Section 4. Natural History of and Factors Affecting the Snowy Plover

4.1. Description and Taxonomy

The western snowy plover (*Charadrius alexandrinus nivosus*) is a small shorebird in the family Charadriidae. Adults range from 15 to 17 centimeters (cm) long, and weigh 34 to 58 grams (Page et al. 1995a). Adults are pale brown-gray on the upperparts and white below, with a white hindneck collar and dark lateral breast patches. The bill is black and the legs are slate gray to black. In breeding plumage, males usually have black markings on the forehead, foreneck, and behind the eye. In females, these markings are generally lighter, varying from drab to mostly black. Early in the breeding season, a rufous crown may be seen on males but not on females. In non-breeding plumage, the sexes cannot be distinguished. Fledged juveniles may be distinguished from adults by the white edges on their wing coverts and scapulars until they molt to their basic plumage. Onset of this molt is determined by hatching date, and usually occurs from July to mid-September (Page et al. 1995a). In Oregon, an average of 48 percent of the fledglings banded return the following year (Castelein et al. 2002).

The American Ornithologists' Union (1957) recognizes two subspecies of *Charadrius alexandrinus* in North America. *C. a. nivosus* breeds along the Pacific Coast from southern Washington to southern Baja California, east to the Harney Valley in Oregon, Salton Sea in California, Nevada, Utah, Arizona, New Mexico, Colorado, Kansas, Oklahoma, Texas and possibly Tamaulipas, Mexico (Davis and Russell 1984). *C. a. nivosus* winters along the Pacific coast, Gulf of California, and the Gulf of Mexico. This Habitat Conservation Plan (HCP) focuses on the population of *C. a. nivosus* that winters and breeds along the Oregon coast. *C. a. tenuirostris* breeds along the Gulf of Mexico coast and in the Caribbean. This subspecies winters from western Florida and the Bahamas to the Virgin Islands, south to the coast of northern Venezuela. More recent works recognize only *C. a. nivosus* for North America (Hayman et al. 1986; Sibley and Monroe 1990). Paton (1994) estimated a mean lifespan for adult snowy plovers breeding at the Great Salt Lake in Utah of 2.7 years.

4.2. Life History

4.2.1. Breeding

Population Size and Distribution

The current Pacific coast breeding population of snowy plover extends from Damon Point, Washington, to Bahia Magdalena, Baja California, Mexico (Page et al. 1995a). There are approximately 2,230 birds breeding along the Pacific coast of California (Fish and Wildlife Service unpublished data 2006), 162 resident adults in Oregon (Lauten et al. 2006), and 70 adult birds in Washington (Pearson et al. 2007). A survey of breeding snowy plovers along the Pacific coast of Baja California, Mexico in 1991 and 1992 found 1,344 adults (Palacios et al. 1994). A current population estimate for Baja Mexico is 2,470 (Fish and Wildlife Service 2006).

The Pacific coastal population of snowy plover in Oregon was once found along the entire coast but is currently located among eight breeding areas from Florence south (Oregon Department of Fish and Wildlife 1994; Lauten et al. 2006). Oregon breeding sites in 2006 included Sutton Beach, the Siltcoos River estuary, beachgrass removal sites at Dunes Overlook, the Tahkenitch Creek estuary, the Tenmile Creek estuary, Coos Bay North Spit, Bandon State Nature Area (SNA), and the New River spit area. Other Oregon sites where snowy plovers have nested in the recent past (since 1980) include the beach between Clatsop Spit and Gearhart, mouth of the Necanicum River, Bayocean Spit, Sand Lake Spits, South Beach (Newport), mouth of the Siuslaw River, Threemile Creek/Umpqua River, Menasha Spoils (Coos Bay North Spit), and the Floras Lake area (Bruce and Walter 1981).

Arrival and Courtship

Nesting birds at coastal locations consist of both year-round residents and birds that migrate for the winter (Page et al. 1995a). Snowy plovers begin arriving at their Oregon breeding sites in early March (Wilson 1980). Since some individuals nest at multiple locations during the same year, birds may continue to arrive through July.

Although pair bonds are first noticed on the breeding grounds, they are likely to begin while birds are together in wintering flocks. Mated birds from the previous season frequently reunite (Page et al. 1995a). Old and new pair bonds may be established prior to territory defense and nest scraping (Warriner et al. 1986). In Oregon, bonding and courtship activities may begin during the winter months, but increase significantly in March.

During courtship, males appear to solicit females by calling from their territories and by using a horizontal display in which the male's bill, body, and tail are held parallel to the ground as the male walks in a partial crouch (Page et al. 1995a). Males make multiple depressions, or scrapes, in the sand, and one is selected for the nest. Prior to

copulation, the female will scrape in the nest while the male bows next to the female and simultaneously flashes the white on his tail (Page et al. 1995a).

Nests and Nesting Habitat

On the Oregon coast nesting may begin as early as mid-March (Wilson-Jacobs and Meslow 1984), with peak nest initiation occurring from mid-May to early July (Stern et al. 1990). Along the Pacific coast snowy plovers nest primarily above the high tide line on coastal beaches, sandy spits, dune-backed beaches, sparsely-vegetated dunes, beaches at creek and river mouths, and salt pans at lagoons and estuaries. Less common nesting habitats include bluff-backed beaches, dredged material disposal sites, salt pond levees, dry salt ponds, and river bars. These habitats tend to be unstable because of winds, wave action, and unconsolidated soils. Along the Oregon coast, snowy plover nesting habitat is characterized by wide, open, sandy beaches, river mouths, or dredge spoils, often with scattered driftwood or vegetation. Driftwood, wrack, and native dune plants often harbor snowy plover food sources and provide cover for chicks hiding from predators. Driftwood and plants can also provide protection from wind. Where there is a foredune, a gentle slope down to the beach provides openings for birds to move between the relatively sheltered habitat behind the foredune and the open beach.

Nests consist of a shallow scrape or depression in the sand, lined with small bits of beach debris. Nests are typically located on sparsely vegetated sandy beaches with some driftwood and vegetation. Wilson-Jacobs and Meslow (1984) found that nests are more likely to be located within 20 meters of driftwood or vegetation than would be predicted randomly. As wind causes many nests to be buried, nests that are behind the foredune, a piece of driftwood, or some other windbreak, may be more successful than those on the open beach (Castelein and Lauten, pers. comm. 2002). Most nests are within 100 meters of water, but can be several hundred meters away when there is no vegetative barrier between the nest and the water, allowing the chicks to have easy access to the shoreline (Page and Stenzel 1981; Powell et al. 1995, 1996). Snowy plovers show a high degree of breeding site fidelity, but also disperse among breeding sites within and between years (Warriner et al. 1986; Stenzel et al. 1994).

Egg Laying, Clutch Size, and Incubation

Egg-laying usually takes 4 to 5 days (Warriner et al. 1986). The usual clutch size is three eggs (range two to six) (Page et al. 1995a). Single-egg clutches are almost always abandoned (Warriner et al. 1986). Incubation is intermittent over incomplete clutches. Sustained incubation begins after the third egg is laid and averages 28.4 to 26.9 days (Warriner et al. 1986). Both sexes incubate the eggs, with the female tending to incubate during the day and the male incubating at night. In Oregon, mean nest success (percent of nests hatching at least one egg, calculated using the Mayfield

method (Mayfield 1961, 1975) from 1990 through 2006 was 42.8 percent, with a range of 13 to 72 percent (Lauten et al. 2006). During this time, exclosures were placed around some nests to reduce losses from predators. Exclosures initially included large boxes made of fencing material designed to prevent access to the nest by predators. These evolved into smaller mini-exclosures that are now used due to ease of transport and speed of installation. Mean nest success for standard exclosures and mini-exclosures was 68.4 percent. The mean nest success for nests without exclosures was 19.7 percent (Lauten et al. 2006).

When disturbed by approaching people or predators, incubating adults typically run from the nest, usually without being seen; however, they will fly when surprised (Page et al. 1995a). During hatching, and occasionally during incubation, adults will attempt to lure people or predators away from nests with alarm calls and distraction displays (Page et al. 1995a). Young snowy plovers on the other hand have limited mobility. Their main defense against predators is to remain still and hunker down in depressions in the sand. They rely on camouflage provided by their early downy feathers to protect them from predation. Snowy plovers readily re-nest after loss of their eggs (Wilson 1980; Warriner et al. 1986). As many as five re-nesting attempts have been observed for a pair (Warriner et al. 1986). After hatching, females typically leave the male to rear the brood to fledging and attempt to re-nest with a different male. This allows the female to find a new mate and lay a second, and occasionally third clutch of eggs (Page et al. 1995a). Males may also mate again and initiate second clutches after the first clutch has fledged.

Brood-rearing

Along the Oregon coast, hatching occurs from mid-April through mid-August, and the chicks fledge approximately 31 days after hatching (Warriner et al. 1986). Peak hatching occurs from June through July, and most fledging occurs from mid-July through August, though some individuals from late nests may not fledge until the third week in September.

Newly hatched young are precocial and leave the nest approximately 1 to 3 hours after hatching, usually staying within 100 meters of the nest (Boyd 1972). Chicks leave the nest permanently within hours of the last chick hatching. If the third egg of a clutch is 24 to 48 hours behind the others in hatching, it may be deserted. Chicks are able to walk, run, swim, and forage, but require periodic brooding from parents for many days after hatching (Page et al. 1995a). Most chick mortality occurs within 6 days after hatching (Warriner et al. 1986). This is the period when chicks are least mobile. Adults lead chicks to suitable feeding areas, warn chicks of approaching predators with alarm calls, use distraction displays to draw predators away from chicks, and lead larger chicks away from predators. Adults also chase and fight other snowy plovers that come too close to their broods (Page et al. 1995a).

Most broods remain within 1 mile of the nesting area until fledging, but some have traveled as far as 7 miles from the nest (Casler et al. 1993; Hallett et al. 1994), often to a river mouth. During the first 7 days following hatching, thermoregulation is an issue for snowy plovers (Lauten pers. com. 2002). The survival rate after 16 days is generally 97 percent (Page et al. 1995a)

Fledging Success

The fledging success of snowy plovers (percentage of hatched young that reach flying age) varies considerably between years, and between nesting beaches within the same year. In Oregon, between 1990 and 2006, the mean fledging success was 39 percent, with a range of 11 to 55 percent (Stern et al. 1990, 1991; Craig et al. 1992; Casler et al. 1993; Hallett et al. 1994, 1995; Estelle et al. 1996; Castelein et al. 1997, 1998, 2000a 2000b, 2001, 2002, 2003; Lauten et al. 2006). In 2004, the 55-percent rate (a total of 107 fledglings were confirmed) was the highest since monitoring began in 1990.

4.2.2. Productivity

Because female snowy plovers may lay clutches with more than one male, and because males are responsible for the majority of post-hatching parental care, the measure of reproductive success used in the Recovery Plan is the number of young fledged per adult male (Warriner et al. 1986; Nur et al. 1999). For Oregon, Nur et al. (1999) report a mean number of young fledged per adult male of 1.04 between 1993 and 1997. Between 1996 and 2001 (the period for which the best data are available), the average number of young fledged per male was 0.77, with a range of 0.58 and 1.28 (Estelle et al. 1996; Castelein et al. 1997, 1998, 2000a, 2000b, 2001, 2002, and 2003).

Since 1991, predator exclosures have been used to limit losses to nest predation. Although exclosures do nothing to improve fledging success, they have improved nest success. Without this intervention, the number of young hatched would likely have been much lower, possibly resulting in a lower number of young fledged per male.

4.2.3. Feeding Habits and Habitats

Snowy plovers are primarily visual foragers, and will look, run, stop, and then peck at prey items from the surface of the beach. They feed on terrestrial and marine invertebrates found above and below the mean high tide line, often in wrack washed up on the shore (Page et al. 1995a). They will occasionally probe in the sand at the base of low-growing plants for insects. Reported food items along the Pacific coast include sand hoppers (*Orchestoidea*), small fish, mole crabs (*Emerita analoga*), crabs (*Pachygrapsus crassipes*), polychaetes (*Neridae, Lumbrineris zonata, Polydora socialis, Scoloplos acmaceps*), amphipods (*Corophium* spp., *Ampithoe* spp.,

Allorchetes angustus), tanadacians (*Leptochelia dubia*), flies (*Ephydridae, Dolichopodidae*), beetles (*Carabidae, Buprestidae, Tenebrionidae*), clams (*Transenella* sp.), and ostracods (Reeder 1951; Jacobs 1986; Page et al. 1995a).

4.2.4. Migration

The Pacific coast population of the snowy plover consists of both migratory individuals and year-round residents (Warriner et al. 1986). Birds nesting along the Oregon coast have wintered in California as far south as San Diego (M. Stern, unpublished data), and it is likely that some birds also winter in Washington. In California, migrant snowy plovers leave their nesting areas from late June to late October (Page et al. 1995a); the timing along the Oregon coast is likely similar. Snowy plovers wintering in Oregon tend to disperse in March; some remain in Oregon to breed (though not necessarily at the same beach used over the winter), and some migrate to Washington or California. Likewise, some birds wintering in California or Washington return to Oregon to breed (Stern et al. 2000).

4.2.5. Wintering

Distribution and Abundance

The Recovery Plan anticipates that less than 2 percent of the wintering snowy plover population would occur in Oregon (Fish and Wildlife Service 2007), and currently less than three 3 percent of the population has been found to winter in the state (Fish and Wildlife Service unpublished data). The snowy plover winters mainly in coastal areas from southern Washington to Central America (Page et al. 1995a). Wintering locations in Oregon consist of the following sites:

- Siuslaw North Jetty,
- Sutton/Baker Beach,
- Siltcoos Breach,
- Siltcoos Estuary/Dunes Overlook/Tahkenitch,
- Tenmile,
- Coos Bay North Spit,
- Bandon SNA, and
- New River (Fish and Wildlife Service 2001).

Bayocean Spit has been used as a plover wintering site in recent history. However, few plovers have been observed at the site since 2000 (unpublished data, Fish and Wildlife Service 2008). In winter, snowy plovers are found on many of the beaches used for nesting as well as on beaches where they do not nest, in human-made salt ponds, and on estuarine sand and mud flats. Both coastal and interior populations use

coastal locations in winter (Stern pers. comm. 2002). Birds that nest on the Oregon coast have wintered as far south as San Diego, California, and some birds that nest in California and Washington winter along the Oregon coast (Page et al. 1995a). Even though less than 2 percent of the Pacific coast snowy plover population may winter on the Oregon Coast, it is thought that approximately 80 percent of those birds breeding in the state also stay through the winter. Therefore the availability of good wintering habitat is vital to the recovery of plovers in Oregon.

Fewer than 40 plovers winter on the Washington coast, and around 100 winter on the Oregon coast. More than 2,500 winter along the mainland California coast, and hundreds more at the San Francisco Bay and Channel Islands (Fish and Wildlife Service 2001). Surveys of mainland coastal sites in California (including San Francisco Bay) and Oregon between November and February, 1979 to 1985, suggest that approximately 3,100 plovers wintered there (Page et al. 1986). The 2006 winter window survey numbers for Washington, Oregon, and California are 38, 104, and 3,524, respectively, totaling 3,666 individuals (Fish and Wildlife Service unpublished data).

Site Fidelity

There are no published data on winter site fidelity of birds from coastal Oregon. Some studies have been conducted on snowy plovers from populations further inland. While these studies are instructive the data may not be completely transferable to the coastal snowy plover population. For example, after 166 adults and 204 chicks were banded at Lake Abert in interior Oregon, 15 percent of the banded birds were relocated on their wintering grounds in California. Of those birds located during winter, 67 percent of the adult males, 73 percent of the adult females, and 60 percent of the birds banded as chicks were found in the same winter location for at least 2 consecutive years, and 33 percent of the males, 32 percent of the females, and 35 percent of the birds banded as chicks were found at the same winter location for at least 3 years (Page et al. 1995b).

Unpublished reports on winter site fidelity along the Oregon coast suggest a much stronger fidelity to overwintering sites. Observations of wintering snowy plovers following the New Carissa accident found that, of the 21 adult males and 23 adult females that wintered at sites along the Oregon coast in both 1998/1999 and 1999/2000, all of the birds wintered at the same location both seasons indicating that the [coastal] adult plovers have very strong inter-annual fidelity to individual wintering sites. Strong site fidelity to wintering sites was further demonstrated by eight adult plovers that wintered at the same sites in both 1998/1999 and 1999/2000, even though they bred elsewhere, presumably in Washington or California (Lauten pers. comm.).

Behavior

Snowy plovers tend to be gregarious in winter, often feeding and roosting in loose flocks (Page et al. 1995a). Roosting snowy plovers will often sit in small depressions in the sand, or in the lee of kelp or other debris that provides some shelter from the wind and makes the birds more difficult for predators to detect. When disturbed, roosting birds often run a few meters to new positions, sometimes displacing other individuals (Page et al. 1995a).

4.3. Population Status and Trends

4.3.1. Historical Trends

Overall, snowy plover numbers and breeding locations have declined on the U.S. Pacific coast over the past century. Between 1977 and 1980 there were an estimated 2,300 breeding snowy plovers along the coasts of Washington, Oregon, and California. In 1988–1989 this number was estimated to be 1,900 (Page et al. 1991). Historical trends within Oregon and Washington are discussed below.

Oregon Coast

Historical information on snowy plovers in Oregon prior to the 1970s is fragmented. Gabrielson and Jewett (1940) state that it was a "permanent resident of such spits as those at Bayocean, Netarts, Siletz, and Pistol River, where its lacy tracks are in evidence everywhere among the thick evergreen patches of the sand verbena (*Abronia*) that grow above the high tide line in the dry sand dunes that it frequents." Snowy plovers are no longer found during the breeding season at any of the sites Gabrielson and Jewett list. Snowy plovers historically bred at a minimum of 21 locations on the coast (ODFW 1981). By 1978, birds were present at only 12 of these sites (Wilson 1980); and by 2003, snowy plover were nesting at only seven sites (Castelein et al. 2003).

In addition to the reduction in the number of sites supporting snowy plovers, the numbers of snowy plovers at the remaining sites has declined. By 1972, biologists with the Oregon Department of Fish and Wildlife were concerned that the coastal population of snowy plovers was dwindling (Hoffman 1972, ODFW unpublished data). In August 1972, Hoffman counted 216 (adult and juvenile) snowy plovers at 19 beaches along the Oregon coast and estimated a maximum population of about 300 individuals; this is more than twice the size of the current statewide adult breeding population of approximately 177 to 179 (Lauten et al. 2006).

In Oregon, annual window surveys conducted by ODFW of adult snowy plovers began in 1978 and continue to the present, with counts ranging from a high of 139 in 1981 to a low of 30 in 1992 (Castelein et al. 2002). Window surveys are a one-time

pass of a surveyor or team of surveyors through potential snowy plover nesting habitat during January (Table 4.1), and again in May or June (Table 4.2). The surveyor counts all adult snowy plovers in the habitat and separates the adults into males and females when possible. These surveys are used as an index to examine population trends at each site and coast-wide. These surveys also allow for a comparison of the number of snowy plovers using each site during different times of the year. A lack of detections at a given location does not mean that no snowy plovers will use that site during the year.

Table 4.-1. Numbers of Snowy Plovers Counted During Winter Window Surveys along the Oregon Coast

Area	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996*	1995	1994	1993	1992	1991
Columbia R-Necanicum R	-	0	0	0	0	0	0	0	-	0	-	0	-	-	-	0	0
Nehalem Spit	0	0	0	0	0	0	0	0	-	-	-	0	-	-	0	0	0
Bayocean Spit	0	0	0	0	0	0	0	1	4	5	4	3	4	0	5	3	3
Netarts Spit	0	0	0	0	0	-	6	-	-	0	-	0	-	-	-	-	-
Sand Lake Spits	-	-	-	0	0	-	0	0	0	0	-	0	-	-	-	0	0
Nestucca Spit	0	0	0	0	0	-	0	0	-	0	-	-	-	-	-	0	0
Neskowin Beach	-	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-
Siletz Spit	-	0	0	0	0	-	-	-	0	0	-	0	0	-	0	0	0
South Beach, Newport	0	0	0	-	0	0	0	-	-	-	-	-	-	0	0	0	0
Seal Rock-N Spit Alsea Bay	0	-	-	0	0	-	0	0	0	0	-	-	0	-	-	-	0
S Spit Alsea Bay-Big Creek	-	-	-	0	0	-	-	0	0	-	-	-	-	-	-	-	-
Berry Ck-Sutton Ck	13	21	9	8	17	0	25	17	14	13	14	14	0	6	10	11	6
Sutton Ck-N Jetty Siuslaw	6	0	0	11	4	9	-	-	-	-	-	-	0	0	0	0	0
Siuslaw R-Siltcoos Spit	36	26	38	20	19	5	0	0	23	26	22	3	4	0	0	11	10

Area	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996*	1995	1994	1993	1992	1991
Siltcoos Spits	0	0	0	-	2	24	34	20	1	0	0	11	19	18	1	0	0
Siltcoos Spit-Tahkenitch Spits	0	2	9	0	0	0	0	0	0	-	0	1	-	0	6	0	0
Tahkenitch Spits	0	1	5	-	0	-	0	1	0	-	7	4	0	0	0	0	0
Tahkenitch Spit-Threemile Ck	-	-	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0
Threemile Spit-N Jetty Umpqua River	0	0	0	0	-	0	0	0	0	0	-	0	-	0	1	0	0
S Jetty Umpqua River-Tenmile Spit	0	27	13	0	0	0	1	3	0	0	0	1	0	0	7	12	0
Tenmile Spits	10	0	0	0	8	-	0	11	0	-	19	21	18	12	0	0	0
Tenmile Spit-Horsfall Beach	-	0	-	0	0	-	14	0	0	12	0	0	0	0	13	0	0
Horsfall Beach-N Jetty Coos Bay	-	0	9	0	0	0	0	0	7	0	0	0	0	0	0	0	0
Coos Bay N Spoil	0	0	0	0	-	-	-	-	-	0	-	0	0	0	0	0	0
Coos Bay S Spoil (94/95 HRA)	6	15	0	0	3	0	6	1	-	0	0	-	0	0	0	0	0
Whiskey Run-Coquille R	0	0	0	0	-	0	0	-	-	-	0	0	0	0	2	-	0
Bandon St Pk-New River	19	27	26	0	0	1	8	6	18	19	14	2	24	0	13	17	19
New River-Floras Lake	14	23	-	0	18	15	0	6	0	-	4	4	2	0	0	0	0
Euchre Ck-Greggs Ck	-	0	0	0	0	0	0	0	0	-	0	-	-	0	0	-	-

Area	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996*	1995	1994	1993	1992	1991
Myers Ck-Pistol R	0	0	0	0	0	0	0	0	0	-	0	0	-	-	0	-	-
Sixes/Winchuck/ Elk	0	0	0	0	0	0	0	0									
TOTAL COUNT	104	154	96	39	71	54	88	66	67	75	84	69	71	36	58	54	38

*1996 counts occurred over several days due to poor weather conditions. Duplicate counting of individual birds is believed to be minimal because 47 birds were identified by color bands. Source: FWS 2008.

Table 4.2. Numbers of Snowy Plovers Counted During Breeding Window Surveys along the Oregon Coast

Area	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991
Columbia River-Necanicum River	0	0	0	-	0	2	0	-	0	0	-	-	-	-	-	0	0
Nehalem Spit	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	0	0
Bayocean Spit	0	0	0	0	-	-	-	-	?	0	0	0	6	0	2	0	0
Netarts Spit	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-
Sand Lake Spits	0	0	0	0	0	0	0	-	-	0	-	-	0	-	-	0	0
Nestucca Spit	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	0	0
Neskowin Beach	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	0	-
Siletz Spit	0	0	0	-	-	-	0	-	-	0	-	-	-	0	0	0	0
South Beach, Newport	0	0	0	-	-	-	-	-	-	-	-	-	-	0	0	-	-
North Spit Alsea Bay	0	0	0	-	-	-	-	-	-	0	-	-	0	-	0	0	-
Heceta Head-Sutton Creek	0	0	0	-	1	4	16	-	0	-	5	5	2	0	0	2	-

Area	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991
Sutton Creek-North Jetty Siuslaw	-	2	0	-	0	0	-	-	-	2	-	-	0	0	0	0	0
Siuslaw River-Siltcoos Spit	-	0	0	0	-	0	-	-	0	-	0	1	3	0	0	1	0
Siltcoos Spits	16	18	11	5	7	8	9	-	13	4	3	5	2	3	0	0	0
Siltcoos Spit-Tahkenitch Spits	19	2	9	13	8	4	8	-	2	0	-	-	0	2	0	2	0
Tahkenitch Spits	5	1	5	8	11	17	24	-	0	7	3	1	9	4	0	0	0
Tahkenitch Spit-Threemile Creek	-	-	0	-	-	0	-	-	0	0	2	8	0	0	0	0	0
Threemile Spit-North Jetty Umpqua River	-	0	0	-	-	0	-	-	0	0	2	0	0	0	0	2	0
South Jetty Umpqua River-Tenmile Spit	-	0	-	-	-	3	-	-	-	0	0	0	0	0	-	6	6
Tenmile Spits	17	15	13	12	6	9	10	-	0	4	1	0	2	3	6	3	4
Tenmile Spit-Horsfall Beach	-	-	-	-	-	-	-	-	2	0	4	3	2	0	2	0	0
Horsfall Beach-North Jetty Coos Bay	-	-	0	-	-	-	-	-	0	3	5	16	8	13	4	7	7
Coos Bay North Spoil	26	27	27	-	-	-	-	-	-	-	-	-	-	0	7	0	4

Area	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991
Coos Bay South Spoil (94/95 HRA)	-	-	-	21	16	13	14	-	15	17	14	20	18	15	0	0	0
Whiskey Run-Coquille River	0	0	0	-	0	0	0	-	-	0	0	0	0	0	0	-	-
Bandon State Park-New River	15	12	22	8	2	2	3	-	2	3	7	8	10	9	12	2	9
New River-Floras Lake	17	14	13	16	16	9	11	-	18	23	39	29	10	11	12	5	5
Sixes River	-	0	0	-	0	0	-	-	-	-	0	-	0	0	-	-	-
Elk River	0	-	-	-	0	0	0	-	-	-	0	0	0	-	-	-	-
Euchre Ck-Greggs Creek	-	0	0	-	0	0	0	-	-	0	0	0	0	0	0	-	-
Myers Creek-Pistol River	-	0	0	0	0	0	0	-	-	0	0	0	-	-	0	-	-
TOTAL COUNT	125	91	100	83	63	71	95	-	52	63	85	96	72	60	45	30	35

Source: FWS 2008

Washington Coast

Records for snowy plovers in Washington date from 1899 (Bowles 1918). There were at least five historic breeding areas on the Washington coast (Washington Department of Fish and Wildlife 1995). Although Bowles characterized snowy plovers as "quite common" in Pacific County in 1914, most early accounts described snowy plover abundance at specific sites with terms such as "several" or "small numbers." Although similar descriptors could still be applied today, current field efforts are more thorough than in the past. In addition, significant habitat losses have occurred, primarily through erosion and invasion of introduced European beachgrass. Some sites no longer support nesting snowy plovers. Although a decline in the Washington population is believed to have occurred, it is difficult to quantify. Snowy plovers are currently found breeding in four areas of the Washington coast

from Gray's Harbor south to Long Beach Peninsula. The breeding population was estimated at 70 in 2006 (Pearson 2007).

4.3.2. Current Breeding Trends – Oregon Coast

Since 1993, the snowy plover population on the Oregon coast has been closely monitored, with many of the adults and chicks being uniquely color-banded. The presence of marked birds has allowed for more precise population estimates. Along the Oregon coast, the number of snowy plovers has decreased from the levels seen prior to 1980. However, without the intensive management efforts that began in 1993 (habitat maintenance, predator control, and beach access restrictions) it is likely that current snowy plover numbers would be considerably lower. The coastal snowy plover breeding population in Oregon is currently estimated at around 175 birds (Lauten 2006).

In 2006, snowy plovers nested at eight sites in Oregon: Sutton Beach, Siltcoos Estuary, Dunes Overlook, Tahkenitch Estuary, Tenmile Estuary, Coos Bay North Spit, Bandon SNA, and New River Spit (table 4.3). In the past 20 years snowy plovers have sporadically bred at Necanicum River mouth, Bayocean Spit, Siuslaw River mouth, Threemile Creek, Menasha Spoils, and the Floras Lake area (Castelein et al. 2002).

Table 4.3. Nesting and Fledging Success 2002 through 2006

	*2007 eggs	2007 hatched	2007 fledged	*2006 eggs	2006 hatched	2006 fledged	*2005 eggs	2005 hatched	2005 fledged	*2004 eggs	2004 hatched	2004 fledged	*2003 eggs	2003 hatched	2003 fledged	*2002 eggs	2002 hatched	2002 fledged
Necanicum Spit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0
Sutton Beach	9	0	0	12	0	0	0	0	0	0	0	0	3	1	0	12	0	0
Siltcoos Estuary	67	24	11	60	22	13	44	17	9	31	18	12	16	5	2	28	8	0
Dunes Overlook	46	19	11	28	18	8	42	16	7	39	14	6	17	9	3	24	13	2
Tahkenitch North	23	6	2	12	9	4	26	14	8	21	14	6	37	17	3	30	16	1
Tenmile Estuary	89	43	27	59	28	16	49	21	8	50	29	12	43	20	10	32	14	3
Coos Bay North Spit	108	45	26	86	54	22	80	38	23	73	42	31	57	29	21	48	21	11
Bandon Beach	73	24	13	53	19	8	83	37	11	50	33	15	13	6	2	10	0	0
New River	96	47	30	69	34	16	63	36	9	70	37	21	44	25	12	39	17	6
Floras Lake	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0
Total	511	208	120	379	184	87	387	179	75	334	187	103	230	112	53	229	91	23

* Data do not include undiscovered nests. Source: Lauten et al. 2007.

4.3.3. Threats and Sources of Threats

As mentioned above, overall, snowy plover numbers have declined on the U.S. Pacific coast over the past century. Habitat degradation caused by human disturbance, urban development, and introduced European beachgrass (*Ammophila arenaria*), as well as expanding predator populations have resulted in a decline in active nesting areas and in the size of the breeding and wintering populations. Natural factors such as inclement weather have also limited coastal snowy plover populations. The reasons for the population decline and the degree of threats are intertwined and vary by geographic location. These factors as they pertain to the Oregon Coast are discussed below.

Habitat Degradation

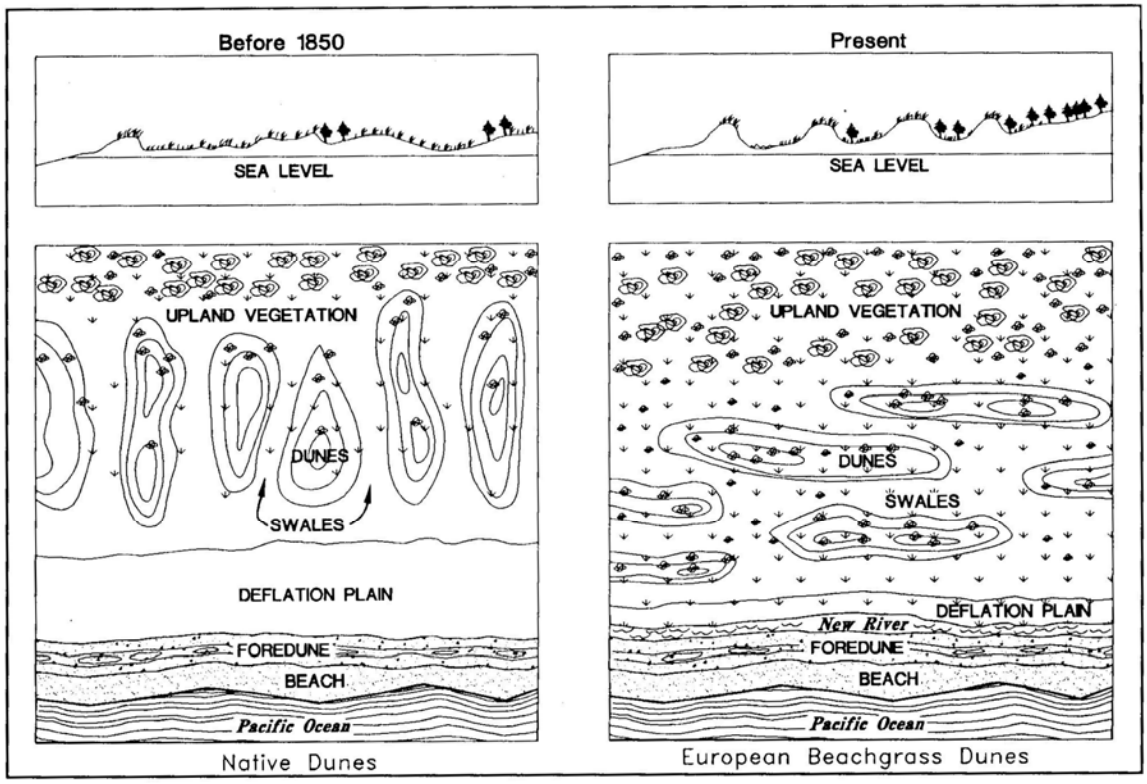
The wide, flat, sparsely vegetated beaches preferred by snowy plovers are an unstable habitat, subject to the dynamic processes of accretion and erosion and dependent on natural forces for replenishment and renewal. These habitats are highly susceptible to degradation from shoreline stabilization and development projects, driftwood removal, and especially encroachment of non-native vegetation.

Non-Native Vegetation

One of the most significant causes of habitat degradation for coastal breeding snowy plovers in Oregon has been encroachment of introduced European beachgrass. Steep foredunes dominated by introduced European beachgrass have replaced the original low, rounded, open mounds formed by the native American dunegrass (*Elymus mollis*) and other beach plants. Native dune plants do not bind sand like European beachgrass and thus allow for sand movement and regenerating open expanses of sand. European beachgrass on the other hand, forms tall, densely vegetated foredunes that exclude many native plant species and prevent the overwashing and scour that creates the open sand habitat favored by snowy plovers. On beaches dominated by this invasive grass, species vegetation richness is halved in comparison with foredunes dominated by native dune grass (Barbour and Major 1990).

On the Oregon coast, the establishment of European beachgrass has produced dramatic changes in the landscape (ODFW 1994). The spread of this non-native species was greatly enhanced by aggressive dune stabilization programs in the 1930s and 1940s (Wiedemann 1987) and has provided a place for predators to hide (figure 4.1).

Figure 4.1. Changes in Beach Profile since Introduction of European Beachgrass



In areas with European beachgrass, the open features that characterize snowy plover breeding habitat are destroyed. Stabilizing sand dunes with introduced European beachgrass has reduced the amount of unvegetated area above the tide line, decreased the width of the beach, and increased its slope. These changes have reduced the amount of potential snowy plover nesting habitat on many beaches and may hamper brood movements (Fish and Wildlife Service 2001). In Oregon, the European beachgrass community may provide habitat for snowy plover predators (e.g., striped skunks (*Mephitis mephitis*), coyotes (*Canis latrans*), red foxes (*Vulpes vulpes*) gray foxes (*Urocyon cinereoargenteus*), raccoons (*Procyon lotor*), and feral cats (*Felis domesticus*)) that historically would have been largely precluded by the lack of cover in the dune community (Stern et al. 1991).

Other non-native vegetation that has invaded coastal dunes, thereby reducing snowy plover breeding habitat includes Scotch broom (*Cytisus scoparius*), gorse (*Ulex europaeus*), South African iceplant (*Carpobrotus edulis*), sea rocket (*Cakile maritima and C. edulis*), and iceplant (*Mesembryanthemum sp.*). Shore pine (*Pinus contorta*), while a native plant species, has stabilized vast areas of open dunes due to extensive planting and through plant succession accelerated by the introduction of European beachgrass.

Beach Development

Coastal habitats are highly susceptible to degradation by construction of shoreline protection structures (e.g., riprap, seawalls, etc.) breakwaters, jetties, piers, homes, hotels, parking lots, access roads, trails, bike paths, day-use parks, marinas, recreational facilities, and support services that may cause direct and indirect losses of breeding and wintering habitat for the snowy plover. Construction of homes, resorts, and parking lots on coastal sand dunes constitutes irreplaceable loss of habitat for snowy plovers. Construction of these and other facilities adjacent to sand dunes can result in increased human disturbance, rendering habitat unsuitable for snowy plover winter or breeding use.

In addition to rendering habitat unsuitable for snowy plovers, there are other potential adverse impacts from urban development. When urban areas interface with natural habitat areas, the habitat value to native animal species may be diminished by increased levels of illumination at night (e.g., building and parking lot lights); increased sound and vibration levels; and pollution drift (e.g., pesticides) (Kelly and Rotenberry 1993). Also, construction of residential development in or near snowy plover habitat attracts predators, including domestic cats.

Resource Extraction

Resource extraction, including driftwood collection, sand removal, and dredging, can negatively alter snowy plover habitat. Driftwood can be an important component of snowy plover breeding and wintering habitat, providing protection from wind and blowing sand, and providing chicks with cover from predators. Removal of driftwood can reduce suitability of habitat and can result in nests being crushed as driftwood is dragged across the beach. The likelihood of nests being crushed increases when driftwood is collected at night for beach fires. Driftwood and driftwood structures built by beach users, are used as perches by snowy plover predators. Too much driftwood can aid in the formation of steep foredunes, making habitat behind the foredune inaccessible to chicks.

Dredging activities may be detrimental to snowy plovers when it alters natural patterns of beach erosion and deposition that maintain habitat. Activities associated with dredging may disturb breeding or wintering snowy plovers. Alternatively, dredge materials generated from dredging activities can be placed on the beach to enhance snowy plover habitat. Dredged material placed east of the foredune at Coos Bay North Spit has provided an important breeding site for many years.

Sand removal may cause erosion and loss of breeding or wintering habitat. Activity associated with sand removal can disturb snowy plovers, destroy nests or chicks, and reduce available invertebrates and wrack for snowy plovers.

Human Disturbance

The increasing level of human recreation is cited as a major threat to the breeding success of the coastal population of snowy plover (Fish and Wildlife Service 1993, 2001a and 2005). Human activities along the Oregon coast may contribute to snowy plover reproductive failures (Stern et al. 1990, 1991; Craig et al. 1992; Casler et al. 1993; FWS 1993; Hallett et al. 1994, 1995; Estelle et al. 1996; Castelein et al. 1997, 1998, 2000a, 2000b, 2001). Incubating birds often run from their nests as people or pets approach. Such disturbances may result in clutch loss to predation or increased incubation times (which in turn exposes nests to predation pressures for longer periods) (Warriner et al. 1986). Unattended nests may be buried by windblown sand, trampled by horses, pets or people, and may be run over by vehicles. Broods may be separated from adults, resulting in lowered fledging success. Alternatively, Page et al. (1977) noted that, "birds exposed to prolonged human activity near the nest seemed to become accustomed to it." This decline in wariness by snowy plovers may actually make snowy plovers an easier target for predators on beaches that are subject to ongoing high levels of human disturbance (Person and Applegate 1997). Thus, even when snowy plovers become accustomed to increased levels of human disturbance, they may be subjected to higher levels of predation. In studies conducted in Washington and California, fledging success was higher on beaches without human disturbance than on beaches with recreational activity (Saul 1982; Persons and Applegate 1997).

In 1998, all nests failed and snowy plovers abandoned the Floras Lake area by mid-June, most likely due to recreational activity (Castelein et al. 1998; FWS 1999). Recreational activity at this site appeared to be heavier than in previous years (Castelein et al. 1998), and violations of nesting areas and beach restrictions were common (Mraz 1998).

Human disturbance also may adversely affect wintering snowy plovers, causing birds to switch from feeding and roosting activities to predator avoidance strategies. Interruption of feeding and roosting behaviors in favor of avoidance activity can negatively alter energy balances, reducing individual survival during the breeding and winter seasons (Burger 1986; Pfister et al. 1992).

Dogs (with or without owners) pose a serious threat to snowy plovers. In a California study, nesting snowy plovers flushed (scared off their nest) more frequently and remained off the nest longer when a person was accompanied by a dog than when alone (Page et al. 1977). Unleashed dogs may chase adults and chicks, cause broods to be separated from adults, crush nests, and interrupt feeding, incubating, and brood-rearing activities.

Horseback riding and use of motorized vehicles, including ATVs/OHVs and street legal vehicles, on beaches can harass wintering and nesting snowy plovers, crush nests, and destroy sensitive native dune vegetation. Snowy plover chicks and adults

may crouch in OHV tracks, and chicks may not be able to get out of the ruts quickly, increasing the likelihood that they will be crushed. These activities have a greater potential to harm nesting and roosting snowy plovers because much larger distances can be covered compared to activities such as walking or hiking. Vehicles, especially ATVs/OHVs are often used for glass float hunting and other beachcombing activities. This practice is of greater concern because the search is often concentrated in the upper portions of the dry sand where snowy plovers nest and concentrate their activities. Snowy plovers roosting at night are particularly vulnerable to nighttime vehicle driving.

Camping on the beach and surf fishing can result in prolonged disturbance to nesting snowy plovers. Recreational users often leave behind food or trash, which can attract predators. Collection of driftwood for campfires can disturb incubation and even cause accidental crushing of eggs or chicks. Driftwood is an important component of snowy plover habitat as it provides protection from blowing wind and sand, and snowy plovers often nest beside chunks of driftwood on otherwise barren beaches.

Human use of the Ocean Shore can also have some benefits, such as the removal of trash by equestrian groups. At Baker Beach over the past several years, equestrian groups have worked with the U.S. Forest Service (USFS) to remove trash prior to the nesting season, rather than during the annual spring SOLV (Stop Oregon Litter and Vandalism) event, which occasionally occurs during the nesting season. The latter event is conducted under a permit issued by the Oregon Parks and Recreation Department (OPRD) with restrictions designed to avoid nesting areas during cleanup activities.

Predation

Predator pressures have contributed to limiting snowy plover populations along the Oregon coast (table 4.4). Nests are lost to predation from American crows (*Corvus brachyrhynchos*), common ravens (*Corvus corax*), California gulls (*Larus californicus*) foxes, raccoons, coyotes, feral cats, skunks, and black rats (Oregon Department of Fish and Wildlife 1994). Other confirmed or suspected snowy plover predators along the Oregon coast include American kestrels (*Falco sparvarius*), merlin (*Falco columbarius*), peregrine falcon (*Falco peregrinus*), northern harrier (*Circus cyaneus*), and great horned owl (*Bubo virginianus*). Predator density is a significant factor affecting the quality of snowy plover nesting habitat (Stenzel et al. 1994). The kind of predators along the coast will vary from site to site depending on a number of conditions, including suitable habitat and foraging opportunities for the predator.

Table 4.4. Nest Predation 1990 to 2000

Predator	Number of Nest Failures
Corvid (species unknown)	24
American crow	25
Common raven	15
Gull	1
Fox	1
Raccoon	1
Skunk	13
Unknown mammal	5
Unknown predator	62
Total	147

Predation can result in the loss of adults, chicks, or eggs. The snowy plover generally cannot defend itself or its nests against predation but must rely on anti-predator adaptations, including (1) pale coloration of adults, eggs, and young, which acts as camouflage against detection by predators; (2) a skulking retreat from the nest at a predator's approach; (3) extreme mobility and elusiveness of precocial young; and (4) maintenance of low nesting density (Page et al. 1983). Snowy plover chicks are brooded by an adult for approximately 1 month after hatching. The adult leads chicks to food, alerts chicks to predators, and uses distraction displays to lure potential predators away from chicks (Page et al. 1995a). The presence of predators on beaches used for brood rearing may result in separation of chicks from adults, leading to decreased fledging success (U.S. Forest Service 2002).

Although predation is a natural phenomenon that snowy plovers have evolved with, its effects are exacerbated through the introduction of non-native predators and human encouragement of larger populations of native predators in the vicinity of snowy plover populations. Signing and fencing of restricted areas on the beach may provide perches for avian predators of snowy plover adults or chicks. In 1995, corvids were known predators of snowy plovers at the Siltcoos River area in Oregon, and there was evidence they used restrictive signs as perches (Hallett et al. 1995). From 1966 to 2000, Breeding Bird Survey (BBS) data for Oregon show a long-term increasing trend in American Crows, averaging +1.5 percent per year (Sauer et al. 2001).

On the Oregon coast, the spread of European beachgrass, Scotch broom, and shore pine, which have transformed vast areas of open sand into dense grass-shrub habitat, has provided excellent habitat for native and non-native mammalian predators, such as skunks, raccoons, foxes, and feral cats (Stern et al. 1991). Additionally, beach litter attracts predators such as skunks and coyotes.

In addition to natural predation, disturbance as a result of recreation can indirectly increase predation. Behavior responses to disturbance, such as flushing or leaving nests or chicks, can make adults more visible to predators and leaves nests and chicks unattended. These responses can inadvertently make snowy plovers more susceptible to predation.

Natural Events

Weather-related causes also contribute to low nesting success. High tides and strong winds that bury eggs, and heavy rain or hail that damage eggs may cause nest failure (Wilson 1980; Stenzel et al. 1981; Warriner et al. 1986). These factors are naturally occurring aspects of the coastal environment, and the snowy plover has evolved with them. However, through habitat alterations, increased predation due to introduced species, and increased human use of beaches, human influences have reduced the snowy plover population's ability to respond to these naturally occurring weather events.

4.3.4. Existing Conservation and Protection Measures in Place

Conservation and protection measures in place for snowy plovers along the Oregon coast include:

- Yearly monitoring,
- Managing predators (including use of exclosures),
- Implementing seasonal dry sand beach restrictions,
- Conducting habitat restoration,
- Conducting outreach and education, and
- Conducting law enforcement activities.

These measures have helped to slow the decline in snowy plover populations in Oregon.

Monitoring

Snowy plover surveys began along Oregon's south coast in 1972 (Hoffman 1972) and continue to be conducted annually (Wickham 1981; Anderson and Maine 1983; Wilson-Jacobs and Meslow 1984; Wollington 1984; Wilson-Jacobs and Dorsey 1985; Herman et al. 1988; Stern et al. 1990, 1991; Craig et al. 1992; Casler et al. 1993; Hallett et al. 1994, 1995; Estelle et al. 1997; Castelein et al. 1997, 1998, 1999, 2000, 2001). After the snowy plover Federal listing in 1993, the scope and intensity of survey efforts increased. Since 1994, all current and most potential nesting sites along the Oregon coast have been censused twice each year through window surveys

(Hallett et al. 1994, 1995; Estelle et al. 1997; Castelein et al. 1997, 1998, 2000a, 2000b, 2001). During the breeding season, active nests and broods are monitored at least weekly through the fledging stage. Adults and chicks are color-banded to facilitate nesting activity tracking and brood movements and estimating population dynamics over time (Craig et al. 1992; Casler et al .1993; Hallett et al. 1994, 1995; Estelle et al .1997; Castelein et al. 1997, 1998, 2000a, 2000b, 2001; Lauten et al. 2006). These monitoring efforts contribute to the information base on nesting success and population trends and archive important data for use in future monitoring, restoration, and other recovery efforts.

Predator Management

Some predation is a natural phenomenon that snowy plovers have evolved with; however, because of the population's low numbers and the increase in the number and type of predators as a result of human activities, snowy plovers are more vulnerable to predation. Therefore, predation can be a significant influence on snowy plover levels making it necessary to manage for predation along with conducting other management efforts in an attempt to increase snowy plover reproductive success. In 1999, as part of an emergency response to the New Carissa grounding, Federal agencies initiated a limited predator control program at New River, with the removal of 17 red fox (Castelein et al. 2000a). Field researchers believed that introduced red fox populations suppressed fledging success from Bandon SNA to Floras Lake (Castelein et al. 2000a, 2000b, 2001). Introduced red fox were removed from this area. An analysis of the effectiveness of predator management activities can be found in Appendix C of Lauten et al. 2006.

In 2002, the U.S. Fish and Wildlife Service (FWS), the U.S. Bureau of Land Management (BLM), and USFS issued a Finding of No Significant Impact on a proposal to implement an integrated predator control program (U.S.D.A. Forest Service 2002). Efforts to deter predation have included removing vegetation that provides predators with cover, erecting nest exclosures, removing mammalian predators, and the dispersing and removing of corvids. In 2003 and 2004, BLM and OPRD contracted with the U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS) -Wildlife Services Division to conduct predator management at Bandon, New River, and Coos Bay North Spit. Corvids and red fox were the primary focus of this effort. An estimated 94 birds, of a total 174 predators, in 2004 (table 4.5), and an estimated 56 birds, of a total 79 predators, in 2005 (table 4.6) were removed from Bandon SNA, the New River/Storm Ranch area, and Coos Bay North Spit (Western Snowy Plover Working Group 2005, 2006). During the 2004 field season, predator management activities in addition to exclosures were also conducted at USFS sites (APHIS 2004) (table 4.7). APHIS also conducts litter removal, which has the potential to attract predators.

Table 4.5. Total Number of Predators Removed from Three South Coast Snowy Plover Areas during the 2004 Breeding Season

Predator	Coos Bay North Spit	Bandon SNA	New River/Storm Ranch	Totals
Red fox	0	10	17	27
Gray fox	3	0	0	3
Raccoon	5	9	5	19
Opossum	17	0	0	17
Striped skunk	2	5	3	10
Feral cat	2	0	0	2
Bob cat	0	1	0	1
Domestic Dog	0	0	0	0
Mink	0	1	0	1
Common raven	0	2	5	7
American crow	1	2	1	4
Common raven (DRC)*	2	3	59	64
American crow (DRC)	4	8	7	19
Total	36	41	97	174

* Taken with DRC-1339 avicide. Total animals is an estimate.

Table 4.6. Total Number of Predators Removed from Three South Coast Snowy Plover Areas during the 2005 Breeding Season

Predator	Coos Bay North Spit	Bandon SNA	New River/Storm Ranch	Totals
Red fox	0	4	11	15
Gray fox	0	0	0	0
Raccoon	0	0	0	0
Opossum	3	0	0	3
Striped skunk	3	0	0	3
Feral cat	2	0	0	2
Bobcat	0	0	0	0
Domestic Dog	0	0	0	0
Mink	0	0	0	0

Predator	Coos Bay North Spit	Bandon SNA	New River/Storm Ranch	Totals
Common raven	1	1	2	4
American crow	19	6	0	25
Common raven (DRC)*	1	10	2	13
American crow (DRC)	0	14	0	14
Total	29	35	15	79

* Taken with DRC-1339 avicide. Total animals is an estimate.

Table 4.7. Total Numbers of Predators Taken from the U.S. Forest Service Sites during the 2004 Season

Predator	Siltcoos Estuary	Dunes Overlook	Takhenitch Estuary	Tenmile Estuary	Total
Red fox	0	0	0	0	0
Gray fox	0	0	0	0	0
Raccoon	0	0	0	0	0
Opossum	0	0	0	1	1
Striped skunk	0	0	0	0	0
Feral cat	2	0	0	0	2
Bobcat	0	0	0	0	0
Domestic dog	0	0	0	1	1
Mink	0	0	0	0	0
Common raven	1	3	0	0	4
American crow	9	5	0	1	15
Common raven (DRC)*	7	27	1	40	75
American crow (DRC)	26	9	11	17	63
Total	45	44	12	60	161

*Taken with DRC-1339 avicide. Total animals is an estimate.

Predator Exclosures

Predator exclosures have been used on Oregon beaches to protect nests since 1990 (Stern et al. 1990b, 1991; Craig et al. 1992; Casler et al. 1993; Hallett et al. 1994, 1995; Estelle et al .1997; Castelein et al. 1997, 1998, 2000a, 2000b, 2001). Their design and use has been modified as needed to maximize snowy plover success based on the primary predator threats in the area. Generally, exclosures are small,

circular, square or triangular metal fences that can be quickly assembled and are designed to keep predators out of nests and/or prevent people from trampling nests (Fish and Wildlife Service 2007). The numbers of nests that are protected with predator exclosures each year varies, depending on when the nest was found and the likelihood that the exclosure will protect the nest rather than draw attention to it. In the first 15 years of their use, exclosures proved quite effective at increasing nest success (table 4.8) and were shown to be successful in excluding both corvid and mammalian predators.

Table 4.8. Success of Exclosed and Unexclosed Snowy Plover Nests on the Oregon Coast, 1990 to 2006

Year	Number of Nests	Mayfield % Nest success	Exclosed Nest Success Rate (Mayfield Method)	Unexclosed Nest Success Rate (Mayfield Method)
1990	36	13	Not available	13
1991	36	20	77	5
1992	36	55	79	9
1993	41	56	77	16
1994	51	72	75	68
1995	76	41	62	7
1996	89	47	66	7
1997	93	40	52	26
1998	78	52	70	15
1999	78	54	62	40
2000	100	31	46	2
2001	111	26	67	4
2002	89	38	67	13
2003	91	43	79	23
2004	117	56	86	20
2005	144	45	70	27
2006	147	38	60	40
2007	202	33	66	41

Source: Lauten et al. 2007.

Recently, success of nests in exclosures has been lower, although nest success with exclosures continues to be better than success of nests without exclosures (Castelein et al. 2001). Researchers are concerned that predators (particularly corvids) may key into exclosures as a way to find the cryptic nests and then learn how to get inside (Castelein et al. 2000b). For this reason, exclosure design has been adaptively

modified from year to year as researchers try to find the most effective deterrent to predators while minimizing disturbance to snowy plovers. Although exclosures clearly improve hatching success, predators continue to pose a threat to adults and chicks around exclosures.

At the Coos Bay South Spoil and the 1994 Habitat Restoration Area (HRA), 71 acres of snowy plover habitat have been fenced off to deter vehicular access and mammalian predators. This practice was initially deemed successful at deterring mammalian predators and ATVs/OHVs (Stern et al. 1991). However, during a 2002 study Little observed that this fencing posed an insufficient barrier for foxes, raccoons, and skunks, as they were able to climb over or dig under fences. Additionally, the fencing provides no deterrent to avian predators (Little 2002).

Beach Restrictions

Of the approximately 230 miles of sandy Ocean Shore along Oregon's 362-mile coastline, fewer than 20 miles of snowy plover-related seasonal dry sand beach restrictions were implemented in 2004. Symbolic fencing and signage is used to restrict pedestrian, pet, or vehicular use of portions of the dry sand. Public education and outreach has been successful in increasing compliance with beach use restrictions, but field researchers document numerous violations of these restrictions annually. Continued enforcement of these restrictions will be necessary for snowy plover conservation and recovery (Castelein et al. 2001). The number of miles of Ocean Shore on which seasonal beach use restrictions have been imposed, by beach, by year is shown in table 4.9.

Table 4.9. Beach Restrictions by Location and Year during Nesting Season (in miles)

Location	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Sutton/Baker Beach	1.00	1.00	3.00	3.00	3.00	3.00	3.00	3.50	3.50	3.50	3.50	3.50	3.50
Siltcoos Estuary	0.30	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Dunes Overlook	0	0	0	0	0	0.75	0.75	1.50	1.50	1.50	1.50	1.50	1.50
Tahkenitch Estuary	0.60	2.00	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30
Tenmile Estuary	1.30	1.30	0.80	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Coos Bay North Spit	0.50	4.00	1.00	6.10	6.10	2.80	2.80	2.80	2.50	2.50	2.50	2.50	2.50
Bandon	0	0	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20	2.20
New River	0	0	0	4.80	4.80	4.80	4.80	4.90	5.35	5.35	5.35	5.35	5.35
Floras Lake	0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0	0	0	0	0
Total Miles	3.70	9.90	9.90	19.08	19.60	17.05	17.05	18.40	17.55	17.55	17.55	17.55	17.55

Habitat Restoration

Habitat restoration work has been successful in reclaiming snowy plover habitat in Oregon. The Coos Bay District of the BLM has conducted multiple projects to clear and control European beachgrass on dredged spoil disposal sites and adjacent areas, including hand-pulling, burning, scarification, spraying with seawater, and removal with a front-end loader. At some sites, European beachgrass is bulldozed and the foredune lowered, allowing overwash areas to be created during winter storm events. At the Oregon Dunes National Recreation Area, the USFS has used mechanical, manual, and herbicide treatments to control European beachgrass (USDA Forest Service 1994). Approximately 50 acres of Bandon SNA has been restored near the mouth of Two Mile Creek. This restoration effort, begun in fall 2002, resulted in the area being used by snowy plover for nesting during the 2003 and 2004 nesting season. Effective control of European beachgrass will require ongoing maintenance efforts at each of the sites.

Law Enforcement

Since 2006, OPRD has three full-time beach rangers who patrol all 230 miles of Oregon's coastal beaches. In addition, at beaches within State parks, park staff with citation authority can issue citations for beach rule violations, if observed. These employees occasionally patrol the State park beaches and beach accesses and respond to reported incidents. Also, coastal State troopers and local law enforcement (city and county) occasionally patrol ocean beaches, especially beaches that are open to driving, and patrol beach accesses. They also respond to OPRD calls for assistance. As needed, OPRD will contract with retired senior troopers to provide additional supervision and citation authority.