3.8 Wildlife

This affected environment section includes descriptions of the marine wildlife and benthic invertebrate resources important in predicting impacts that could occur as a result of the Proposed Action or alternatives. This section focuses primarily on the seabird and marine mammal species that are known or thought to be directly or indirectly impacted by commercial fisheries, but also provides a succinct overview of all wildlife resources that might be encountered by any Puget Sound commercial and sport fishery. Important information gaps are identified.

3.8.1 Marine Habitats

The diversity and distribution of marine wildlife in Puget Sound and the Strait of Juan de Fuca are strongly influenced by the distribution of marine habitats, and nearshore terrestrial habitats that provide substrate for resting or breeding. These habitat types in Puget Sound have been variously classified depending on the intended use of the system. Buchanan et al. (2001) developed a classification more reflective of the distribution and composition of marine organisms. Buchanan et al. (2001) recognizes *estuarine habitat* as tidal flats and river mouths like Padilla Bay and mouth of the Nooksack River. *Nearshore marine habitats* include the marine areas of Puget Sound between high tide and the end of the photic zone (66 feet depth), and *inland marine deeper water* as waters greater than 66 feet deep. Further, Buchanan et al. (2001) classified the deeper water of the Strait of Juan de Fuca west of a line from the mouth of the Elwha River north to Race Rocks on the southeastern tip of Vancouver Island (see Figure 3.3.14) as *marine shelf* due to the influence of oceanic currents on the western half of the strait. While Buchanan et al. (2001) are not the only scientists to develop a habitat classification system (e.g., Dethier 1990), this classification system was developed specifically for determining habitat relationships of wildlife inhabiting Oregon and Washington (Johnson and O'Neill 2001); therefore, it is the system followed in this assessment.

The inland marine deeper water habitat comprises nearly 2 million acres in Puget Sound and the Strait of Juan de Fuca. At least 63 species of marine birds and marine mammals are known to frequent this habitat zone, although 40 percent are found only during the winter (Johnson and O'Neill 2001). The seabirds most closely associated with this habitat include white-winged/black scoters, Bonaparte's/Heermann's/Thayer's/glaucous-winged/glaucous gulls, pigeon guillemots, common murres, rhinoceros auklets, tufted puffins, marbled/ancient murrelets, Brandt's/double-crested/pelagic cormorants, western/Clark's grebes, and Pacific/common/red-throated loons (Table 3.8-1), most of which reach their highest abundance during the winter months (Angell and Balcomb 1982; and Nysewander et al. 2001a; Table 3.8-2) when most commercial salmon fishing has concluded. This zone

also provides foraging habitat for seven species of marine mammals: harbor seal, California sea lion, Steller sea lion, harbor porpoise, Dall's porpoise, minke whale, and killer whale (Johnson and O'Neill 2001; Table 3.8-1).

The marine shelf habitat of the western half of the Strait of Juan de Fuca generally supports the same marine mammals found in inland marine deeper water. The proximity of these waters to the open ocean allows the intrusion of more open ocean species such as humpback whales and Pacific white-sided dolphins (Table 3.8-1). The seabirds most commonly found in this habitat type within the strait include Pacific loon, western/Clark's grebe, northern fulmar, sooty/short-tailed shearwater, red-necked/red phalarope, Thayer's/western/glaucous-winged/Sabine's gull, black-legged kittiwake, common/Arctic tern, common murre, Cassin's/rhinoceros auklet, and tufted puffin (Nysewander et al. 2001a; Table 3.8-1).

The marine nearshore habitat comprises nearly the entire shoreline of Puget Sound, Hood Canal, San Juan Islands, Strait of Juan de Fuca, and Strait of Georgia. About 75 species of marine birds are associated with this habitat, including nearly all the same species found in deeper water habitat. Important additions to the avian assemblage in this habitat include red-necked grebes, brown pelicans, surf scoters, red-breasted mergansers, mew/herring gulls, and Caspian/common terns (Table 3.8-1). The marine mammals most commonly associated with this habitat type are sea lions, harbor seal, and harbor porpoise. Resident gray whales and wintering sea otters can be found at the western end of the Strait of Juan de Fuca.

Table 3.8-1. Presence and association of marine birds and mammals with the marine habitats of Puget Sound.

Species	Bays and Estuaries	Inland Marine Deeper Waters	Marine Nearshore	Marine Shelf
Loons				
Red-throated Loon	◆	◆	◆	•
Pacific Loon	◆	◆	◆	◆
Common Loon	◆	◆	◆	•
Grebes				
Horned Grebe	◆	•	•	•
Red-necked Grebe	◆	•	◆	•
Eared Grebe	•		•	
Western/Clarke's Grebe	◆	◆	◆	◆
Fulmars and Shearwaters				
Northern Fulmar				◆
Sooty Shearwater	•	•	•	◆
Short-tailed Shearwater		•	•	◆
Pelicans				
Brown Pelican	◆		◆	
Cormorants				
Double-crested Cormorant	◆	◆	◆	
Brandt's Cormorant	◆	◆	◆	•
Pelagic Cormorant	◆	◆	◆	•
Geese				
Snow Goose	•			
Dabbling Ducks				
Northern Pintail	◆		•	
American Wigeon	◆	•	•	
Sea Ducks				
Greater Scaup	◆	•	•	
Lesser Scaup	•			
Harlequin Duck	•		◆	
Long-tailed Duck	•	•	◆	
Black Scoter	◆	◆	◆	•
Surf Scoter	◆	•	◆	•
White-winged Scoter	•	◆	◆	•
Common Goldeneye	•		•	
Barrow's Goldeneye	•		•	
Bufflehead	◆		•	

Table 3.8-1. Presence and association of marine birds and mammals with the marine habitats of Puget Sound *(continued)*.

Species	Bays and Estuaries	Inland Marine Deeper Waters	Marine Nearshore	Marine Shelf
Mergansers				
Red-breasted Merganser	◆	□	◆□	□
Osprey				
Osprey	◆□	□	◆□	□
Eagles				
Bald Eagle	◆□	◆□	◆□	◆□
Oystercatcher				
Black Oystercatcher	◆□	□	□	□
Phalaropes				
Red-necked Phalarope	◆□	◆□	◆□	◆□
Red Phalarope	□	□	◆□	◆□
Gulls				
Bonaparte's Gull	◆□	◆□	◆□	◆□
Heermann's Gull	◆□	◆□	◆□	◆□
Mew Gull	◆□	◆□	◆□	◆□
Ring-billed Gull	◆□	◆□	◆□	◆□
California Gull	◆□	◆□	◆□	◆□
Herring Gull	◆□	◆□	◆□	◆□
Thayer's Gull	◆□	◆□	◆□	◆□
Western Gull	◆□	◆□	◆□	◆□
Glaucous-winged Gull	◆□	◆□	◆□	◆□
Glaucous Gull	◆□	◆□	◆□	◆□
Sabine's Gull			◆	◆
Black-legged Kittiwake			◆	◆
Terns				
Caspian Tern	◆□	□	◆□	□
Elegant Tern	◆□	□	◆□	◆□
Common Tern	◆□	◆□	◆□	◆□
Arctic Tern	◆□	◆□	◆□	◆□
Alcids				
Common Murre	◆□	◆□	◆□	◆□
Pigeon Guillemot	◆□	◆□	◆□	◆□
Marbled Murrelet	◆□	◆□	◆□	◆□
Ancient Murrelet	□	◆□	◆□	◆□
Cassin's Auklet	□	◆□	◆□	◆□
Rhinoceros Auklet	◆□	◆□	◆□	◆□
Tufted Puffin	□	◆□	◆□	◆□

Table 3.8-1. Presence and association of marine birds and mammals with the marine habitats of Puget Sound *(continued)*.

Species	Bays and Estuaries	Inland Marine Deeper Waters	Marine Nearshore	Marine Shelf
Marine Mammals				
Pinnipeds				
Steller Sea Lion		◆	◆	◆
California Sea Lion	◆	◆	◆	◆
Harbor Seal	◆	◆	◆	◆
Northern Elephant Seal		◆	◆	◆
Otter				
Sea Otter	□	□	◆□	◆□
Baleen Whales				
Minke Whale	□	◆□	□	◆□
Gray Whale	◆□	◆□	◆□	◆□
Fin Whale	□	□	□	◆□
Humpback Whale	□	□	□	◆□
Toothed Whales and Dolphins				
Killer Whale	◆□	◆□	◆□	◆□
Pacific White-sided Dolphin	□	□	□	◆□
Short-finned Pilot Whale	□	□	□	◆□
Risso's Dolphin	□	□	□	◆□
Harbor Porpoise	◆□	◆□	◆□	◆□
Dall's Porpoise		◆	◆	◆

Source: Johnson and O'Neill 2001□

Present ◆ Generally Associated ◆ Closely Associated ◆

1 Table 3.8-2. Seasonal abundance of birds and marine mammals in Puget Sound.

	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
Marine Birds												
Loons	⬩				⬩	⬩	◆	◆	◆	◆	◆	◆
Grebes	⬩	⬩	⬩	⬩	⬩	◆	◆	◆	◆	◆	◆	⬩
Shearwaters	⬩	⬩	⬩	⬩	⬩							⬩
Fulmars					⬩	⬩	⬩	⬩	⬩	⬩	⬩	⬩
Pelicans	⬩	⬩	⬩									⬩
Cormorants	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Herons	◆	◆	⬩	⬩	◆	◆	◆	◆	◆	◆	◆	◆
Geese	◆				⬩	◆	◆	◆	◆	◆	◆	◆
Dabbling Ducks	◆	⬩	⬩	⬩	◆	◆	◆	◆	◆	◆	◆	◆
Bay Ducks					◆	◆	◆	◆	◆	◆	◆	◆
Sea Ducks	◆	⬩	⬩	⬩	◆	◆	◆	◆	◆	◆	◆	◆
Mergansers	⬩			⬩	◆	◆	◆	◆	◆	◆	◆	◆
Osprey	⬩	⬩	⬩	⬩	⬩	⬩	⬩	⬩	⬩	⬩	⬩	⬩
Eagles	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Oystercatcher	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Phalaropes	⬩	⬩	⬩	◆	◆	◆	⬩					⬩
Gulls	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Terns	◆	⬩	⬩	⬩	◆	◆	◆	⬩			⬩	◆
Alcids	◆	◆	◆	◆	◆	◆	◆	⬩	⬩	⬩	⬩	◆
Marine Mammals												
Harbor Seal	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Elephant Seal	◆			◆	◆	◆						◆
Sea Lions	◆						◆	◆	◆	◆	◆	◆
Minke Whale	◆	◆	◆	◆	◆	◆	⬩	⬩	⬩	⬩	⬩	◆
Gray Whale	◆	◆	◆	◆	◆	◆	⬩	⬩	⬩	⬩	⬩	⬩
Harbor Porpoise	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Dall's Porpoise	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Killer Whale	⬩	◆	◆	◆	◆	◆	⬩	⬩	⬩	⬩	⬩	⬩

2 Sources: Angell and Balcomb 1982; and Nysewander et al. 2001a.
3 Occasional ⬩ Common ◆ Very Common ◆ Abundant ◆

Based solely on the importance of estuarine tidal flats to wintering and migrating waterfowl and shorebirds, this habitat ranks as one of the richest and most diverse in the state of Washington. Some of the most prominent species include the double-crested cormorant, great blue heron, American wigeon, northern pintail, snow goose, sanderling, western sandpiper, several species of gulls, osprey, and bald eagle (Table 3.8-1). Harbor seals commonly forage in the tidal channels.

3.8.2 Marine Birds

The breeding seabird population in the United States' waters of Puget Sound and the Strait of Juan de Fuca comprises about 38,000 pairs. More than 90 percent of these birds are rhinoceros auklets, glaucous-winged gulls (or intergrades with western gulls), and pigeon guillemots. The only other breeding seabirds are double-crested and pelagic cormorants, marbled murrelets, and a very few tufted puffins (Speich and Wahl 1989). These birds, plus variable numbers of non-breeding common murres and Brandt's cormorants, comprise the summer (June-August) seabird community (Table 3.8-2).

The winter marine bird community is dramatically larger with the influx of tens of thousands of scaups, dabbling ducks, western grebes, common murres, scoters, and loons (Table 3.8-2). Manuwal et al. (1979) and Wahl et al. (1981) estimated that 200,000 common murres alone migrated into Washington's inland waters in September 1978, although those numbers may be considerably less today (Nysewander et al. 2001a).

3.8.2.1 Rhinoceros Auklet

Rhinoceros auklets are one of the few seabirds that breed within the inland waters of Washington. Speich and Wahl (1989) estimated that approximately 34,000 of these birds nest annually at Protection Island, and about 2,500 nest on nearby Smith Island in the eastern end of the Strait of Juan de Fuca (see Figure 3.3-14 in Subsection 3.3 of this Environmental Impact Statement). Survey efforts by Nysewander et al. (2001a) (based on summer aerial surveys) suggest the summer population of rhinoceros auklets has gradually declined since Speich and Wahl's 1978 to 1982 colony surveys. During the summer (July), rhinoceros auklets are generally confined to deeper water regions of the northern two-thirds of greater Puget Sound (mainly Marine Catch Areas 6, 7, and 9; Figure 3.3-1), within 30 to 50 miles of the Protection Island and Smith Island breeding colonies. Rhinoceros auklets are especially abundant near offshore banks and tide-rips where they forage mainly on Pacific sandlance and Pacific herring (Leschner 1976). Pierce et al. (1996) found that 92 percent of the 2,383 rhinoceros auklets recorded during August 1994 surveys in the San Juan Islands were located more

than 2,000 feet from the nearest shoreline. Localized densities of 381 birds per square mile have been recorded (WDFW 2002).

By winter, most rhinoceros auklets have migrated out of greater Puget Sound, likely to Washington's outer coast (Angell and Balcomb 1982). Some, however, overwinter in south Puget Sound (Paulson 1980).

Rhinoceros auklets have been incidentally entangled in purse seine nets during the Puget Sound coho fishery (Anderson 1993), and in gillnets in the Puget Sound sockeye/pink salmon fishery (Wolf et al. 1995; Thompson et al. 1998; and Melvin et al. 1999). The 1994 non-treaty sockeye gillnet fishery entangled an estimated 787 rhinoceros auklets in Marine Catch Areas 7 and 7A (Wolfe et al. 1995). Thompson et al. (1998) determined that 79 percent of the rhinoceros auklets confirmed killed in the 1993 and 1994 sockeye and chum fisheries in Marine Catch Areas 7, 7A, 10, 11, and 12 were hatch-year (i.e., born that year; 63%) or subadult (i.e., non-breeding; 16%) birds, likely originating from the Protection Island and Smith Island colonies. The large percentage of hatch-year birds probably reflects the high number of these young birds on the water at the peak of the sockeye fishery (Wilson and Manuwal 1986; and Thompson et al. 1998).

3.8.2.2 Common Murre

Common murres do not nest within Washington's inland waters, although a few non-breeders can be found in the summer (WDFW 2002). They are, however, the predominant winter alcid in the greater Puget Sound area, with tens of thousands of birds originating from the Oregon and Washington outer coasts. Manuwal et al. (1979) and Wahl et al. (1981) estimated that 200,000 birds entered the Strait of Juan de Fuca in September 1978. Most of these birds, however, were gone by November, likely moving north through the Strait of Georgia (although about 80,000 remained through the winter). Hamel and Parrish (2001) radio-tracked Tatoosh Island murres and found them to move inland to the eastern end of the Strait of Juan de Fuca where, presumably, food resources are more predictable and waters more calm than the outer coast. Surveys conducted by Wahl et al. (1981) in 1978–1979 indicated that the most important winter habitat for murres occurs throughout the Strait of Juan de Fuca, through Rosario Strait, to the Strait of Georgia (Marine Catch Areas 4, 5, 6, and 7; Figure 3.3-14). Aerial surveys conducted between 1992 and 1999 (Nysewander et al. 2001a) found similar results for wintering common murres with the exceptional note of high murre concentration on the British Columbia side of the Strait of Juan de Fuca near Victoria, and relatively high densities in Admiralty Inlet (northern Marine Catch Area 9).

Common murre populations in the Pacific Northwest have been greatly impacted by several events over the past few decades (Carter et al. 2001). Breeding activity was greatly reduced from colony abandonment during the El Nino events of 1982–1983, 1987–1988, and 1992–1993. Further, major oil spills in 1988 (*NESTUCCA*) and 1991 (*TENYO MARU*) collectively killed between 34,000 and 50,000 murres. Military activity, aircraft overflights, and entanglement in gillnet fisheries have also been implicated in common murre population declines within Washington State (Carter et al. 2001). Annual declines of 32.9 percent were reported between 1979 and 1986, and 13.3 percent between 1979 and 1995. The Washington breeding population, estimated at 53,000 in 1979 (Carter et al. 2001), was reduced to an estimated 13,600 by 1995 (*TENYO MARU* Oil Spill Natural Resources Trustees 2000) with the steepest decline coinciding with the 1982–1983 El Nino coupled with military activity and fishing boat disturbance documented in 1984 and 1985 (Speich et al. 1987; and Carter et al. 2001).

Nysewander et al. (2001a) found higher densities of common murres in the deeper water regions of greater Puget Sound, which is not surprising given the ability of these birds to dive to depths of nearly 600 feet (Piatt and Nettleship 1985). Similarly, Pierce et al. (1996) found 95 percent of 5,889 common murres sighted in Marine Catch Area 7 were more than 2,000 feet from shore. Because of their deep-diving capability, common murres are able to exploit a variety of prey. Nevertheless, schooling baitfish such as Pacific herring, Pacific sand lance, northern anchovy, Pacific whiting, smelt, and market squid universally dominate their diet (Manuwal and Carter 2001). Wilson and Thompson (1998) found murres in the San Juan Islands to have fed largely on Pacific herring, Pacific sand lance, salmon smolts, and Pacific tomcod.

Gillnet-associated deaths have been identified as a chronic mortality factor for common murres in Washington (Carter et al. 2001). The 1994 non-treaty sockeye gillnet fishery entangled an estimated 2,700 common murres in Marine Catch Areas 7 and 7A (Wolfe et al. 1995). Thompson et al. (1998) determined that 63 percent of the common murres confirmed killed in the 1993 and 1994 sockeye and chum fisheries in Marine Catch Areas 7, 7A, 10, 11, and 12 were adults (which may reflect a large number of failed or non-breeding adults within the marine catch areas at the peak of the sockeye fishery). It is likely that many, if not most, of the murres killed in Puget Sound gillnet fisheries originate not from the lightly populated (13,600 in 1995; *TENYO MARU* Oil Spill Natural Resources Trustees 2000) and later-breeding Washington colonies, but from the much larger (breeding population averaging about 700,000 birds during the 1990s; personal communication with Roy Lowe, U.S. Fish and Wildlife Service, Refuge Biologist, February 25, 2003) and earlier (one month) nesting Oregon colonies. The hatch-year chicks killed in the 1993 and 1994 sockeye fisheries likely originated

from Oregon, as much the fishery occurred prior to the fledging of chicks at the Washington colonies (Thompson et al. 1998).

3.8.2.3 Pigeon Guillemot

The pigeon guillemots are perhaps the most widespread nesting seabirds in Puget Sound and the Strait of Juan de Fuca. They are especially prevalent along the Washington shoreline of the Strait of Juan de Fuca from Crescent Bay east to Admiralty Inlet (Marine Catch Area 6), within the San Juan Islands (Marine Catch Area 7), and in the South Puget Sound region (Marine Catch Area 13; see Figure 3.3-7). They are conspicuously absent west of Crescent Bay, Hood Canal, and Puget Sound's scattered estuarine and beach areas. Speich and Wahl (1989) estimated the breeding population to be about 3,600 at 121 breeding locations. Since that time, Evenson et al. (2001) have identified more than 300 new breeding locations. These sites, along with the original 121, support nearly 15,000 guillemots based on surveys conducted in 2000 (Evenson et al. 2001). It is unclear whether the difference in population estimates between Speich and Wahl (1989) and Evenson et al. (2001) reflects a population increase or simply an increase in survey effort, although Evenson et al.'s results suggest they may have concentrated more effort on the smaller-sized colonies (62% of the colonies surveyed in 2000 supported less than or equal to 25 birds) perhaps missed by Speich and Wahl (1989).

Pigeon guillemots generally forage along the shallow nearshore zone for epibenthic fish such as gunnels, blennies, pricklebacks, and sculpins (Drent 1965, Koelink 1972). Ewins (1993) compiled dietary information from 11 different studies and found salmonids to be completely absent. Pigeon guillemots are cavity-nesters and generally nest in rock rubble, but will use driftwood piles, bird and mammal burrows, and artificial structures such as wharves, bridges, navigation aids, drainage pipes, and even spent shell casings (Speich and Wahl 1989). When cavities are in short supply, they will excavate their own burrows in loose earth or sandy banks (Speich and Wahl 1989; and Vermeer et al. 1993). They generally nest within small "colonies" or isolated pairs, although there are several colonies in Puget Sound and the Strait of Juan de Fuca that support more than 50 pairs (Evenson et al. 2001).

Pigeon guillemots have been incidentally captured in coho purse seine fisheries off Kingston-Edmonds (Anderson 1993). However, entanglement of guillemots in the Marine Catch Area 7/7A sockeye salmon gillnet fisheries is apparently rare compared to rhinoceros auklets and common murres (Pierce et al. 1996; and Melvin et al. 1997, 1999). Only one pigeon guillemot was one captured during 642 observed net sets during the 1996 test sockeye gillnet fishery (Melvin et al. 1999).

3.8.2.4 Gulls and Terns

Seventeen species of gulls and terns at least occasionally inhabit greater Puget Sound, but only four species – glaucous-winged and western gull, and Caspian and arctic tern – nest here (Speich and Wahl 1989). Speich and Wahl (1989) estimated the greater Puget Sound breeding population of glaucous-winged gulls to be 20,000 with more than 11,000 on Protection Island (located in Marine Catch Area 6) alone (Figure 3.3-14). These gulls nest in a variety of situations throughout greater Puget Sound, from large colonies to isolated pairs using both natural and man-made substrates. The presence of western gull breeding populations in Washington inland waters is somewhat confusing. Speich and Wahl (1989) did not identify western gull breeding colonies *per se* in greater Puget Sound, but they did refer to Hoffman et al.'s (1978) contention that they hybridize with glaucous-winged gulls in the inland waters of Washington State. Angell and Balcomb (1982) did state that a small population of western gulls nests among the glaucous-winged gulls on Protection Island, and Nysewander et al (2001a) noted some western/glaucous-winged intergrade gulls during their surveys. A small colony of arctic terns have nested at Jetty Island off Everett (Angell and Balcomb 1982), and approximately 1,000 Caspian terns nested on the ASARCO slag piles along the Commencement Bay shoreline in 2000 (personal communication with Christopher Thompson, Washington Department of Fish and Wildlife, Research Biologist, February 26, 2003; Figures 3.3-1 and 3.3-7).

The Nysewander et al. (2001a) surveys found gulls and terns to comprise by far the largest component (73%) of the summer marine bird population. Besides glaucous-winged gulls, this summer population is supplemented with a sizable population of Heermann's gulls and smaller numbers of non-breeding Bonaparte's, California, ringed-billed, and mew gulls (Angell and Balcomb 1982). Heermann's gulls breed in Mexico during the winter months and spend their off-season in more northern climes (Angell and Balcomb 1982).

The winter gull and tern population is comprised largely of resident glaucous-winged gulls and wintering Thayer's, mew, and Bonaparte's gulls. California and ring-billed gulls, and common terns are common spring and fall migrants (Angell and Balcomb 1982). Most gulls exhibit a more nearshore life history strategy reflecting their inability to dive to more than marginal depths. Nysewander et al. (2001a) found gull distributions to be quite variable, but to average more than a dozen times higher in nearshore habitat than offshore. Nevertheless, large flocks of glaucous-winged and Heermann's gulls are commonly seen feeding on surfacing herring in deeper channel waters. Nysewander et al. (2001b) estimated that the gull densities between surveys conducted in 1978 and 1979 (Wahl et al. 1981) and their surveys conducted between 1992 and 1999 (Nysewander et al. 2001a) had declined 43 percent.

However, Carter et al. (2002) stated that breeding glaucous-winged gull numbers are either stable or increasing.

Gulls and terns are apparently not susceptible to net entanglement from Puget Sound commercial fisheries based on the results from studies in Puget Sound (Anderson 1993; Melvin and Conquest 1996; Pierce et al. 1996; and Melvin et al. 1997). They are, however, occasionally hooked in the sport fisheries (Noviello 1999). However, during Noviello's (1999) study to determine rates of bird and marine mammal encounters in the Puget Sound sport fisheries (Marine Catch Areas 4, 5, 8, and 10), only 4 bird captures were recorded in 1,090 apparent "hook-ups" – all immature gulls. All were released apparently unharmed.

3.8.2.5 Grebes, Loons, and Cormorants

Four species of grebes – western, Clark's, red-necked, and horned – winter in greater Puget Sound, with western grebes comprising about 85 percent of all grebes (Nysewander et al. 2001a). Together, the four grebe species comprise about 4 percent of all wintering marine birds (Nysewander et al. 2001a). Western grebes generally rest in large flocks in deep waters, then scatter at night to feed on schooling baitfish (Clowater 1998). They are most common in the protected inlet and bay waters of Puget Sound, and tend to avoid the open waters of the straits. Angell and Balcomb (1982) showed grebes arriving in the Puget Sound area in November and peaking December to February (Table 3.8-2). Morgan (1987) and Clowater (1998), however, found western grebe populations in the Strait of Georgia to reach high numbers in October, and then gradually build to a peak in March. Courtney et al. (1997) surveyed various locations of Puget Sound in Fall 1996. Both found western grebes to be one of the more common marine birds, comprising more than 20 percent of all marine bird sightings. Consequently, considerable numbers of western grebes can be found in Puget Sound and the Strait of Juan de Fuca coincident with the fall chum fishery. Between surveys conducted 1978 to 1979 (Wahl et al. 1981), and 1992 to 1999 (Nysewander et al. 2001a), these birds have apparently experienced severe (95%) population declines in the greater Puget Sound (Nysewander et al. 2001b).

Three species of loons winter in Washington inland marine waters. The most common, the red-throated loon, occurs in several habitats, but generally prefers nearshore waters where they forage along tidal fronts. In contrast, the Pacific loon feeds in the deeper offshore inland marine waters, primarily on herring. Common loons are intermediary, using both nearshore and offshore habitats. Loons are primarily a winter resident in Puget Sound and the Strait of Juan de Fuca with large numbers first arriving in October (Angell and Balcomb 1982; and Morgan 1987). Collectively, the greater Puget Sound population of loons has declined 79 percent since 1978–79 (Nysewander et al. 2001b).

Cormorants are year-around residents of greater Puget Sound. Only two, the double-crested and pelagic cormorants, nest within the marine inland waters of Washington, although non-breeding Brandt's cormorants (an outer coast nester) contribute significantly to the summer greater Puget Sound population (Nysewander et al. 2001a). Speich and Wahl (1989) stated that about 1,100 double-crested cormorants nest in the inland waters, most of them in three colonies at the south end of Rosario Strait (Marine Catch Area 7/7A; Figure 3.3-1). Approximately twice as many pelagic cormorants nest in greater Puget Sound, most at the Protection Island and Smith Island colonies at the east end of the Strait of Juan de Fuca (Marine Catch Area 6). Nysewander et al. (2001a) found double-crested and pelagic cormorants to occur mainly in nearshore waters close to drying perches (their feathers are not waterproof), but Brandt's cormorants were commonly found in deeper offshore waters in winter. Nysewander et al. (2001b) found little change in overall wintering cormorant populations in Washington inland marine waters between 1992 and 1999. They found a significant 53 percent decline since 1978–79, 62 percent among double-crested cormorants alone. Chatwin et al. (2002) saw similar declines in breeding populations of pelagic and double-crested cormorants in the nearby Strait of Georgia, attributing these declines to variable herring populations, and harassment by bald eagles and recreational boaters.

Although common in nearshore waters in the summer (Angell and Balcomb 1982; Table 3.8-2), especially in Marine Catch Area 7, cormorants have not been recorded as a bycatch in the Puget Sound salmon driftnet fishery, although they have been recorded as entangled in fishing nets elsewhere (Terres 1991). Large numbers of grebes and loons occur in Puget Sound, Hood Canal, and the Strait of Juan de Fuca coincident with the fall chum fishery, yet information on these birds as a bycatch of this fishery is lacking. It is unknown whether this is due to low susceptibility to entanglement on the part of the birds (western grebes forage at night when gillnet fishing has ceased), or a lack of interaction studies during October and November.

3.8.2.6 Sea Ducks

Thousands of sea ducks (including diving ducks that use marine waters) winter each year in the inland waters of Washington. The most common of these are the scoters, buffleheads, goldeneyes, scaups, long-tailed ducks, and harlequin ducks (Nysewander et al. 2001a). Scoters alone comprise nearly half of all sea ducks during the winter and migration periods (Nysewander et al. 2001a). Most are either surf or white-winged scoters; black scoters comprise less than 10 percent of all sea ducks. Overall, scoters have declined 57 percent since 1978–79, with nearly all of this decline occurring in South Puget Sound (Nysewander et al. 2001b). Buffleheads comprised 23 percent of the sea ducks recorded between 1991

and 1999 (Nysewander et al. 2001a), and goldeneyes about 17 percent. Both have declined about 20 percent since 1978–79. Common goldeneyes were found to be more common than Barrow's goldeneyes except at certain bay locations. Scaups made up 8 percent of the sea ducks recorded during surveys by Nysewander et al. (2001a), with greater scaups comprising the overwhelming majority of the two species (the other the lesser scaup). Both scaup species have declined significantly since 1978–79 (72%; Nysewander et al 2001b). Puget Sound represents the southern end of the long-tailed duck's winter range. Long-tailed ducks comprise about 1 to 2 percent of the winter sea duck population, and are largely found in the eastern end of the Strait of Juan de Fuca and around the San Juan Islands (Marine Catch Areas 6 and 7; Nysewander et al. 2000). Although they do not occur in great numbers within the inland marine waters of Washington, the few sea ducks that do winter here have declined 92 percent (Nysewander et al. 2001b).

Declines in the sea duck species described above may represent a movement northward into the Canadian Strait of Georgia (where sea duck surveys have not been conducted in recent years), rather than major population declines. However, surveys conducted at other sea duck wintering locations do suggest a universal decline in this group. Only the harlequin ducks, which occur in low numbers during winter, have significantly increased (189%) in Puget Sound between the late 1970s and the 1990s (Nysewander et al. 2001b). But even these birds have fallen off considerably since peaking in 1996 at a little over a 1,000 individuals (Nysewander et al. 2001a).

Buffleheads, goldeneyes, and scaup feed largely on blue mussels, snails, and small crabs, although scaup also supplement their diet with sea lettuce and seasonally forage on herring spawn (Vermeer and Ydenberg 1987). Scoters and long-tailed ducks feed chiefly on small clams and snails, with some crustaceans and herring eggs when available (Vermeer and Ydenberg 1987). Harlequin duck diets in marine waters are much more diversified. Vermeer (1983) found snails, limpets, small fish, fish eggs, crabs, chitons, algae, and clams all of relative importance.

Sea ducks do not appear as bycatch in the Puget Sound gillnet fisheries, probably because they do not begin arriving in the Puget Sound area until November (Angell and Balcomb 1982; and Morgan 1987), when the annual salmon fishery has nearly concluded.

3.8.3 Marine Mammals

The inland marine waters of Washington support a diverse group of marine mammals. Year-around residents include harbor seals, minke whales, harbor porpoise, Dall's porpoise, and killer whales. All these animals occur primarily in north Puget Sound, the Strait of Juan de Fuca, and around the San Juan

Islands (Marine Catch Areas 4B, 5, 6, 7, and 9; Figures 3.3-1 and 3.3-14), except harbor seals, which are well distributed throughout Puget Sound. Regular winter visitors include California and Steller sea lions. Groups of male sea otters winter in the western end of the Strait of Juan de Fuca between Neah Bay and Port Angeles. More infrequent visitors include humpback and gray whales and elephant seals, although the latter may become a more important regional member, including possibly breeding on islands in the Strait of Juan de Fuca in the future as its west coast population continues to expand (Jeffries et al. 2000). Oceanic species that occasionally enter the Straits of Juan de Fuca include Pacific white-sided and Risso's dolphins. Short-finned pilot whales also used to visit the area in the past (Angell and Balcomb 1982, Green et al. 1992), and on at least one occasion a group of false killer whales reached Puget Sound (Baird et al. 1989). Virtually all the marine mammals forage in subtidal and deeper waters, especially the tidal channels. However, harbor seals and sea lions will also forage intertidally, and resident minke whales and wintering sea otters occur relatively close to shore.

3.8.3.1 Harbor Seal

Harbor seals are year-around residents and the most common marine mammal inhabiting the inland waters of Washington. Unlike many other marine wildlife species, harbor seals have experienced an average annual population growth of 6 to 8 percent during the 1980s and 1990s. An inland waters population estimated in 1978 at 2,600 by Everitt et al. (1979) had grown to more than 14,000 by 1999 (Jefferies et al. 2001). Food habit studies have shown that the significance of salmon in the diets of Puget Sound harbor seals depends on location and season. Besides salmon, harbor seals prey on herring, Pacific whiting, anchovy, tomcod, flounder, sticklebacks, and eelpouts (Scheffer and Sperry 1931; Scheffer and Slipp 1944; Keyes 1968; Calambokidis et al. 1978; Lance et al. 2001; and London et al. 2002). A recent study at Gedney Island (near Everett; Figure 3.3-1) showed that these Puget Sound harbor seals were preying almost exclusively on Pacific whiting and Pacific herring (National Marine Fisheries Service 1997). Similarly, London et al. (2002) found Pacific whiting and Pacific herring to dominate the diet of harbor seals in Hood Canal. Regardless, London et al. (2002) concluded that harbor seals do have the capability to negatively impact recovering salmon runs where escapement is small (e.g., Hood Canal chum salmon), and London et al. (2002) did identify salmon remains in 24.5 percent of 608 scat samples collected in Hood Canal.

Harbor seals can dive to 295 feet and remain underwater for 20 minutes (Angell and Balcomb 1982), but prefer to haul out on rocky shores, docks, log booms, buoys, and other structures. For this reason, they are distributed across both nearshore and deeper water habitat zones.

As with harbor seals elsewhere in the world (Northridge 1991; Lennart et al. 1994), Puget Sound harbor seals have been entangled in driftnets. In Puget Sound, Pierce et al. (1996) estimated that 15 harbor seals were entangled in the Marine Catch Area 7A gillnet fishery in 1994, based on an observed capture of two live (and released) and one dead seal during a study of that fishery.

3.8.3.2 California Sea Lion

California sea lions breed at island rookeries off southern California, the west coast of Baja California, and in the Gulf of California. A post-exploitation (mainly for meat and oil) population of about 1,000 animals breeding in California in the 1920s (Cass 1985) had increased to between 161,000 and 181,000 by 1994 (Barlow et al. 1995). After the breeding season, males migrate north to Oregon, Washington, and British Columbia. Annual populations peak off the Washington coast during March and May at numbers between 3,000 and 5,000 (Gearin et al. 2001). The percentage of California sea lions using inland marine waters of Washington has varied considerably. Systematic counts of Puget Sound California sea lions began in 1979, but intensified after the 1985 to 1986 season amid concerns of impacts these pinnipeds were having on steelhead stocks passing through the Hiram Chittendon Locks in Seattle (Pfeifer 1987; and Pfeifer et al. 1989). More than 1,000 animals were recorded in Puget Sound during 1986 (1,031), and 1995 (1,234), while counts between 1998 and 2001 ranged between 177 and 323 (Gearin et al. 2001). However, these smaller Puget Sound counts have corresponded with higher counts on the outer coast, suggesting a change in use away from inland waters (Gearin et al. 2001). Haulout sites include North Waadah Island in the Strait of Juan de Fuca, Everett Harbor in north Puget Sound, and Eagle Island, Edmonds Scuba Float, Commencement Bay, Shilshoe Bay, and 22 channel buoys in south Puget Sound (Jefferies et al. 2000).

Although California sea lions often feed in the deeper inland waters of Washington, and commonly dive to extreme depths in oceanic waters, they are more closely associated with nearshore environments. Important prey in Washington include Pacific whiting, herring, squid, spiny dogfish, gadids, and salmonids (Everitt et al. 1981; and Gearin et al. 1986, 1988). Scat samples from near Everett and at Shilshoe Bay show that Pacific whiting and herring dominate their diet (Gearin et al. 2001). While only 6 percent of the scats collected near Everett contained salmonids, 25 percent did from the Shilshoe Bay sample. However, Shilshoe Bay is located at the entrance to the Lake Washington Ship Canal where the Hiram Chittendon Locks concentrate migrating winter-run steelhead, which these sea lions heavily exploit.

California sea lions are clearly susceptible to gillnet mortality outside Washington. The California set-gillnet fishery for halibut and angel sharks is estimated to have killed about 1,000 California sea lions

annually between 1994 and 1998, based on an observed mortality of more than 100 animals (NMFS 2000). However, while monitoring the 1994 Puget Sound sockeye gillnet fishery in Marine Catch Areas 7 and 7A, Pierce et al. (1996) noted little interaction with California sea lions, and no entanglements. For the most part, California sea lions do not arrive in Puget Sound until after most salmon fisheries are complete. Two fisheries that are still open when the California sea lions arrive, and with which the sea lions interact include the late season river chum salmon and the winter run steelhead fisheries. Although sea lion entanglement in gillnets has not been reported, a small number of these animals are legally harvested by tribal fishermen (usually to protect fisheries and fishing gear) under subsistence regulations pursuant to tribal treaties (personal communication with Will Beattie, Northwest Indian Fisheries Commission, December 19, 2003).

3.8.3.3 Gray Whale

Nearly the entire Eastern North Pacific stock of gray whale, recently estimated at 26,635 individuals (Hobbs and Rugh 1999), passes twice annually along Washington's outer coast, in transit between Mexican breeding lagoons and Alaskan summer feeding grounds. Calambokidis described four patterns of gray whale use in Washington (personal communication with John Calambokidis, Cascadia Research, Senior Research Biologist, December 16, 2002). The first is the regular migrating herd that passes quickly through Washington outer coast waters. The second involves a group of about 250 whales that have taken up residency between northern California and southeastern Alaska. Although these whales move around considerably within this range, they do not partake in the annual migration to Alaska. A few of these whales can be found in the Strait of Juan de Fuca as far east as Protection Island, but most typically spend their time in Neah Bay (Figure 3.3-14). The third group is composed of what are thought to be migration stragglers, such as sick whales that do not complete the migration and find themselves exhausted and emaciated in south and central Puget Sound. These whales, generally 1 to 12 annually, suffer high mortality rates. The fourth group is comprised of about a half-dozen identified whales that annually (since 1991) spend March to May in the shallow, mud-bottomed areas of Saratoga Passage, Port Susan, Port Gardner, and Everett (Marine Catch Area 8; Figure 3.3-1), where they feed on dense populations of ghost shrimp.

Gray whales have been entangled in a variety of fishing gear (Hill and DeMaster 1999) including gillnets (Gearin et al. 1994; and Cameron and Forney 1999). Single gray whales were killed in the Makah set-gillnet fishery (Marine Catch Area 4) in 1990 and 1995, and a third was entangled but released unharmed in 1996 (personal communication with Patrick Gearin, NOAA-National Marine Mammal Laboratory, Research Biologist, December 30, 2002). Healthy gray whales are most likely to

be encountered in Marine Catch Areas 4 and 8, but not Area 7 where most gillnet fishing in Puget Sound presently occurs.

3.8.3.4 Killer Whale

Killer whales in the Pacific Northwest are classified in two distinct forms: resident and transient. The resident form is further divided into three population segments: northern, southern, and offshore. It is the southern residents, composed of three pods (J, K, and L) that frequent the San Juan Islands and enter Puget Sound on a semi-regular basis. The southern residents, like the other resident forms, feed almost exclusively on fish, especially salmon (Ford et al. 1998). These killer whale populations were exploited in the 1960s and early 1970s by the marine display trade. From a low of 67 in 1973, this population grew to 97 individuals in 1996. However, the number of animals in these groups declined dramatically to only 78 by 2001. Attributing the decline to increased vessel traffic (including whale watching), declining salmon populations, and polychlorinated biphenyl (PCB) contamination (Ross et al. 2000; and Taylor 2001), several groups petitioned in 2001 for listing the southern resident group as an entity (threatened or endangered) under the Endangered Species Act (ESA). In 2002, NMFS did not find that a listing was justifiable, but did designate the population as "depleted" under the Marine Mammal Protection Act, citing recent declines that may be attributed to pollution, prey reduction, and disturbance.

The transient form of killer whales is morphologically and behaviorally different from resident whales. In general, transients travel in smaller groups (usually less than 6), are less vocal, range from northern California to southeastern Alaska, and prey mostly on marine mammals (Bigg et al. 1987; and Ford et al. 1998). Harbor seals and harbor porpoise apparently constitute most of their diet in coastal and inland waters of the Pacific Northwest (Ford et al. 1998). The number of transients in 1995 was estimated at 179 whales.

Although mortalities have occurred with fishery interactions in Alaska (Small and DeMaster 1995), there are no recent reports (e.g., Anderson et al. 1993; Melvin and Conquest 1996; Pierce et al. 1996; and Melvin et al. 1997, 1999) that suggest Puget Sound gillnet fisheries pose an entanglement threat to killer whales.

3.8.3.5 Harbor Porpoise and Dall's Porpoise

The distribution of harbor porpoise in the inland marine waters of Washington is dramatically different compared to what it once was. Today, harbor porpoise are rarely observed in southern Puget Sound where they were once considered common (Scheffer and Slipp 1948). Pollutants, vessel traffic,

fisheries, and other factors (including competition with an increasing population of Dall's porpoise) are thought to have contributed to this change in distribution (Osmek et al. 1995, 1996). In contrast, harbor porpoise population densities in the Strait of Juan de Fuca and the San Juan Islands appear to have remained stable. The most recent estimate for this region is 3,509 animals, about two-thirds found in the Strait of Juan de Fuca (Calambokidis et al. 1997; and Laake 1997a,b).

Inland water harbor porpoise inhabit nearshore and offshore waters (Pierce et al. 1996), where they feed largely on schooling fishes, such as herring, and cephalopods such as squid and octopus (Wilke and Kenyon 1952; and Angell and Balcomb 1982). Salmon do not appear to be an important component of their diet. Harbor porpoise are, however, encountered in Washington gillnet fisheries. In 1988, at least 102 harbor porpoise were killed in the outer coast Marine Catch Area 4 and 4A gillnet fishery (Figure 3.3-14), and another 52 were taken between 1989 and 1992 (Osmek et al. 1996). Only two porpoise were taken in Marine Catch Areas 4B and 5 between 1988 and 1993, and two were entangled (one released) in the 1994 sockeye gillnet season in Marine Catch Area 7 (Osmek et al. 1996; and Pierce et al. 1996). Melvin et al. (1999) report that two harbor porpoise were captured (fate unknown) in a 1996 test sockeye fishery in Marine Catch Area 7.

Dall's porpoise are commonly found in the Strait of Juan de Fuca and through Admiralty Inlet (Marine Catch Areas 4B, 5, 6, 7, and 9), but rarely extend farther south into Puget Sound than Possession Bar (Marine Catch Area 9), or north into the Strait of Georgia (Marine Catch Area 7A; see Figure 1.1-1) (Angell and Balcomb 1982). Nysewander et al.'s (2001a) observations suggest that movements of Dall's porpoise into South Puget Sound is most likely to occur during winter.

During 1994 boat surveys in Marine Catch Area 7, Pierce et al. (1996) observed 18 Dall's porpoise, all in Haro Strait (Figure 3.3-1). Seventeen (94%) of these were greater than one mile offshore (averaging more than 3 miles), indicating their preference for deep-water habitats. Morejohn (1979) described their diet as predominately deep-water schooling fish and squid. Although diet information from inland waters is limited (Scheffer and Slipp 1948), Dall's porpoise inhabiting the Strait of Juan de Fuca likely feed on Pacific whiting, Pacific herring, and squid. Although animals from the California/Oregon/Washington stock are often captured in oceanic drift gillnet and trawl fisheries (Perez and Loughlin 1991; and Cameron and Forney 1999), there is little evidence of interaction with inland water salmon gillnet fisheries. The only report is of three Dall's porpoise incidentally taken in a 1996 test sockeye fishery in Marine Catch Area 7 (Melvin et al. 1999).

3.8.3.6 Sea Otter

In 1969 and 1970, 59 sea otters were translocated from Alaska to the Washington outer coast (Bowlby et al. 1988; and Jameson and Jeffries 2001). This population grew to an estimated 555 individuals in 2001 (Jameson and Jeffries 2001). Virtually the entire sea otter population inhabits the nearshore zone of the outer coast, although a large group of males has been observed since 1995 wintering along the south shore of the Strait of Juan de Fuca, 20 to 30 miles east of Tatoosh Island, in the vicinity of Sekiu and Pillar Point, respectively (Jameson and Jeffries 2000). A single otter was observed near Pillar Point (Marine Catch Area 5) in summer 2000 (Jameson and Jeffries 2000), and confirmed sightings of wandering single otters were recorded near Olympia and Tacoma (Marine Catch Areas 11 and 13; see Figure 3.3-7) in summer 2001 (Jameson and Jeffries 2001).

Sea otters have been entangled in gillnet fisheries outside Washington, but encounters within Puget Sound are rare. Wendell et al. (1985) estimated that net entanglement killed an average of 80 sea otters per year off California in the 1970s and 1980s. Lennart et al. (1994) estimated that the set-net gillnet fishery for Pacific angel shark and California halibut killed 33 sea otters during the second half of 1990. Currently, non-treaty gillnet fishing is prohibited within the sea otter range in Washington. One otter was taken in the outer coast Marine Catch Area 4 gillnet fishery in 1989 (Figure 3.3-14)(Kajimura 1990).

3.8.4 Benthic Invertebrates

Kozloff (1996) described the intertidal and subtidal communities found in the marine waters of Washington. His habitat divisions relevant to the inland waters of Washington include the intertidal and subtidal zones with rocky, sandy, or muddy sand substrates, and salt marsh. All are discussed below.

The rocky shores of greater Puget Sound support a diversity of marine invertebrates with a community composition that changes quickly with water depth. Marine invertebrates that occur in the upper reaches of the rocky intertidal zone include periwinkle snails, limpets, shore crabs, and barnacles. These invertebrates are able to withstand long periods exposed to open air and corresponding changes in temperature. As the water deepens, Nucella snails, hermit crabs, blue mussels, goose barnacles, Pisaster sea stars, and chitons dominate the intertidal community. The lower limit of the intertidal is also occupied sea anemones, sea urchins, northern abalone, and scallops. The rocky subtidal includes sea stars, anemones, urchins, abalone, and scallops, but also species unable to withstand periods of air exposure, such as octopus, broken-back shrimp, and sea slugs.

Marine invertebrates that typically inhabit the sandy intertidal zone include sand dollars, crangon shrimp, basket whelks, and burrowing sea cucumbers. Moon snails are also common in this zone, preying on a variety of clams including bent-nosed, sand, tellina, and heart cockles. Intertidal zones with muddy sand substrates support an even more diverse clam population including gaper, geoduck, littleneck, Manila, bent-nosed, butter, soft-shelled, and heart cockle. Ghost shrimp supplant the crangon shrimp. Burrowing shore crabs extend their distribution from this habitat up into the salt marshes. Invertebrates characterizing the deeper water subtidal zone of both these habitats include brittle stars, mediaster sea stars, sea pens, and Dungeness, red, and helmet crabs.

None of the major Puget Sound/Strait of Juan de Fuca marine salmon fishing types (drift and set-gillnet, seine, troll, or sport) occur on the sea floor in a manner that would significantly disturb benthic invertebrate communities. The one exception is beach seine fisheries in Hood Canal and South Puget Sound, where nets are cast out and dragged back in to the beach. However, these fisheries are small in size, limited to the nearshore shallow zone, and occur in beach areas without potential snagging rocks (where few invertebrates live on the seafloor surface). Thus, the impact of beach seine fisheries on marine invertebrates is probably insignificant.

3.8.5 Threatened and Endangered Species

The National Marine Fisheries Service is consulting with the U.S. Fish and Wildlife Service and with itself on the effects of the Proposed Action or alternatives on these listed species. NMFS is incorporating these evaluations into the NEPA process in order to coordinate the environmental review processes as required by NEPA (40 CFR Part 1502.25). The biological evaluations and biological opinion are included in Appendix H.

3.8.5.1 Marbled Murrelet

The marbled murrelet was listed as threatened under the Endangered Species Act in 1992 after decades of population decline. Ralph et al. (1995) identified several possible causes for this decline, including loss of forest nesting habitat due to logging, mortality from gillnets and oil spills, and high predation rates. Marbled murrelets forage in nearshore marine waters and nest in inland old-growth and mature conifer forests (Hamer and Nelson 1995). Booth (1991) concluded that 82 to 87 percent of this forest that existed in 1840 has now been eliminated. Speich et al. (1992) estimated the Washington marbled murrelet population at 5,000 individuals, with 2,600 of these birds occurring in the Strait of Juan de Fuca, San Juan Island, and Puget Sound waters. Beissinger (1995), Beissinger and Nur (1997), and Nysewander et al. (2001b) have concluded that the marbled murrelet population has declined significantly since that time.

Thompson (1997) conducted surveys for marbled murrelets along the Strait of Juan de Fuca (Marine Catch Areas 4 and 5) in 1996 and 1997, and found about 20 to 50 birds between Neah Bay and Pillar Point, and a large aggregation of 500 to 1,000 between Pillar Point and Port Angeles (Figure 3.3-14). The highest densities of birds were found 656 feet offshore. The San Juan Islands and Rosario Straits area (Marine Catch Areas 7 and 7A) has the highest concentrations of marbled murrelets in greater Puget Sound. On August 15, 1995, Ralph et al. (1996) observed between 404 and 467 murrelets during systematic boat surveys of the islands. Burrows Bay (east of the San Juan Islands in Marine Catch Area 7) apparently supports significant numbers (100 to 200) of murrelets from August to October (Courtney et al. 1997; Stein and Nysewander 1999; and Raphael et al. 2000). Courtney et al. (1997) surveyed Admiralty Inlet and Hood Canal south to Quatsop Point and found numbers of marbled murrelets varying between 205 and 476. Surveys conducted in waters east of Whidbey Island (Skagit Bay, Saratoga Passage, and Everett Bay) – Marine Catch Area 8 – by Courtney et al. (1997) showed a decline from more than 250 birds in 1995 to about 125 in 1996. South Puget Sound has been surveyed by Courtney et al. (1997), Raphael et al. (2000), and Nysewander et al. (2001a), none of whom found murrelets in any abundance.

Because marbled murrelets have been incidentally caught in the Puget Sound salmon gillnet fisheries (Pierce et al. 1994, Erstad et al. 1994; Northwest Indian Fisheries Commission 1994; Lummi Nation 1994; and Gearin et al. 1994), Pierce et al. (1996) monitored the 1994 Puget Sound sockeye gillnet fishery (Marine Catch Areas 7 and 7A) to quantify the impact to murrelets. After observing more than 2,200 gillnet sets (7% of the total sets), and recording only one marbled murrelet entanglement, the authors estimated that the fishery may have killed approximately 15 murrelets. Melvin et al. (1997) recorded one murrelet entanglement in 642 sets (at Burrows Bay) of modified test gillnets designed to reduce seabird mortality.

3.8.5.2 California Brown Pelican

The California brown pelican is a colonial nester in Mexico and southern California that wanders north as far as British Columbia during the non-breeding period. The population segment that nests in California represents about 10 percent of the total population, and nesting colonies are currently confined to a few locations in the Channel and Santa Barbara Islands. These colonies suffered dramatic declines in the 1960s from the effects of chlorinated hydrocarbons (DDT, DDE). Eggshell thinning from these pesticide derivatives resulted in dramatic nesting failures to such an extent that the 1969 and 1970 nesting seasons were virtually shut down (Anderson et al. 1975; Anderson and Gress 1983; and Carter et al. 1992). Consequently, the California population of brown pelican was federally listed as

endangered in 1970. The population was further impacted in the mid-1970s by crashes in stocks of their principal prey, northern anchovy. Since that time, the brown pelican population has recovered dramatically with the West Anacapa Island (Channel Islands) colony supporting 4,000 to 6,000 nesting attempts annually, and the nearby Santa Barbara Island colony supporting 400 to 700 nesting attempts.

Since recovery, brown pelicans have become more prevalent along the Washington coast, especially during the fall. By 1991, more than 7,000 brown pelicans were observed using the Washington coast, mostly in the vicinity of the Columbia River and Grays Harbor (Jaques 1994). Angell and Balcomb (1982) stated that brown pelicans make only rare appearances in Puget Sound. Brown pelicans feed primarily on schooling baitfish, especially anchovy, and are not known to interact with salmon fisheries.

3.8.5.3 Bald Eagle

The bald eagle was listed as threatened under the Endangered Species Act in 1978 after decades of persecution (despite the Bald Eagle Protection Act of 1940), nest failure due to chlorinated hydrocarbon (DDT) contamination, loss of prey due to declining salmon runs, and habitat loss due to logging and human development. The summer population of bald eagles prior to European settlement of Washington was estimated at about 6,500 birds (Stinson et al. 2001). By 1980, this population had declined to only 105 pairs (103 in western Washington). Increased protection and recent recovery efforts since then have resulted in a dramatic increase in the state's breeding population. In 1998, the number of occupied nests had increased to 664 (active pairs), and the number of nesting territories to 817. These populations are continuing to grow toward a predicted carrying capacity of 733 active pairs (Stinson et al. 2001). One of the more dramatic population increases occurred in the San Juan Islands where five nesting territories in 1962 had grown to 102 by 1998 (Stinson et al. 2001). Collectively, the 12 counties encompassing Washington's inland marine waters currently support 76 percent (617) of the state's bald eagle nesting territories. Overall, the Washington nesting population exhibits the high productivity expected of a growing population. One exception, however, is the Hood Canal nesting population, which, despite increasing from three to 33 pairs between 1980 and 1998, has consistently exhibited low reproductive success (Mahaffy et al. 2001). Studies of this population were initiated in the late 1990s (Mahaffy et al. 2001) after high levels of polychlorinated biphenyls (PCBs) and other contaminants were found, but the results were inconclusive. (PCBs were used in a variety of industrial and electrical applications, including as hydraulic fluid. Hydraulic fluid leaks and spills from shipyards and industrial-complex machinery are likely sources of Puget Sound PCB contamination.)

Between 1982 and 1989, approximately 1,000 to 3,000 bald eagles wintered annually in Washington, 80 percent coming from Alaskan and Canadian breeding areas. While the majority of these birds concentrate on major salmon rivers (especially the Skagit, Nooksack, and Columbia Rivers), the Puget Sound shorelines annually support 400 to 600 of these birds (Taylor 1989).

Watson and Pierce (1998) concluded that coastal eagles preyed more on birds, while inland (river) eagles foraged more on fish. Differences in surface behavior of fish and abundance of waterfowl and seabirds may account for these differences. However, Retfalvi (1970) found rockfish and lingcod important in the diets of San Juan Island bald eagles, and diet studies by Knight et al. (1990) and Watson and Pierce (1998) did show that both groups of bald eagles prey on a wide variety of fish and birds (perhaps a close reflection of what is available). Common bird prey included glaucous-winged gulls, scoters, grebes, and cormorants, while common fish prey included flounders, herring, Pacific whiting, plainfin midshipman, dogfish shark, and sculpins (Retfalvi 1970; Knight et al. 1990; and Watson and Pierce 1998). Salmonids were also present in the diet of bald eagles, but do not contribute as greatly to the marine diet as they do to the diet of bald eagles foraging along inland rivers and reservoirs (especially during fall and winter salmon runs).

Bald eagles do not interact with the Washington salmon gillnet fisheries, and coastal breeding birds are probably not impacted by harvest because they rarely feed on salmon at this time of the year (Watson and Pierce 1998). However, fall and winter spawning salmon are a critical food source for winter bald eagles, especially along the major spawning rivers of western Washington.

3.8.5.4 Steller Sea Lion

The Steller sea lion was listed as threatened under the Endangered Species Act in 1990, after a decade of 12 percent annual population declines in the Aleutian Islands and Gulf of Alaska (NMFS 2001a). However, the eastern population segment that ranges from southeastern Alaska to California, has remained stable or increased slightly (NMFS 2001a,b). There is no indication that Steller sea lions breed in Washington, but each year a few hundred overwinter in the inland waters (Everitt et al. 1979), likely originating from rookeries in Oregon and British Columbia (NMFS 2001b). A known haulout is located on Sucia Island immediately north of Orcas Island within the San Juan Islands (Marine Catch Area 7; Figure 3.3-1) (Angell and Balcomb 1982).

Steller sea lions use both nearshore and deeper (greater than 60 feet) waters. Diet studies in Oregon showed a preference for Pacific whiting and lampreys, although Pacific herring, eulachon, anchovy, sculpin, and salmon, were also important (Beach et al. 1985; Reimer and Brown 1996). Steller sea lions

are caught incidentally in fisheries. Perez and Loughlin (1990) estimated that 20,000 of these animals were incidentally caught in the Alaska trawl fisheries between 1966 and 1988. Matkin and Fay (1980) calculated that more than 300 were shot while interfering with the 1978 Copper River gillnet fishery. Stellar sea lions have been occasionally taken in gillnets and trawls off Oregon and Washington (NMFS 1992), but there are no reports of incidental captures in Washington inland waters.

3.8.5.5 Humpback Whale/Fin Whale

Humpback whales occur seasonally off the Washington coast, inhabiting continental shelf and shelf-edge waters (Green et al. 1992; and Calambokidis et al. 2000, 2001). They rarely enter Washington inland marine waters, although they were once so common that a whaling station was established at Victoria, British Columbia (Schmitt et al. 1980). Today, just a very few humpback whales annually frequent the Canadian side of the Strait of Juan de Fuca, and about every other year, humpbacks stray into Puget Sound (personal communication with John Calambokidis, Cascadia Research, Senior Research Biologist, December 16, 2002). Humpback whales use of greater Puget Sound is likely too infrequent to interact with the salmon gillnet fisheries.

There are no recently confirmed sightings of fin whales in the inland marine waters of Washington, although they have been reported in the Strait of Georgia. However, in the past few years, three large ships have docked in Puget Sound (Cherry Point, Everett, and Port of Seattle) with struck fin whales still adhering to their bows (personal communication with John Calambokidis, Cascadia Research, Senior Research Biologist, December 16, 2002). It is suspected that one of the whales was part of the Strait of Georgia group, and another was struck in the western Strait of Juan de Fuca. However, there are no reports of encounters with fin whales in Puget Sound salmon fisheries.

3.8.5.6 Pacific Leatherback Turtle

Pacific leatherback turtles were listed as endangered throughout their range under the jurisdiction of the Endangered Species Act after experiencing precipitous declines in their nesting populations (NMFS and USFWS 1998). Although they do not nest in U.S. Pacific waters, Pacific leatherback turtles do inhabit the shelf and offshore Pacific Ocean waters of the United States, including Washington (Bowlby et al. 1994), during the summer months. Their entanglement with fishing gear has been well-documented in other areas (NMFS and USFWS 1998). However, leatherback turtle use of the inland waters of Washington is accidental at best; therefore, this species is unlikely to interact with Puget Sound salmon fisheries.