahl 1975).

Shorebirds

Shorebirds observed utilizing the refuge rocks and islands include black-bellied plover (*Pluvialis squatarola*), semipalmated plover (*Chardadrius semipalmatus*), surfbird (*Aphriza virgata*), black oystercatcher (*Haematopus bachmani*), wandering tattler (*Heteroscelus incanus*), whimbrel (*Numenius phaeopus*), ruddy turnstone (*Arenaria interpres*), black turnstone (*Arenaria melanocephala*), sanderling (*Calidris alba*), least sandpiper (*Calidris minutilla*), western sandpiper (*Calidris mauri*), and rock sandpiper (*Calidris ptilocnemis*) (Paulson 1993; Speich et al. 1987). These shorebird species forage on invertebrates in rocky and sandy tidal and splash zones. In addition to using tidal areas for foraging, shorebirds are known to use the upland island habitats for roosting and protection during storm events.

The black oystercatcher inhabits the rocky shorelines of the west coast of North America (Speich and Wahl 1989). Breeding habitat is composed of offshore rocks, islands, and sometimes rocky coastal beaches (Speich and Wahl 1989). This shorebird species forages in the intertidal zone, where they primarily take mussels, limpets, and chitons (Speich and Wahl 1989). Oystercatchers do not nest in colonies, and nest sites incorporate large feeding territories that are defended from other individuals. Thus, this species is fairly evenly distributed among the available nesting habitat within the Washington Islands NWRs (Speich and Wahl 1989). The breeding estimate for this species for the State is around 400 (Speich and Wahl 1989). Washington population trend estimates over the past 25 years have shown that this species is remaining stable or declining slightly (Nysewander 2000). The uncertainty regarding their population status in the State is due to the estimated dispersal of birds among breeding areas (Nysewander 2000). This species is particularly vulnerable to nest site disturbance, oil spills, and intertidal zone habitat degradation (Drut and Buchanan 2000; Nysewander 2000). The black oystercatcher has been

identified nationally and regionally as a species of high concern by the U.S. Shorebird Conservation Plan (Brown et al. 2000) and the Northern Pacific Coast Regional Shorebird Management Plan (Drut and Buchanan 2000). It is also on the Federal list of Birds of Conservation Concern 2002 (USFWS 2002).

The Service, in cooperation with other Federal and State agencies, NGOs and private individuals, recently developed a Northern Pacific Coast Regional Shorebird Management Plan, due to concerns over declining shorebird populations and loss of habitat, especially during migration (Drut and Buchanan 2000). As throughout the Pacific Coast, shorebird migration sites in the northwest will become increasing concentrated and important as habitat degradation continues. Rocky shorelines are identified as a key habitat type utilized by migrating shorebirds (Drut and Buchanan 2000). Migration monitoring and habitat utilization studies are called for in the management plan as important steps needed to promote restoration and conservation of shorebird species (Drut and Buchanan 2000).

Landbirds

In addition to seabirds, a handful of landbirds breed on the Refuges' islands and rocks. These species are generally found on the larger, more vegetated islands. These landbirds, such as raptors, songbirds, and shorebirds, utilize the islands for foraging or nesting. Raptor species that nest along Washington's outer coast and use the islands for foraging include the osprey (*Pandion haliaetus*), bald eagle (*Haliaeetus leucocephalus*), rough-legged hawk (*Buteo lagopus*), and peregrine falcon (*Falco peregrinus*) (Speich et al. 1987). Passerines (i.e., songbirds) documented to occur on upland habitats of the Washington Islands NWRs include northern rough-winged swallow (*Stelgidopteryx serripennis*), barn swallow (*Hirundo rustica*), northwestern crow (*Corvus caurinus*), common raven (*Corvus corax)*, European starling (*Sturnus vulgaris*), savannah sparrow (*Passerculus sandwichensis*), fox sparrow (*Passerella iliaca*), song sparrow (*Melospiza melodia*), American goldfinch (*Carduelis tristis*), winter wren (*Troglodytes troglodytes*), and barn swallow (*Riparia riparia*) (Speich et al. 1987; USFWS 1985). Great blue heron (*Ardea herodias*), a disturbance sensitive species, was known to breed on some of the larger islands, and a few common mergansers (*Mergus merganser*) were observed on refuge islands (Speich et al. 1987). Brant (*B. bernicla*) and Canada geese (*Branta canadensis*) are also known to use the refuge waters during migration periods (Speich et al. 1987).

Due to the limited access to refuge islands, not much is known about most landbird breeders on the islands. Information from the few existing studies or inventories is presented below. Of the raptor species, information is available for bald eagles and peregrine falcons. Bald eagles are common in saltwater areas in Washington, especially along Puget Sound, the San Juan Islands, and the Olympic Peninsula coastline (Smith et al. 1997). The Copalis Beach area holds an especially high concentration of eagles (Smith et al. 1997). The Service and the WDFW have documented approximately 40 breeding territories along the Olympic Outer Coast (USFWS 1992). They are also known to nest on at least five islands within the refuge boundaries (WDFW

2000c). Bald eagle management areas established by the WDFW encompass many refuge islands (WDFW 2000c). Forage species for the bald eagle include fish, seabirds, small mammals, and carrion (Anderson et al. 1986). Bald eagles feed on seabirds, especially during the seabird nesting season (Speich et al. 1987). On refuge islands, they are often observed attacking common murres, gulls, puffins, and cormorants (Speich et al. 1987). Common murres are the most commonly taken seabird species by Olympic Peninsula eagles (Knight et al. 1990). Seabirds are a significant and historical prey for eagles on the Washington Coast (Speich et al. 1987).

In Washington, one of the major nesting areas for the peregrine falcon is the outer coast. The birds nest on ledges and grassy benches associated with many island and mainland cliffs. Breeding territories are generally in the vicinity of colonies of the smaller seabirds, which are their main prey during the breeding season. On the Washington Coast, successful breeding pairs produce between one and four young, with breeding success being lower during severe El Niño and post El Niño years. The peregrine breeding season is protracted, and it is not uncommon to have newly hatched young at some of the eyries while young of other pairs have already fledged. Fledging occurs as early as June 2nd and as late as July 20th. After fledging, the young remain in the general area of their parent's territory for several weeks. Many of the territories are occupied year round. This marine peregrine population has undergone a significant population increase. In 1980, only three territories were known. Currently, there are at least 25 territories, with about two thirds of the nests on refuge islands. During this same time period, there has also been a significant increase in the birds' breeding success, approaching that of a reproductively healthy, stable population at Langara Island, British Columbia. These increases are thought to be due to the discontinued use of DDT and the resulting reduction in DDE levels (a metabolite of DDT) in the peregrine's prey. Because of widespread increases in peregrines in many areas in North America, the peregrine falcon was taken off the Federal Endangered Species List in 1999. The Service is currently committed to closely monitoring the species for another five years. On the Washington coast, as in many other areas, peregrine populations are currently still increasing and have not reached their carrying capacity. Because the current and historical carrying capacity of the Washington coast is unknown, to what degree the species has recovered in this area, is also unknown. The major threat to Washington peregrines is contact with prey that has been exposed to environmental contaminants. This population has been intensively monitored by refuge and State biologists since 1980 (Wilson et al. 2000; pers. obs. U.W. Wilson).

Passerines use the islands for both breeding, and—along with shorebird species—for migration resting areas. There is much concern over the conservation of migratory birds (Terborgh 1989). Quality habitat for migrating birds for foraging and resting during their difficult long distance passages has been shown to be extremely important to the health of migratory avian populations (Moore et al. 1995).

Non Avian Terrestrial Fauna

There are a few terrestrial fauna that can be found on the larger, vegetated islands such as Destruction, Ozette, Bodelteh, Alexander, and Carroll Islands (Aubry and West 1984). These

include European rabbits (*Oryctolagus cuniculus*), river otter (*Lutra canadensis*), Townsend's vole (*Microtus townsendi*), Destruction Island shrew (*Sorex trowbridgii destructioni*), shrew-mole (*Neurotrichus gibbsi*), northwestern garter snake (*Thamnophis ordinoides*), and salamanders (Family: Plethodontidae) (Aubry and West 1984; Johnson and Cassidy 1997; Speich and Pitman 1984). Except for the rabbits and river otter, the terrestrial fauna is not well documented on the islands, and population estimates are unknown for all species.

The Destruction Island shrew was discovered in 1942 by Scheffer and Dalquest (1942). This species lives in grasses found on the island. The shrew breeds in late April or early May and averages four young per litter (Dalquest 1941). This species eats mainly insects (Dalquest 1941). In the 1942 study, researchers found relatively high densities of the shrew; however, 1983 research resulted in few shrews observed (Aubry and West 1984). The decrease in shrew abundance is blamed on habitat loss resulting from European rabbit grazing (Aubry and West 1984). This shrew is listed as a Federal Species of Concern, which are species whose conservation standing is of concern to the Service, but status information is still needed. With only two studies existing on this species, there is a serious lack of data. More research is needed to determine the population status and outlook for this endemic small mammal.

European rabbits were introduced to Destruction Island in 1970 and have been successful in colonizing the island's grassy habitats (Aubry and West 1984). The rabbits have been documented to be degrading native small mammal habitat on the island, especially impacting native shrew and shrew-mole populations (USFWS 1990; Aubry and West 1984). It is unclear what effect rabbits have on seabird populations. Past research from other seabird nesting islands where rabbits have been introduced has shown mixed results (Aubry and West 1984; Rodway et al. 1990; Tomich et al. 1968; Warner 1963). The Service has stated, that based on Aubry and West's 1984 research the rabbit is considered a "serious pest species" worthy of control on the Refuges, and has conducted a variety of control measures with no success (USFWS 1983; USFWS 1992).

River otters are commonly associated with freshwater habitat but do have limited use of marine environments (NOAA 1993). They have been documented on Destruction Island and are considered to be widespread (Aubry and West 1984; Speich and Pitman 1984). River otters are known to forage on seabird eggs and chicks (Speich and Wahl 1989).

3.4.3 Species with Special Status

There are 13 species and habitats with special status which are known to occur on the Washington Islands NWRs (Table 3-2). Special status species include Federal- and/or State-listed endangered, threatened, candidate, and sensitive species, as well as State priority species. Biological inventories, focusing on birds and marine mammals, have been conducted annually by refuge staff as species are listed and funding allows. Other data have been gathered by a variety of sources including the WDFW, university researchers, and U.S. Navy personnel.

Table 3-2. Special Status Species and Habitats That Have Been Documented on the Washington Islands NWRs.

Species/ Habitat Name	Federal Status[1]	Washington State Status[2]
BIRDS		
Brown Pelican	Endangered	Endangered
Marbled Murrelet	Threatened	Threatened
Bald Eagle	Threatened	Threatened
Peregrine Falcon	none	Sensitive
Cassin's Auklet	none	Candidate
Brandt's Cormorant	none	Candidate
Common Murre	none	Candidate
Tufted Puffin	none	Candidate
MAMMALS		
Sea Otter	none	Endangered
Steller Sea Lion	Threatened	Threatened
PLANTS		
Scurvygrass	none	Sensitive
HABITATS		
Cliffs	none	Priority
Marine Shoreline	none	Priority

Sources: WDFW 2000, USFWS 2001b

[1] Federal Status- Endangered and Threatened species are protected by the Endangered Species Act. Endangered status is given to those animal or plant species in danger of extinction within the foreseeable future throughout all or a significant portion of its range. Threatened status is given to those animal or plant species likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

[2] State Status -The State maintains a Threatened and Endangered species protection program, given authority under WAC. Endangered status is given to any wildlife species native to the State that is seriously threatened with extinction throughout all or a significant portion of its range within the State. Threatened status is given to any wildlife species native to the State that is likely to become an endangered species within the foreseeable future throughout a significant portion of its range within the State without cooperative management or removal of threats.

Federally Protected Species

The Endangered Species Act of 1973 allows for protection of animals or plants from adverse effects on species populations. The purpose of the Act is to "conserve the ecosystems upon which endangered and threatened species depend and to conserve and recover listed species" (USFWS 2001a).

The highest level of protection given is endangered, which are species deemed to be "in danger of extinction throughout all or a significant portion of its [their] range" (ESA 1973 Section 3-6). Species listed as endangered that are found in the area of the Washington Islands NWRs are the brown pelican and a number of whale species.

Though population estimates have been showing an increase from the 1970s, the brown pelican is nonetheless considered highly imperiled in Washington, as shown by its Federal and State endangered species listing (Brueggeman 1992). The pelican, however, limits its use of the Washington Islands NWRs to post breeding foraging in the waters surrounding the islands and rocks, as well as resting on the islands and rocks. This species was listed in 1970 due to pesticide poisoning and other threats such as human disturbances at breeding colonies, fisheries-related entanglement, oil and other toxic spills, and prey availability (USFWS 1995). Human disturbances at roost sites, as represented by the Washington Islands, may affect distribution patterns and age structure of pelicans using sites during the non-breeding season (Jaques and Anderson 1987 as cited in TNC 1995). Disturbance distances are variable in the literature for this species and range from 100 to 600 meters of a roost site (Jaques and Anderson 1987 as cited in TNC 1995; Collazo and Klaas 1985; Schreiber 1979 as cited in TNC 1995). The Nature Conservancy (TNC) reports that "In some cases (e.g., U.S. Caribbean, California), high levels of human disturbance are tolerated because there is vertical separation between birds (e.g., roosting/nesting on a cliff) and the source of disturbance" (TNC 1995). It is suggested that management efforts should be made to avoid human access to roost sites (Jaques and Anderson 1987 as cited in TNC 1995).

A number of whale species observed in the waters surrounding the Washington Islands NWRs are listed as Federal and State endangered species. These whale species include the Sei whale (*Balaenoptera borealis*), fin whale (*B. physalis*), blue whale, (*B. musculus*), humpback whale (*Megaptera novaeangliae*), northern right whale (*Eubalaena glacialis*), and sperm whale (*Physetes catodon*). The killer whale (*Orcinus orca*) is considered a federally depleted species under the MMPA as well as a State endangered species. None of these whale species are considered common users of the outer coastal waters.

Federally threatened species are those plants and animals that are expected to become endangered in the near future in "all or a significant portion of its [their] range" (Endangered Species Act 1973, as amended, Sec 3-19). Threatened species documented on the Washington Islands NWRs are the marbled murrelet, bald eagle, and Steller sea lion.

The marbled murrelet was listed as a State and Federal threatened species in 1992, due to concerns over nesting habitat and success (USFWS 1997). The marbled murrelet nests inland but forages along the Washington coast and can be observed in the area of the Washington Islands NWRs year round (Brueggeman 1992; Wahl 1975). These near shore marine waters within 1.2 miles (2 km) are considered essential to the recovery of the species (USFWS 1997). Critical marine foraging habitat includes "proximity of old-growth forests, distribution of rocky

shoreline/substrate versus sandy shoreline/substrate, and abundance of kelp" (Thompson 1996 as cited in USFWS 1997). Critical resources include fish and invertebrate species, especially Pacific sand lance, Pacific herring, northern anchovy, smelts, and perhaps sardines (USFWS 1997). The current status of this species is unclear due to the difficulty in census techniques (pers. comm., J. Marzluff). Threats identified in the Marbled Murrelet Recovery Plan, include oil spills, prey availability, and gillnet entrapment (USFWS 1997). Management actions applicable to the Refuges include the following: implementing marine-based population monitoring; developing response and restoration plans for oil spills and other catastrophes; and promoting activities that reduce fishery-related entanglements (USFWS 1997).

The bald eagle is a Federal and State threatened species. The Service is considering delisting this species, which would remove it from protection under the Endangered Species Act. This species is currently monitored annually by the WDFW, though monitoring is likely to taper off within five years after delisting. The State's management recommendations for this species include: creating nest site buffers of around 1,000 feet (300 m); creating roost site buffers of 1,000 to 3,000 feet (300-900 m), depending on visibility; and protecting foraging areas (Rodrick and Milner 1991).

The Steller sea lion is a Federal and State threatened species that was listed in 1990 due to concerns over Alaskan breeding grounds (NOAA 1993). This species directly uses the refuge islands and rocks. There are no available trends for this species in Washington (NMFS 1992). The Steller Sea Lion Recovery Plan calls for protection of habitat and prey species from human disturbance (NMFS 1992).

The Fish and Wildlife Conservation Act of 1980, requires the Service to identify "all migratory nongame birds that, without additional conservation action, are likely to become candidates for listing under the Endangered Species Act of 1973." Additionally, the Act further underscores the need to develop actions to ensure the conservation of these species with the underlying philosophy that "an ounce of prevention is worth a pound of cure." The Birds of Conservation Concern list was developed under the authority of this Act. Washington Islands NWRs are located in Bird Conservation Region (BCR) 5, the North Pacific BCR. Species using refuge islands that are on the 2002 Birds of Conservation Concern list, with high national and regional importance, include: black oystercatcher, black turnstone, ruddy turnstone, red knot (*Calidris canutus*), dunlin (*C. alpine*), sanderling, surfbird, whimbrel, black-bellied plover, common snipe (*Gallinago delicate*), greater yellowlegs (*Tringa melanoleuca*), killdeer (*Charadrius vociferus*), rock sandpiper, short-billed dowicher (*Limnodromus griseus*), wanderling tattler (*Heteroscelus incanus*), and western sandpiper (USFWS 2002).

State Protected Species

Washington's species of concern include native flora and fauna legally designated as endangered, threatened, or sensitive under the Washington State Administrative Code's Permanent Regulations of the WDFW (WAC 232-12-297). Candidate species are those species that will be reviewed for future listing as endangered, threatened, and sensitive.

State endangered species are those native plants and animals that are seriously threatened with extinction. The only State endangered species documented in the Washington Islands NWRs is the sea otter. The killer whale is a State endangered species found in the waters surrounding the refuge islands.

The sea otter, listed in 1981, is a State endangered species whose range is limited to the coastline region of the Refuges. Since reintroduction of sea otters in Washington, the population has been increasing toward recovery, with recovery goals specified in the sea otter recovery plan (Lance et. al. 2004). The recovery plan calls for cooperative sea otter monitoring along the outer coast; preparation for oil spill recovery efforts; cooperative documentation of sea otter fisheries-related entrapment; prevention of oil spills; cooperative efforts to minimize take of sea otters; cooperative development of sea otter educational programs; cooperative development of ecotourism regulations to minimize disturbances; promotion of research that enhances recovery efforts for otters; and preparation for direct intervention management (Lance et al. 2004).

State threatened species are those likely to become endangered in Washington within the near future, if factors contributing to population decline or habitat degradation or loss, continue. State threatened species documented on the Washington Islands NWRs are the marbled murrelet, bald eagle, and Steller sea lion. Because they are also federally listed as threatened, they are covered under the previous section.

State sensitive species are those that are considered to be declining and will likely become endangered or threatened without protection. State sensitive species are deemed to need active management to prevent them from becoming threatened or endangered. There are two documented species with this protection level known to occur on the Washington Islands NWRs, the peregrine falcon and scurvygrass (*Cochlearia officinalis*). The peregrine falcon was removed from the Federal endangered species list in August 1999; however, it remains at the sensitive level for the State (http:wdfw.wa.gov/wlm/diversity/soc/endanger.htm). Management recommendations from WDFW include protection of nest sites from human disturbance through the establishment of breeding season buffer zones of about 0.5 mile (0.8 km) (including a 1,500-foot [457 m] aircraft buffer) (Hays and Milner 1999). Scurvygrass is known to occur on Jagged Island within the Quillayute Needles NWR (WDNR 2000a).

State candidate species are those species that will be reviewed for listing as endangered, threatened, or sensitive. Four seabird species, the Cassin's auklet, Brandt's cormorant, common murre, and tufted puffin, are all State candidate species documented on the Washington Islands NWRs. There are currently no management plans for these species. Threats that need to be assessed and managed include, breeding disturbance, prey availability, and pollution.

State Priority Habitats

Two habitat types that have been identified by WDFW as priority habitats occur on the Washington Islands NWRs. These are the marine shoreline and cliffs. "Priority habitats are

those habitat types or elements with unique or significant value to a diverse assemblage of species" (WDFW 2005). The refuge cliffs and marine shoreline provide important seabird and raptor breeding sites and haulout areas for wildlife. "Shorelines include the intertidal and subtidal zones of beaches, and may also include the backshore and adjacent components of the terrestrial landscape (e.g., cliffs, snags, mature trees, dunes, meadows) that are important to the shoreline associated fish and wildlife and that contribute to shoreline function (e.g., sand/rock/log recruitment, nutrient contribution, erosion control)" (WDFW 2005).

3.5 Cultural Resources

While the Pacific Coast of Washington was heavily utilized by Native American groups, investigation of the region's archaeological record has not been extensive. More than 100 archaeological sites have been recorded in the region, yet only 15 have been studied to any extent (Wessen 1990). Most archaeological sites examined are relatively recent, usually containing evidence of occupation within the last 1,500 years. Many contain historic deposits as well.

While it is difficult to determine what percentage of the project area has been systematically surveyed for cultural resources, the figure is certainly small. Those offshore sites that have been recorded are located on the more accessible larger islands. Five recorded cultural resources are located on or near the physical limits of the Washington Islands NWRs. These offshore sites include: 45CA28 on Tskawahyah Island, part of the Ozette Village site; 45CA203/207 on Tatoosh Island; 45CA229, a lighthouse on Tatoosh Island operated by the USCG; and 45JF78, the Destruction Island lighthouse. In addition, a prehistoric midden site has been noted but not recorded on Destruction Island. Ozette Island and the Bodelteh Islands are considered part of the Ozette site (45CA24).

3.5.1 Ethnographic Information

The Wakashan-speaking Makah are the northernmost occupants, situated in the area around Cape Flattery at the tip of the Olympic Peninsula. Five Makah villages, linked by language, kinship and common traditions, existed in precontact times (Reneker and Gunther 1990).

Prehistorically and historically, Makah culture depended on the ocean where they obtained their predominantly marine diet, which included sea mammals (whales, porpoises, sea lions, northern fur seals, harbor seals, and others), fish (halibut, salmon, lingcod, rockfish, and others), intertidal foods (crabs, clams, mussels, barnacles, limpets and others) and birds (pelicans, loons, cormorants, ducks, grebes, and others) (Swan 1870, Reneker and Gunther 1990). Land mammals such as elk, deer, and bear were occasionally eaten and provided additional raw materials such as bone, antlers, and hide (Swan 1870; Reneker and Gunther 1990). Plant foods

included, among others, several kinds of seaweed, sand verbena, surf grass, fern roots, buttercup, and a variety of berries (Swan 1870, Reneker and Gunther 1990).

Similarly, the Chemakuan-speaking Quileute and Hoh subsisted primarily on fishing and hunting of marine mammals (Wesson 1990). While upland hunting of large and small game and birds supplemented the diet, and some families maintained upriver settlements, salmon from the rivers and ocean resources were considered the most important dietary staples. Archaeological investigation in the middens at La Push recovered more than 50 species of shellfish (Reagan 1917). The Quileute were situated at the mouth of the Quillayute River on the Pacific Coast, while the Hoh focused their subsistence activities around the Hoh River watershed.

Quinault refers both to the speakers of Quinault, one of four related Southwestern Coast Salishan languages (the others being Lower Chehalis, Upper Chehalis, and Cowlitz), and also to one particular group of Quinault speakers (the other Quinault speakers were the Queets and the Copalis) (Hajda 1990). Ethnographically, Quinault speakers occupied the Pacific Coast between the north shore of Grays Harbor and to a point between the Hoh and Queets Rivers. The Quinault River, Queets River, and Copalis River watersheds each served as the focus of subsistence activities for its namesake group, where salmon and other fish were the dietary staple. Ocean resources such as halibut, cod, surf smelt, and herring were also taken in large quantities (Hajda 1990).

The ocean and its marine resources are still a vital part of the culture, economy, and subsistence for these four Tribes. While the proportions and types of marine resources utilized vary somewhat by Tribe, all of the Tribes exercise their treaty rights to fish in their usual and accustomed areas along the Olympic Coast.

3.5.2 Archaeology

In addition to ethnographic sources, archaeological sites provide information about coastal cultures. Archaeological sites along the coast fall into two basic categories: “wet” sites occur when archaeological deposits occur in sediments that are consistently wet and exposed to limited oxygen; and “dry” deposits are subject to alternate wetting and drying and have moderate oxygen exposure (Wessen 1990). Organic materials perish under the dry conditions but survive quite well when wet. While most sites in the region are considered dry, it is the wet sites that have proved the richest source of information regarding Washington Coast’s prehistoric cultures.

Dry sites are characterized primarily by shell middens (numerous inland lithic scatters have also been documented). The majority of dry sites identified in the northern coastal region are late prehistoric shell midden deposits, similar to each other and to other Northwest Coast shell middens (Wessen 1990). They are primarily found on the first beach terraces above the ocean. One example of this type of site is at Sand Point (45CA201), where radiocarbon dates occupation to ca. 320 BC to AD 350 (Wessen 1984). This site is unique in that it includes an

assemblage of chipped stone in addition to the food refuse (shells) and ash layers that typically comprise a shell midden deposit.

Of the sites with "wet" components identified on the Washington coast, by far the best documented are the Hoko River site (45CA213, outside the study area) and the Ozette Village site (45CA24). Enormous quantities of wood and plant fiber artifacts were recovered from these sites, shedding light on such cultural issues as fishing and sea mammal hunting technologies, woodworking technologies, house construction, and food procurement and processing procedures (Croes and Blinman 1980).

A number of the sites along the coast are petroglyphs, many of them on beach boulders. More than 43 were recorded at the Wedding Rocks site (45CA31) south of Ozette (Ellison 1977). The possible relationship between these onshore archaeological features and offshore rocks and islands merits further investigation.

Portions of both the Flattery Rocks and Quillayute Needles NWRs are included within the Olympic National Park Archaeological District (45DT36A), a rectangular strip of land and water stretching from south of Cape Alava to Toleak Point. While a nomination form for the district was prepared in 1973, it has never been listed on the National Register of Historic Places (NRHP) (pers. comm., Conca, Archaeologist, Olympic National Park, January 2001).

The Ozette Village site is listed on the NRHP as an historic property. The Makah Tribe has nominated the site to National Landmark status (pers. comm., Bowechop, Tribal Historic Preservation Officer, Makah Tribe, January 2001). Such a listing would include Ozette Island, Tskawahyah (or Cannonball/Indian) Island, and the Bodelteh Islands which are within the physical limits of the Flattery Rocks NWR and its wilderness designation.

Based on the ethnographic and archaeological information available, there exists the potential for the presence of additional prehistoric and historic archaeological sites and traditional cultural properties (TCPs) associated with offshore islands and rocks. The characteristics of the offshore topography–both the small size of many features and the dearth of flat surfaces–may limit the presence of tangible archaeological remains, though such restrictions do not affect the potential for TCPs.

3.5.3 History

In the winter of 1854-1855 Washington Territory Governor Isaac I. Stevens began a series of treaty negotiations among the Tribes and Bands of western Washington (Marino 1990). The focus of these treaties was large-scale relocation of Tribes to reservations. The Makah (including the Ozette), Quileute, Hoh, and Quinault (Queets, Quinault, and Copalis) were all signatories of treaties which resulted in the establishment of reservations. Today, each of these reservations has a border along the Pacific Ocean adjacent to one or more of the Washington Islands NWRs. The Makah signed the Treaty of Neah Bay in 1855. This land centered around

Neah Bay in the northwest corner of their traditional territory. While they insisted that they maintain the right to fish in their traditional places, in the report by Renker and Gunther it states that "instead of capitalizing on the Makah's knowledge and expertise regarding marine hunting and navigation, as well as fishing, the Indian Service emphasized agriculture in an area unsuited to cultivation" (Renker and Gunther 1990). The Makah nevertheless managed to sustain their seafaring culture, and fishing remains an important economic endeavor for the Tribe today. The Ozette group of Makah was also a signatory to the Treaty of Neah Bay, but their reservation, located around the historic Ozette Village, was eventually abandoned as residents moved to allotments on other reservations (Ruby and Brown 1992). The Ozette Reservation was transferred in trust to the Makah and is now part of the Makah Reservation.

In 1855, the Quinault Tribe, along with the Chinook, Lower Chehalis, Queets, Satsop, Upper Chehalis, and Cowlitz Tribes, all came together on the Chehalis River at the request of Governor Isaac I. Stephens (Swan 1992 (first published in 1857)). The government proposed a single reservation for all the Tribes at a location between Gray's Harbor and Cape Flattery (Swan 1992 (1857)). This was not acceptable to several of the Tribes, as each wanted a place within their own lands to live, and negotiations were consequently called off (Swan 1992). Later in 1855, the Quinault, Queets, Hoh, and Quiluete Tribes met with Indian Agent M. T. Simmons, representing governor Stevens, and agreed to a separate treaty, the Quinault River Treaty, on July 1, 1855, on the Quinault River. This treaty was later formalized and signed by Governor Stevens and several tribal chiefs on January 25, 1856, in the territorial capital of Olympia, and became known as the Treaty of Olympia, which was ratified in 1859 (Ruby and Brown 1992).

Under the provisions of the Treaty of Olympia, a reservation was established for all the signing Tribes, but only the Quinaults and Queets settled there. According to Powell (1990), even though the Quileute signed the Treaty of Olympia (1856), a misunderstanding regarding the treaty provisions, left the Quileutes still "unremoved" in 1889. That year, a one-mile square was established at La Push for the 252 inhabitants. The 71 inhabitants at Hoh River, were provided with a reservation four years later.

3.6 Recreation/Public Use

Because the Washington Islands NWRs are closed to the public, there is no official public use of this area. Some research activities do occur, as discussed below. Due to the outstanding visual resources of the islands and associated wildlife species, a limited amount of public use is induced by the islands themselves. These public uses occur on the mainland outside the Washington Islands NWRs and comprise the only recreation related to the Refuges. These activities include sightseeing by boat, car, or aircraft; kayaking; hiking; backpacking; picnicking; visiting interpretative facilities; recreational fishing; diving; and photography. Other public uses such as commercial fishing also occur in the vicinity of the study area and are also discussed below.

Because refuge areas are closed to the public to protect wildlife resources, the only Service-authorized access to the islands occurs as part of either research or official USCG activities. The USCG visits Destruction Island on a quarterly basis to service and maintain the lighthouse and other buildings on the island. The NPS and U.S. Navy have also landed on Destruction Island in the past to service electronic equipment located in the lighthouse. The other uses occurring on refuge islands are wildlife studies or surveys conducted by researchers or agency personnel under a special use permit. However, even this permitted use is limited to a small number of islands due to their extreme topography and inaccessibility.

Four Native American Tribes have treaty rights to fish in their usual and accustomed grounds along the Olympic Coast. There may be some access to refuge islands in association with exercising their treaty rights to fish.

The primary recreational use of the study area involves viewing the islands from the mainland beaches of the Olympic Peninsula. Since many of the islands in the study area are within 2 miles (3.2 km) of the coastline, they are a prominent visual resource for visitors. Olympic National Park encompasses nearly 60 miles (97 km) of coastline adjacent to the study area, much of which is a federally protected wilderness area. Day and overnight hiking along these beaches is an activity that is increasing in popularity among visitors as it is a regional and national resource in terms of its scenery and lack of development. A recent estimate of use indicates that there were 20,507 overnight visitors in 1997, accounting for 43,426 user-nights (pers. comm., Ruth Scott, Olympic National Park, 2000). In nearly all sections of this wilderness coastline, hikers are within view of one or more of the refuge islands, rocks, or reefs. Several of the islands and rocks that are close to the shoreline have the potential to be accessed from land during low tide. Although no formal record of trespass onto these areas has been documented by the NPS, it is assumed that some trespass does occur, particularly during extreme low tide events. Informal reports suggest that some of the islands near Cape Alava are accessed during low-tide events by wilderness visitors (pers. comm., Ruth Scott, Recreation Specialist, Olympic National Park, April 2000).

A series of coastal highways and roads also provide vehicular access to areas where individuals can view the islands and rocks. From north to south, these include Mora Road (Rialto Beach), State Route 110 (First Beach), Highway 101 (parallels the coast for 15 miles [24 km] near Kalaloch), and State Route 109 (Taholah to Copalis Beach). These routes provide access to or parallel the coastline, as well as provide access to various day use areas and beaches within Olympic National Park. However, these roads only provide access to small portions of the coastline, and much of the study area can only be directly viewed from land by wilderness hikers.

Aside from providing access to the coastline, these routes also provide public access to several interpretive panels and facilities managed by the NPS. These interpretive panels were originally designed and funded by the Service. Five of these facilities interpret the natural history and wildlife and specifically address the Washington Islands NWRs. Interpretive panels at Lake

Ozette, Rialto Beach, and Ruby Beach interpret the offshore islands, the Refuges, and the wildlife that frequent these areas, while the interpretive panel at Second Beach focuses on puffins. At Kalaloch, there are three identical panels in different areas, each dealing with the general ecology and geology of the area (pers. comm., Mike Girling, Recreation Specialist, Olympic National Park, April 25, 2000). Although use figures are no longer calculated, it was estimated that visitors spent 2,500 activity hours at these interpretive panels in 1986 (USFWS 1986). It can be assumed that this figure has increased, perhaps dramatically, in the ensuing years.

While the primary public uses of the areas in the vicinity of the Washington Islands NWRs are land-based, other recreational activities take place on the surrounding waters and in the air above the study area. Recreational charter and private watercraft frequent the waters near the islands and rocks. These watercraft are primarily either on fishing or sightseeing trips to the area, while a few charter operations do offer scuba diving opportunities as well. Sea kayaking is an activity that is gaining popularity in this area and is an increasingly common way for visitors to enjoy the visual resources of the coastline, including the area's islands and rocks. Landing a watercraft on any of the Washington Islands NWRs feature is illegal; however, most of the islands are inaccessible anyway due to their steep cliffs and lack of feasible landing sites. Several larger islands such as Ozette Island contain potential landing sites, and it is assumed that some unauthorized landings by recreational users may occur. Aside from water-based recreational use, there are also a small number of private and commercial aircraft that fly over the study area to sightsee and observe wildlife. All aircraft are requested to remain above 2,000 feet (610 m) when flying over any rock, island, or reef. It is anticipated that some wildlife have been disturbed by watercraft or aircraft that venture too close to the islands. Low overflights are documented each year by the NPS; however, it is extremely difficult to obtain the information necessary to contact these individuals (NPS 1981).

Commercial uses, primarily in the form of commercial fishing operations, occur in the near-shore waters adjacent to the Washington Islands NWRs.

3.7 Environmental Justice

In February 1994, Executive Order 12898 was signed requiring all Federal agencies to seek to achieve environmental justice by "identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations" (Executive Order 12898).

As a Federal agency, the Service must address the effects of its programs and policies related to the Washington Islands NWRs. No public use has historically, or is currently allowed on the Washington Islands NWRs. Therefore, no segment of the general public has been, or is currently being unfairly affected by management of the Washington Islands NWRs. The Quinault, Hoh, Quileute, and Makah Tribes rely on fishing as an important component of their

economies. Current public use restrictions and management practices of the Service do not interfere with the Tribes exercising their treaty rights to harvest fish. Therefore, none of the Tribes are being unfairly affected by current management of the Washington Islands NWRs.

3.8 Visual Resources

This section provides a general overview of visual resources in the vicinity of the Washington Islands NWRs. Since no public use of the area is allowed, visual resources from and within the study area are not considered.

The Washington Island NWRs are an important statewide visual resource. The various sea stacks, pillars, and islands are strong visual features that represent the remote and rugged character of the Olympic Peninsula's coastline. Many visitors from around the nation are drawn to this area by the scenic beauty of these offshore islands. The majority of these islands are also part of the Washington Islands Wilderness Area, a designation that preserves these areas in their natural, undisturbed character. The importance of the scenic character of wilderness is specifically addressed in the Wilderness Act of 1964, as a defining feature of a wilderness. Thus, the continued protection of these islands is based upon the preservation of the unique visual resources of the area.

The primary visual resource use associated with the Refuges is a result of public viewing of the islands, rocks, and seastacks from the mainland or from private or commercial watercraft and airplanes. The dominant visual resource in the vicinity of the study area is the coastline of the Pacific Ocean. The open beaches of the Olympic Peninsula provide a visual resource that allows visitors to view offshore islands and rocks that comprise the Washington Islands NWRs. These features appear in varying distances from the shoreline and can be seen in the fore-, middle-, and background from many areas. The islands mostly appear as rock pillars and tables that rise directly out of the ocean in varying shapes and forms. Many of the islands have vegetation such as small trees and dense stands of salmonberry and salal, particularly the larger islands such as Destruction Island and Ozette Island. Other smaller islands have extensive steep grassy slopes or vegetated ledges. Views from the water are similar to those from the mainland, particularly the beaches. The islands often appear in the foreground as flat-topped cliffs rising out of the water, and in the background as clusters of fog-shrouded stacks.

Several key viewpoints provide sweeping views of the coastline and the offshore islands. The longest continuous area of shoreline where road access is available occurs in the Kalaloch-Destruction Island area. A series of pullouts and beaches along Highway 101 provide striking views of the coastline and clusters of offshore islands, including Destruction Island. Other areas along the coastline that have vehicular access to views of the islands include First Beach and Rialto Beach. Aside from these areas, Olympic National Park provides over 60 miles (97 km) of wilderness coastline from which views of the study area can be found.

3.9 Socioeconomics

This section provides an overview of the local economy near the Washington Islands NWRs, including population figures and other economic indicators. Much of the mainland adjacent to the Washington Islands NWRs consists of either sparsely populated areas or land under Federal or county management. Four Indian Reservations are situated along the coastline adjacent to the study area. These are the Quinault, Hoh, Quileute, and Makah Reservations. Most of the areas not contained within one of these reservations are protected either by the NPS, Forest Service, or WDNR. Remaining areas not under Federal or State jurisdiction are mostly public use areas administered by Clallam, Jefferson, or Grays Harbor Counties.

Mainland areas adjacent to the study area are sparsely populated with few large population centers. The largest town in the area is Forks, in Clallam County. Several smaller, unincorporated communities dot the coastline adjacent to the study area. From north to south, these communities include Neah Bay, La Push, Hoh, Kalaloch, Queets, and Taholah. Population figures for the counties adjacent to the study area are shown in Table 3-3. Information on population density provided in this table indicates that the counties adjacent to the study area are sparsely populated when compared to the State as a whole. A higher-than-average proportion of the population consists of Native Americans.

Table 3-3. Population and Density Information for Selected Areas

Area	Population (1999)	Density (persons/square mile)
Clallam County	66,900	38.2
Jefferson County	26,600	14.7
Grays Harbor County	67,700	35.5
Washington State	5,757,400	86.3

Source: OFM 2000

The area economy is primarily resource-based in nature, with industries focusing on commercial fishing, timber, and tourism. All four coastal Tribes have a commercial fishery in finned fish and shellfish serving as a mainstay of their economies. This is especially true for the Hoh and Quileute Tribes who have small reservations and little, if any, timber economy (although they have an allotment on the Quinault Reservation and are entitled to some of the revenue). Of the four coastal Tribes, only the Makah and Quinault rely to a significant extent on timber for their economy (pers. comm. Russell Woodruff, Chairman, Quileute Tribal Council, December 2001.)

While timber has been decreasing in economic importance to the area, tourism is growing in importance, particularly nature-based tourism, such as recreational fishing. The emergence of Olympic National Park as a major regional tourist attraction brings thousands of visitors to the coastline directly adjacent to the Washington Islands NWRs every year. Lodging facilities,

restaurants, and charter fishing or sightseeing guide services are becoming more numerous. The regional hub for these visitor service facilities is the town of Forks (Clallam County).

With a population estimated at 3,500 (1998), Forks has many lodging facilities and charter tour companies that include whale and bird watching, sea kayaking, scuba diving trips, and fishing charters (Forks Chamber of Commerce 2000). Aside from the service industry, the State and Federal government are also major employers with the Olympic Corrections Center (Washington State) in Forks and Olympic National Park. Socioeconomic variables for this area indicate that the median household income (see Table 3-4) is below the statewide median income.

Table 3-4. Median Household Income for Selected Areas.

Area	Median Household Income
Clallam County	$31,038
Jefferson County	$32,141
Grays Harbor County	$29,106
Washington State	$47,897

Source: OFM 2000

3.10 Public Health and Safety

Continued research efforts on the islands related to wildlife studies have the potential to create health and safety issues for researchers. Severe topography in the form of cliffs and crags, coupled with the frequency of extreme weather conditions, have the potential to create unsafe or dangerous working conditions. The Service will advise researchers of the adverse conditions and the need for appropriate training and equipment. While most of the islands are inaccessible due to topography and the lack of landing sites, some unauthorized public use is possible on a few of the larger islands. Due to the dangerous nature of access to these islands, any attempts at these illegal uses could result in health and safety issues.

3.11 Wilderness Resources

Wilderness is defined in Section 2(c) of the Wilderness Act of 1964 as an area "where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain" and "(1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological or other features of scientific, educational, scenic, or historical value."

With the exception of Destruction Island, the Washington Islands Wilderness includes all of the islands, rocks, and reefs within the Flattery Rocks, Quillayute Needles, and Copalis NWRs. The wilderness encompasses approximately 451 acres and more than 600 islands. Although the majority of the islands generally appear to be affected by the forces of nature and untrammeled by man, human impacts on natural values include ordnance and contaminants associated with the U.S. Navy's historic bombing activities and marine debris such as plastic litter, fishing gear, and gillnets.

As described in Section 3.4, the Washington Islands Wilderness contains significant ecological resources. The islands are closed to public access to protect wildlife values. Although the islands are remote and difficult to access, boating and fishing activities on surrounding waters, and aircraft overflights, pose disturbance threats for the area's wildlife. Other resource values associated with the Washington Islands Wilderness include scenic values associated with the area's geology (Sections 3.3 and 3.8) and cultural resources (Section 3.5).