Recovery Plan for the

Pacific Coast Population of the

Western Snowy Plover

(*Charadrius alexandrinus nivosus*)

Volume 1: Recovery Plan

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DISCLAIMER

Recovery plans delineate reasonable actions that are believed to be required to recover and/or protect listed species. We, the U.S. Fish and Wildlife Service, publish recovery plans, sometimes preparing them with the assistance of recovery teams, contractors, State agencies, and others. Recovery teams serve as independent advisors to the U.S. Fish and Wildlife Service. Objectives of the recovery plan will be attained and necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery plans do not obligate other parties to undertake specific actions, and may not represent the views or the official positions or approval of any individuals or agencies involved in the recovery plan formulation other than our own. They represent our official position **only** after they have been signed by the Director, Regional Director, or Operations Manager as **approved**. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery actions.

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An electronic version of this recovery plan also will be made available at http://www.fws.gov/cno/es/recoveryplans.html and http://endangered.fws.gov/recovery/index.html#plans

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EXECUTIVE SUMMARY

CURRENT SPECIES STATUS: The Pacific coast population of the western snowy plover (*Charadrius alexandrinus nivosus*) (western snowy plover) is federally listed as threatened. The current Pacific coast breeding population extends from Damon Point, Washington, south to Bahia Magdalena, Baja California, Mexico (including both Pacific and Gulf of California coasts). The western snowy plover winters mainly in coastal areas from southern Washington to Central America.

HABITAT REQUIREMENTS AND LIMITING FACTORS: The Pacific coast population of the western snowy plover breeds primarily above the high tide line on coastal beaches, sand 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. In winter, western snowy plovers are found on many of the beaches used for nesting as well as on beaches where they do not nest, in man-made salt ponds, and on estuarine sand and mud flats.

Habitat degradation caused by human disturbance, urban development, introduced beachgrass (*Ammophila* spp.), and expanding predator populations have resulted in a decline in active nesting areas and in the size of the breeding and wintering populations.

RECOVERY OBJECTIVE: The primary objective of this recovery plan is to remove the Pacific coast population of the western snowy plover from the *List of Endangered and Threatened Wildlife and Plants* by: (1) increasing population numbers distributed across the range of the Pacific coast population of the western snowy plover; (2) conducting intensive ongoing management for the species and its habitat and developing mechanisms to ensure management in perpetuity; and (3) monitoring western snowy plover populations and threats to determine success of recovery actions and refine management actions.

RECOVERY PRIORITY: 3C, per criteria published by Federal Register Notice (U.S. Fish and Wildlife Service 1983).

RECOVERY CRITERIA: The Pacific coast population of the western snowy plover will be considered for delisting when the following criteria have been met:

1. An average of 3,000 breeding adults has been maintained for 10 years, distributed among 6 recovery units as follows: Washington and Oregon, 250 breeding adults; Del Norte to Mendocino Counties, California, 150 breeding adults; San Francisco Bay, California, 500 breeding adults; Sonoma to Monterey Counties, California, 400 breeding adults; San Luis Obispo to Ventura Counties, California, 1,200 breeding adults; and Los Angeles to San Diego Counties, California, 500 breeding adults. This criterion also includes implementing monitoring of site-specific threats, incorporation of management activities into management plans to ameliorate or eliminate those threats, completion of research necessary to modify management and monitoring actions, and development of a post-delisting monitoring plan.

2. A yearly average productivity of at least one (1.0) fledged chick per male has been maintained in each recovery unit in the last 5 years prior to delisting.

3. Mechanisms have been developed and implemented to assure long-term protection and management of breeding, wintering, and migration areas to maintain the subpopulation sizes and average productivity specified in Criteria 1 and 2. These mechanisms include establishment of recovery unit working groups, development and implementation of participation plans, development and implementation of management plans for Federal and State lands, protection and management of private lands, and public outreach and education.

ACTIONS NEEDED:

1. Monitor breeding and wintering populations and habitats of the Pacific coast population of the western snowy plover to determine progress of recovery actions to maximize survival and productivity.

2. Manage breeding and wintering habitat of the Pacific coast population of the western snowy plover to ameliorate or eliminate threats and maximize survival and productivity.

3. Develop mechanisms for long-term management and protection of western snowy plovers and their breeding and wintering habitat.

4. Conduct scientific investigations that facilitate the recovery of the western snowy plover.

5. Conduct public information and education programs about the western snowy plover.

6. Review progress towards recovery of the western snowy plover and revise recovery efforts, as appropriate.

7. Dedicate U.S. Fish and Wildlife Service staff to allow the Arcata Fish and Wildlife Office to coordinate western snowy plover recovery implementation.

8. Establish an international conservation program with the government of Mexico to protect western snowy plovers and their breeding and wintering locations in Mexico.

Appendices B and C address Actions 1 and 2, providing site-specific recommendations for breeding numbers and management actions. Appendix J addresses Action 1, providing guidelines for monitoring western snowy plovers during the breeding and wintering seasons. Appendix K addresses Action 5, providing a public information and education plan.

ESTIMATED COST OF RECOVERY: $149,946,000 plus additional costs that cannot be estimated at this time.

DATE OF RECOVERY: Delisting could occur by 2047 if the recovery criteria above have been met.

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I. INTRODUCTION

On March 5, 1993, the Pacific coast population of the western snowy plover (*Charadrius alexandrinus nivosus*) (western snowy plover) was listed as threatened under provisions of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*). The Pacific coast population is defined as those individuals that nest within 50 miles of the Pacific Ocean on the mainland coast, peninsulas, offshore islands, bays, estuaries, or rivers of the United States and Baja California, Mexico (U.S. Fish and Wildlife Service 1993*a*) (Figure 1). General locations of the western snowy plover's breeding and wintering locations in the United States are shown in Appendix A. Surveys, status reviews, and literature searches have identified 159 current or historical western snowy plover breeding or wintering locations on the U.S. Pacific coast. These localities include 6 in Washington, 19 in Oregon, and 134 in California (Appendix B). In Baja California, breeding western snowy plovers concentrate at coastal wetland complexes as far south as Bahia Magdalena, Mexico (Palacios *et al.* 1994). The locations listed in Appendix B are important for the recovery of the United States Pacific coast population of the western snowy plover because they represent important breeding, feeding, and sheltering habitat for the species.

In Washington, the western snowy plover was listed as endangered under Washington Department of Fish and Wildlife Policy #402 in 1981. In 1990 the Washington Fish and Wildlife Commission (Washington Administrative Code 232-12-014) reaffirmed the endangered status. In 1975, the Oregon Fish and Wildlife Commission listed the western snowy plover as threatened. Its threatened status was reaffirmed in 1989 under the Oregon Endangered Species Act and again in 1993 and 1998 by the Oregon Fish and Wildlife Commission as part of its periodic review process. Since 1978, the California Department of Fish and Game has classified both the inland and coastal population of western snowy plover as a "species of special concern." (Remsen 1978, California Natural Diversity Database 2001).

In August 2002, we received a petition from the Surf Ocean Beach Commission of Lompoc, California to delist the Pacific Coast population of the western snowy

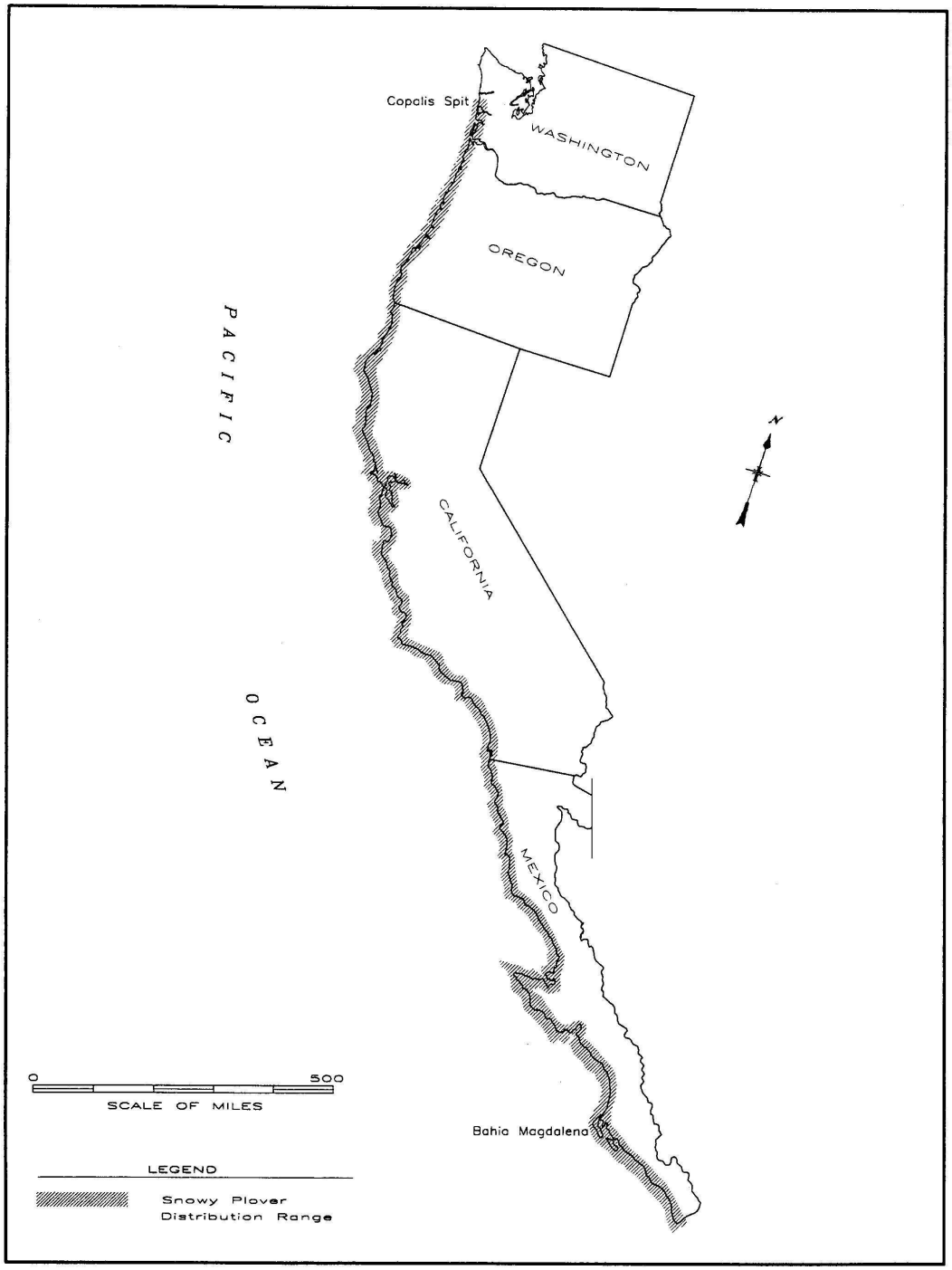

Figure 1. Map of known breeding and wintering distribution of the Pacific coast population of the western snowy plover.

plover. The City of Morro Bay, California submitted substantially the same petition dated May 30, 2003. On March 22, 2004, we published a notice that the petition presented substantial information to indicate that the delisting may be warranted (U.S. Fish and Wildlife Service 2004*a*). This notice also announced our initiation of a 5-year status review for the Pacific coast population of western snowy plover.

Under sections 4(b)(3)(B) and 4(c)(2) of the Endangered Species Act, we conducted a 5-year status review and evaluated whether the petitioned action was warranted. On April 21, 2006, we published a 12-month finding that concluded the petitioned action was not warranted (U.S. Fish and Wildlife Service 2006*a*). We also proposed a special rule pursuant to section 4(d) of the Endangered Species Act (U.S. Fish and Wildlife Service 2006*b*), which would exempt counties that have met western snowy plover recovery goals from most prohibitions on take as long as populations remain above recovery goals. The 5-year status review was completed on June 8, 2006.

Section 4 of the Endangered Species Act of 1973, as amended, requires us to develop a recovery plan for the conservation and survival of a species after it is federally listed as threatened or endangered, unless it is determined that such a plan will not promote the conservation of the species. Recovery is the process of reversing the decline of a listed species, eliminating threats, and ensuring the species' long-term survival. This recovery plan recommends actions necessary to satisfy the biological needs and assure recovery of the Pacific coast population of the western snowy plover. These actions include protection, enhancement, and restoration of all habitats deemed important for recovery; monitoring; research; and public outreach.

This recovery plan will serve as a guidance document for interested parties including Federal, State, and local agencies; private landowners; and the general public. It includes recommendations for western snowy plover management measures for all known breeding and wintering locations (Appendix C). These locations have been divided into six recovery units, as follows: (1) Oregon and Washington; (2) northern California (Del Norte, Humboldt, and Mendocino Counties); (3) San Francisco Bay (locations within Napa, Alameda, Santa Clara,

and San Mateo Counties); (4) Monterey Bay (including coastal areas along Monterey, Santa Cruz, San Mateo, San Francisco, Marin, and Sonoma Counties); (5) San Luis Obispo, Santa Barbara, and Ventura Counties; and (6) Los Angeles, Orange, and San Diego Counties. Designation of these locations and recovery units assists in identifying priority areas for conservation planning across the western snowy plover's breeding and wintering range.

This recovery plan emphasizes management on Federal and State lands, including opportunities to improve or expand upon current efforts. Because of this emphasis on public lands, the cost associated with this emphasis, and potential restrictions of public use on these lands, public support and involvement will be crucial to the recovery of the western snowy plover. Opportunities for public participation in recovery efforts are emphasized in Appendix K (Information and Education Plan).

A. DESCRIPTION AND TAXONOMY

The western snowy plover, a small shorebird in the family Charadriidae, weighs from 34 to 58 grams (1.2 to 2 ounces) and ranges in length from 15 to 17 centimeters (5.9 to 6.6 inches) (Page *et al.* 1995*a*). It is pale gray-brown above and white below, with a white hindneck collar and dark lateral breast patches, forehead bar, and eye patches (Figure 2). The bill and legs are blackish. In breeding plumage, males usually have black markings on the head and breast; in females, usually one or more of these markings are dark brown. Early in the breeding season a rufous crown may be evident on breeding males, but it is not typically seen on females. In non-breeding plumage, sexes cannot be distinguished because the breeding markings disappear. Fledged juveniles have buffy edges on their upper parts and can be distinguished from adults until approximately July through October, depending on when in the nesting season they hatched. After this period, molt and feather wear makes fledged juveniles indistinguishable from adults. Individual birds 1 year or older are considered to be breeding adults. The mean annual life span of western snowy plovers is estimated at about 3 years, but at least one individual was at least 15 years old when last seen (Page *et al.* 1995*a*).

Figure 2. Adult male western snowy plover (photo by Peter Knapp, with permission).

The species was first described in 1758 by Linnaeus (American Ornithologists' Union 1957). Two subspecies of the snowy plover have been recognized in North America (American Ornithologists' Union 1957): the western snowy plover (*Charadrius alexandrinus nivosus*) and the Cuban snowy plover (*C. a. tenuirostris*). The Pacific coast population of the western snowy plover breeds on the Pacific coast from southern Washington to southern Baja California, Mexico. Wintering birds may remain at their breeding sites or move north or south to other wintering sites along the Pacific coast. The interior population of the western snowy plover breeds in interior areas of Oregon, California, Nevada, Utah, New Mexico, Colorado, Kansas, Oklahoma, and north-central Texas, as well as coastal areas of extreme southern Texas, and possibly extreme northeastern Mexico (American Ornithologists' Union 1957). Although previously observed only as a migrant in Arizona, small numbers have bred there in recent years (Monson and Phillips 1981, Davis and Russell 1984). Interior population birds breeding east of the Rockies generally winter along the Gulf coast, while most interior population birds breeding west of the Rockies winter in coastal California and Baja

California, often intermingling with birds from the Pacific coast breeding population. The Cuban snowy plover breeds along the Gulf coast from Louisiana to western Florida and south through the Caribbean (American Ornithologists' Union 1957). More recent works recognize only subspecies *C. a. nivosus* for North America (Hayman *et al.* 1986, Binford 1989, Sibley and Monroe 1990).

A large amount of breeding data indicates that the Pacific coast population of the western snowy plover is distinct from western snowy plovers breeding in the interior (U.S. Fish and Wildlife Service 1993*a*, 2006*a*). A study conducted between 1977 and 1982 reported that western snowy plovers tend to exhibit breeding site fidelity (Warriner *et. al.* 1986). Banding and resighting data show that the Pacific Coast breeding populations and the western interior breeding populations experience limited or rare reproductive interchange (G. Page *in litt.* 2004*a*). Between 1984 and 1995, the period with the most extensive banding studies and search efforts, 907 plovers color-banded in coastal and interior populations were subsequently resighted (excluding birds banded on the coast during winter and birds resighted in their original region without evidence of nesting). Of these, 894 birds (98.6 percent) were observed during the breeding season using the same breeding range in which they were originally banded. Twelve birds (1.3 percent) were banded on the coast and later observed in the interior, only one of which was known to nest in the interior. Only one male (0.1 percent) was banded in the interior (without evidence of nesting) and later found nesting on the coast. Moreover, data from a period of less intensive surveys and banding from 1977 to 1983 corroborate this pattern (G. Page *in litt.* 2004*a*, U.S. Fish and Wildlife Service 2006*a*). During this period, of 400 birds banded in the interior, none were observed on the coast during breeding season, and of 599 birds banded on the coast only one was found nesting in the interior. Finally, 304 retrievals of numbered metal bands reported between 1969 and 2002 show no evidence of movement from interior to coast and only one bird (G. Goldsmith *in litt*. 2004, U.S. Fish and Wildlife Service 2006*a*) that moved from coast to interior (the dates being consistent with a bird from the interior population having been banded on the coast during the non-breeding season).

Thus, intensive banding and monitoring studies have documented only two clear instances of interbreeding between coastal and interior populations, and a few

cases of inter-population movement without confirmed breeding, among thousands of birds observed. These results illustrate that the amount of interchange between coastal and interior populations is likely to be extremely low, though not zero. Movement of birds from coastal to interior populations has been documented more often than the reverse (see also U.S. Fish and Wildlife Service 2006a).

Genetic studies using mitochondrial DNA and microsatellite DNA markers (Gorman 2000, Funk *et al.* 2006) have found no significant genetic differentiation between the Pacific coast and interior populations of the western snowy plover. However, because a small number of dispersing individuals per generation is sufficient to prevent genetic differentiation between two semi-isolated populations (Mills and Allendorf 1996, Funk *et al.* 2006), this result is consistent with the banding data reported above. Because the small number of dispersing individuals indicated by banding data appear insufficient to substantially affect rates of population growth or decline in either population, the two populations evidently function demographically as largely independent of one another. Moreover, the infrequency of observed dispersal from coast to interior further indicates that any declines in the coastal population are not likely to be effectively offset by immigration of interior birds to the coast. Consequently there is no evidence that existing unoccupied habitat along the Pacific coast is currently being or in future would be naturally colonized by birds from the interior population (Funk et al. 2006).

B. LIFE HISTORY AND ECOLOGY

1. Breeding

The Pacific coast population of the western snowy plover breeds primarily on coastal beaches from southern Washington to southern Baja California, Mexico (*e.g.*, Figure 3). Sand spits, dune-backed beaches, beaches at creek and river mouths, and salt pans at lagoons and estuaries are the main coastal habitats for nesting (Stenzel *et al.* 1981, Wilson 1980). This habitat is unstable because of

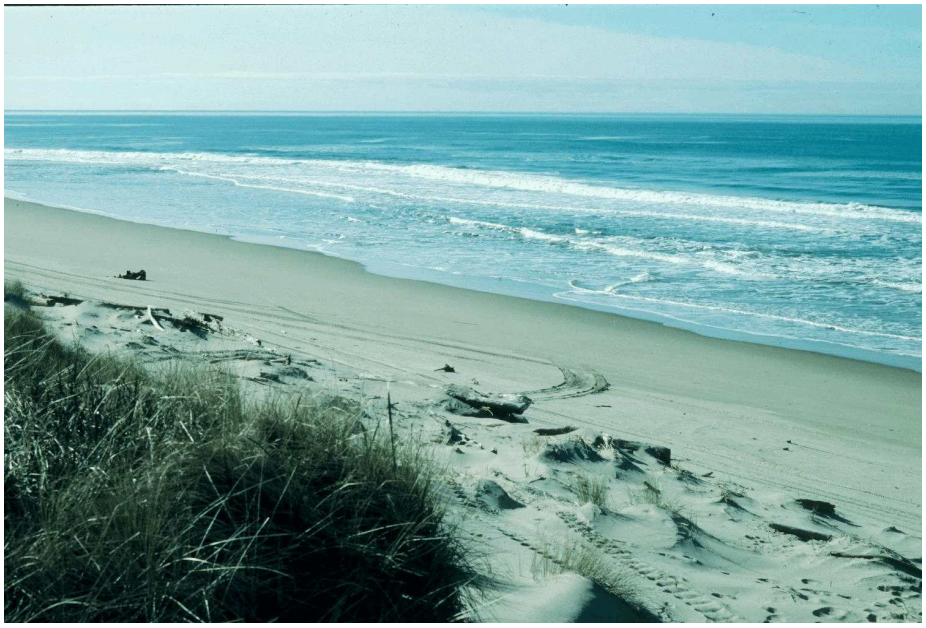

Figure 3. Coastal beach in Oregon Dunes National Recreational Area (photo by Ruth Pratt, with permission)

unconsolidated soils, high winds, storms, wave action, and colonization by plants. Less common nesting habitats include bluff-backed beaches, dredged material disposal sites, salt pond levees, dry salt ponds, and river bars (Wilson 1980, Page and Stenzel 1981, Powell *et al.* 1996, Tuttle *et al.* 1997).

a. Population Size and Distribution

Population estimates referenced below are based on window surveys as well as on more intensive studies involving repeated surveys of populations with individually identifiable color-banded birds. Window surveys are a one-time pass of a surveyor, or team of surveyors, through potential western snowy plover nesting habitat during May or June (see survey protocol in Appendix J). The surveyor counts all adult western snowy plovers in the habitat and identifies the adults as male or female, when possible. Because window surveys may not detect all birds, they are not directly comparable to more intensive studies. A correction factor can be estimated by comparing window survey data with concurrent population estimates from detailed studies of color-banded populations; currently the best

rangewide estimate of the correction factor is 1.3 (U.S. Fish and Wildlife Service 2006*a*), but it is preferable to determine corrections on a more specific regional or site basis if possible due to differences in survey efficiency in different habitats (see action 4.3.1).

Western snowy plovers concentrate in suitable habitat, with the number of adults at coastal breeding locations ranging from 1 to 315, depending in part, on the size of the area (Appendix B). The largest number of breeding birds occurs from south San Francisco Bay to southern Baja California (Page and Stenzel 1981, Palacios *et al.* 1994).

The locations of the following parenthetical references to western snowy plover breeding and wintering locations in Washington, Oregon, and California are shown in Figures A-1 through A-7 of Appendix A, and mapped in greater detail in Appendix L. Information on the numbers of breeding and wintering western snowy plovers at these locations is described in Appendix B.

Four breeding areas currently exist in southern Washington: Damon Point (Washington location 2 [WA-2]) in Grays Harbor; Midway Beach (WA-4); and Leadbetter Point (WA-5) and Graveyard Spit (discovered in 2006) in Willapa Bay. Prior to the 1998 breeding season, fewer than 25 western snowy plovers and 12 nests were found in Washington during regular, standardized surveys. However, surveys from 1998 through 2006 (Sundstrom 2003, 2005; Brennan and Fernandez 2004*a*, 2006; Pearson *et al.* 2006; Washington Department of Fish and Wildlife unpub. data) indicate greater numbers of western snowy plovers are nesting at Leadbetter Point (WA-5) and Midway Beach (WA-4), with a maximum estimated population of 70 western snowy plovers statewide in 2006.

In Oregon, nesting birds have been recorded at 14 sites since 1990 (Castelein *et al.* 2002, Lauten *et al.* 2006*a*, 2006*b*). Nesting has occurred most frequently at 9 sites, including Sutton (OR-8), Siltcoos (OR-10), Dunes Overlook (OR-10), Tahkenitch (OR-10), Tenmile Spits (OR-12), Coos Bay North Spit (OR-13), Bandon (OR-15), New River (OR-15), and Floras Lake (OR-15). An estimated 177-179 adult western snowy plovers were observed at Oregon sites during the 2006 breeding season. A total of 135 individuals were known to have nested in

2006, with 147 nests located. Individual nests have also been found between 1990 and 2002 at several other Oregon sites, including Necanicum (OR-1); Bayocean Spit (OR-3); North Siuslaw (OR-8); Threemile-Umpqua River (OR-11); and Menasha Spoils, North Bend.

Western snowy plover populations in California have fluctuated between roughly one thousand and two thousand birds over the past 30 years, as detailed in section I.C.1.c below. Eight geographic areas support over three-quarters of the California coastal breeding population: San Francisco Bay (CA-27 to CA-47), Monterey Bay (CA-63 to CA-65), Morro Bay (CA-79 to CA-81), the Callendar-Mussel Rock Dunes area (CA-83), the Point Sal to Point Conception area (CA-84 to CA-88), the Oxnard lowland (CA-96 to CA-99), Santa Rosa Island (CA-93), and San Nicolas Island (CA-100) (Page *et al.* 1991, G. Page *in litt.* 2005*a*).

A survey of breeding western snowy plovers along the Pacific coast of Baja California, Mexico between 1991 to 1992 found 1,344 adults, mostly at four coastal wetland complexes: Bahia San Quintin, Lagunas Ojo de Liebre and Guerrero Negro, Laguna San Ignacio, and Bahia Magdalena (Palacios *et al.* 1994).

b. Arrival and Courtship

Nesting western snowy plovers at coastal locations consist of both year-round residents and migrants (Warriner *et al.* 1986). Migrants begin arriving at breeding areas in southern Washington in early March (Widrig 1980) and in central California as early as January, although the main arrival is from early March to late April (Page *et al.* 1995*a*). Since some individuals nest at multiple locations during the same year, birds may continue arriving through June (Stenzel *et al.* 1994).

Mated birds from the previous breeding season frequently reunite. Pair bonds are associated with territorial defense by males and nest scraping behavior, but early in the season birds begin to associate with one another in pairs within and apart from roosting flocks before nest scraping activity is observed, suggesting that pair bonds can be established prior to overt displays (Warriner *et al.* 1986). A scrape is a depression in the sand or substrate that a male constructs by leaning forward

on his breast and scratching his feet while rotating his body axis (Page *et al.* 1995*a*). Copulations are associated with scraping behavior (Warriner *et al.* 1986). Females choose which scrape becomes the nest site by laying eggs in one of them. In California, pre-nesting bonds and courtship activities are observed as early as mid-February. Similar activities begin by March in Oregon. During courtship, males defend territories and usually make multiple scrapes.

c. Duration of Breeding Season

Along the west coast of the United States, the nesting season of the western snowy plover extends from early March through late September. Generally, the breeding season may be 2 to 4 weeks earlier in southern California than in Oregon and Washington. Fledging (reaching flying age) of late-season broods may extend into the third week of September throughout the breeding range.

The earliest nests on the California coast occur during the first week of March in some years and by the third week of March in most years (Page *et al.* 1995*a*). Peak initiation of nesting is from mid-April to mid-June (Warriner *et al.* 1986; Powell *et al.* 1997). Hatching lasts from early April through mid-August, with chicks reaching fledging age approximately 1 month after hatching (Powell *et al.* 1997). On the Oregon coast nesting may begin as early as mid-March, but most nests are initiated from mid-April through mid-July (Wilson-Jacobs and Meslow 1984); peak nest initiation occurs from mid-May to early July (Stern *et al.* 1990). In Oregon, hatching occurs from mid-April through mid-August, with chicks reaching fledging age as early as mid- to late May. Peak hatching occurs from May through July, and most fledging occurs from June through August. On the Washington coast, most adults arrive during late April, with maximum numbers present from mid-May to late June. Fledging occurs from late June through August (Washington Department of Fish and Wildlife 1995).

d. Nests and Nest Sites

Nests typically occur in flat, open areas with sandy or saline substrates; vegetation and driftwood are usually sparse or absent (Widrig 1980, Wilson 1980, Stenzel *et al.* 1981). Western snowy plovers also regularly nest on the gravel bars along the

Eel River in northern California. In southern California, western snowy plovers nest in areas with 6 to 18 percent vegetative cover and 1 to 14 percent inorganic cover; vegetation height is usually less than six centimeters (2.3 inches) (Powell *et al.* 1995, 1996). Nests consist of a shallow scrape or depression, sometimes lined with beach debris (*e.g.*, small pebbles, shell fragments, plant debris, and mud chips); nest lining increases as incubation progresses. Driftwood, kelp, and dune plants provide cover for chicks that crouch near objects to hide from predators. Invertebrates are often found near debris, so driftwood and kelp are also important for harboring western snowy plover food sources (Page *et al.* 1995*a*). Page and Stenzel (1981) found that nests were usually within 100 meters (328 feet) of water, but could be several hundred meters away when there was no vegetative barrier between the nest and water. They believed the absence of such a barrier is probably important for newly-hatched chicks to have access to the shore. Powell *et al.* (1995, 1996) also reported that nests from southern California were usually located within 100 meters (328 feet) of water, which could be either ocean, lagoon, or river mouth. Although the majority of western snowy plovers are site-faithful, returning to the same breeding area in subsequent breeding seasons, some also disperse within and between years (Warriner *et al.* 1986, Stenzel *et al.* 1994). Western snowy plovers occasionally nest in exactly the same location as the previous year (Warriner *et al.* 1986).

e. Egg Laying, Clutch Size, and Incubation

Initiation (eggs and laying) occurs from mid-February/early March through the third week of July (Wilson 1980, Warriner *et al.* 1986). The approximate periods required for nesting events are: scrape construction (in conjunction with courtship and mating), 3 days to more than a month; egg laying, usually 4 to 5 days; and incubation, 26 to 31 days (mean 27 days) (Warriner *et al.* 1986). The usual clutch size (*e.g.*, number of eggs in one nest) is three (Figure 4) with a range from two to six. (Warriner *et al.* 1986, Page *et al.* 1995*a*). Both sexes incubate the eggs, with the female tending to incubate during the day and the male at night (Warriner *et al.* 1986). Adult western snowy plovers frequently will attempt to lure people and predators from hatching eggs with alarm calls and distraction displays. Occasionally, adults behave similarly during the egg-laying period or

Figure 4. Western snowy plover clutch (photo by Bruce Casler, with permission).

incubation of completed clutches. More typical, however, is for the incubating adult to run away from the eggs without being seen. Incomplete clutches are those in which all eggs have not been laid. Partly-incubated clutches are those clutches having some degree (in days) of incubation.

Western snowy plovers will re-nest after loss of their eggs (Wilson 1980, Warriner *et al.* 1986). Re-nesting occurs 2 to 14 days after failure of a clutch, and up to five re-nesting attempts have been observed for a pair (Warriner *et al.* 1986).

Double brooding with polyandry (meaning the female successfully hatches more than one brood [*i.e.* sibling chicks of a hatched nest] in a nesting season with different mates) is common in coastal California (Warriner *et al.* 1986) and Oregon (Wilson-Jacobs and Meslow 1984). On the California coast, the breeding season is long enough for some females to triple brood and for some males to double brood (Page *et al.* 1995*a*). Triple brooding in a male has, on rare occasion, been recorded; a male triple brooded at Moss Landing salt ponds in 2001 (D. George *in litt.* 2001). After losing a clutch or brood or successfully hatching a

nest, western snowy plovers may re-nest at the same site or move up to several hundred kilometers to nest at other sites (Stenzel *et al.* 1994, Powell *et al.* 1997).

f. Clutch Hatching Success

Widely varying clutch hatching success (percent of clutches hatching at least one egg) is reported in the literature. Clutch hatching success ranging from 0 to 90 percent has been recorded for coastal western snowy plovers (Widrig 1980, Wilson 1980, Saul 1982, Wilson-Jacobs and Dorsey 1985, Warriner *et al.* 1986, Wickham unpubl. data *in* Jacobs 1986). Low clutch hatching success has been attributed to a variety of factors, including predation, human disturbance, high tides, and inclement weather. Heavy recreational beach use coincides with the peak hatching period for western snowy plover eggs (Powell 2001), adding additional pressures to western snowy plover adults and chicks that are more exposed to human disturbance. Observed clutch hatching success ranged from 12.5 to 86.8 percent and averaged 50.6 percent in eight studies of coastal breeding western snowy plovers (Page *et al.* 1995*a*). In San Diego County, estimated nesting success ranged from 43 to 68 percent between 1994 and 1998, averaging 54 percent (Powell *et al.* 2002); nesting western snowy plovers in San Diego County likely benefitted from predator management efforts for snowy plovers and California least terns (*Sternula antillarum browni*) (A. Powell, U.S. Geological Survey, pers. comm. 1998). In Monterey Bay, hatching rate was significantly increased from 43 percent (during 1984-1990) to 68 percent (during 1991-1999) by intensive control of mammalian predators and use of nest exclosures (Neuman *et al.* 2004).

g. Brood-rearing

The first chick hatched remains in or near the nest until other eggs (or at least the second egg) hatch. The adult western snowy plover, while incubating the eggs, also broods the first chick. The non-incubating adult also may brood the first-born chick a short distance from the nest. If the third egg of a clutch is 24 to 48 hours behind the others in hatching, it may be deserted. Western snowy plover chicks are precocial, leaving the nest within hours after hatching to search for food. They are not able to fly (fledge) for approximately 1 month after hatching;

fledging requires 28 to 33 days (Warriner *et al.* 1986). Broods rarely remain in the nesting area until fledging (Warriner *et al.* 1986, Stern *et al.* 1990). Western snowy plover broods may travel along the beach as far as 6.4 kilometers (4 miles) from their natal area (Casler *et al.* 1993).

Adult western snowy plovers do not feed their chicks, but lead them to suitable feeding areas. Adults use distraction displays to lure predators and people away from chicks. With vocalizations, adult western snowy plovers signal the chicks to crouch as another way to protect them (Page *et al.* 1995*a*). They also may lead chicks, especially larger ones, away from predators. Warriner *et al.* (1986) reported that most chick mortality occurs within 6 days after hatching.

Females generally desert mates and broods by the sixth day after hatching and thereafter the chicks are typically accompanied by only the male. While males rear broods, females obtain new mates and initiate new nests (Page *et al.* 1995*a*). Females typically help rear the last brood of the season.

h. Fledging success

The fledging success of western snowy plovers (percentage of hatched young that reach flying age) varies greatly by location and year. Even western snowy plovers nesting on neighboring beach segments may exhibit quite different success in the same year. For example, the percentage of chicks fledged on different beach segments of Monterey Bay in 1997 varied from 11 to 59 percent (average 24 percent) (Page *et al.* 1997). During the prior 13 years, fledging success on Monterey Bay beaches averaged 39 percent (Page *et al.* 1997). From the former Moss Landing salt ponds (now known as the Moss Landing Wildlife Area) in Monterey Bay (CA-64), fledging success ranged from 13.2 percent to 57.1 percent from 1988 to 1997. In San Diego County, fledging success ranged from 32.6 to 51.4 percent (Powell *et al.* 1997). In Oregon, annual fledging success for 1992 to 2006, for all coastal sites combined, ranged from 26 to 55 percent (Lauten *et al.* 2006*a*, 2006*b*). As in California, there is considerable variation among sites within years. For example, in 2005, the fledging success ranged from 24 percent at New River (OR-15) to 70 percent at Coos Bay South Beach (OR-13). There also is variation at individual sites among years. At the Coos Bay North Spit

(OR-13), one of the larger nesting areas in coastal Oregon, annual fledging success for 1992 to 2006 ranged from 38 to 74 percent.

i. Productivity

The productivity information most useful for this recovery plan is reproductive success (the annual number of young fledged per adult male). For the population viability analysis (Appendix D), males were used in the model because their population parameters can be estimated with greater certainty than for females. In addition, it is reasonable to consider that the availability of males is limiting reproductive success because they are responsible for post-hatching parental care, and females can lay clutches for more than one male (Warriner *et al.* 1986).

Chicks are considered fledged at 28 to 33 days after hatching. Estimates of the number of young fledged per adult male are available for Oregon; northern California from Mendocino to Del Norte Counties; Monterey Bay, California; and San Diego County, California. Along the Oregon coast, the average number of young annually fledged per male during the period between 1992 and the initiation of predator management (2002 to 2004 depending on site) was estimated as 0.87 (Lauten *et al.* 2006*b*); this fledging success significantly increased to 1.44 since implementation of predator management. Male fledging success in Oregon has annually ranged between 0.70 and 1.64 (Lauten *et al.* 2006*a*). In northern California, fledging success ranged from 0.8 to 1.7 fledglings per male between 2001-2005, with birds nesting on river gravel bars consistently achieving greater success than those nesting on beaches (Colwell *et al.* 2005). At Monterey Bay, California, from 1984 to 1990, when little effort was made to protect chicks from predators and people, males averaged 0.86 fledglings annually. When intensive efforts were undertaken to control mammalian predators from 1993 to 1999, the number of young fledged per adult male initially increased above 1.1, then declined sharply as avian predation on chicks became increasingly significant (Neuman *et al.* 2004). After live trapping and removal of avian predators was initiated, fledging success again increased in target areas (G. Page *in litt.* 2004b). Over 16 years of study at Monterey Bay, the annual number of young fledged ranged from 0.32 to 1.23 per male (Neuman *et al.* 2004). In San Diego County from 1994 to 1998, an average of 0.15 to 0.44 young were fledged per male

(Powell et al. 2002). Fledging success in Washington cannot be accurately estimated due to lack of banded chicks and adults and variable monitoring effort prior to 2006 (S. Pearson *in litt.* 2006); however it was roughly estimated at between 0.76 and 1.45 young fledged per male in 2006, excluding Leadbetter Point which was insufficiently surveyed but may have had poorer fledging success (Pearson *et al.* 2006).

j. Survival

Annual survival rates for adult and juvenile western snowy plovers have been calculated from studies of color banded birds from the coast of Oregon (M. Stern unpubl. data), the shoreline of Monterey Bay, California (Point Reyes Bird Observatory unpublished data), and the coast of San Diego County, California (A. Powell and J. Terp unpublished data) using the program SURGE (Lebreton *et al.* 1992, Cooch *et al.* 1996). Annual juvenile survival rates for fledged young average 48.5 percent (1992-2002) from the Oregon coast, 45 percent from Monterey Bay, and 45 percent from the San Diego coast. Annual survival rates for adult females and males, respectively, averaged 75 and 75 percent from the Oregon coast, 69 and 75 percent from Monterey Bay, and 72 and 71 percent from the San Diego coast. Differences between males and females were statistically significant only for the Monterey Bay area. Appendix D explains how these survival rates were incorporated into the population viability analysis.

2. Feeding Habitat and Habits

Western snowy plovers are primarily visual foragers, using the run-stop-peck method of feeding typical of *Charadrius* species. They forage on invertebrates in the wet sand and amongst surf-cast kelp within the intertidal zone, in dry sand areas above the high tide, on salt pans, on spoil sites, and along the edges of salt marshes, salt ponds, and lagoons. They sometimes probe for prey in the sand and pick insects from low-growing plants. At the Bolsa Chica wetlands in California, western snowy plovers have been observed pecking small, flying insects from mid-air and shaking one foot in very shallow water to agitate potential prey (Fancher *et al.* 1998). Western snowy plover food consists of immature and adult forms of aquatic and terrestrial invertebrates. Little quantitative information is

available on food habits. In San Diego, California, invertebrates found in western snowy plover feces during the breeding season included rove beetles (Staphylinidae), long-legged flies (Dolichopodidae), shore flies (Ephydridae), water bugs (Saldidae), hymenopterans (Braconidae), and unidentified insect larvae (Tucker and Powell 1999). During the breeding season, Jacobs (1986) observed adult western snowy plovers feeding on sand hoppers (Orchestoidea) and small fish on the Oregon coast. Other food items reported for coastal western snowy plovers include Pacific mole crabs (*Emerita analoga*), striped shore crabs (*Pachygrapsus crassipes*), polychaetes (Neridae, *Lumbrineris zonata, Polydora socialis, Scoloplos acmaceps)*, amphipods (*Corophium* ssp., *Ampithoe* spp., *Allorchestes angustus*), tanadacians (*Leptochelia dubia*), shore flies (Ephydridae), beetles (Carabidae, Buprestidae, Tenebrionidae), clams (*Transenella* sp.), and ostracods (Page *et al.* 1995*a*). In salt evaporation ponds in San Francisco Bay, California, the following prey have been recorded: brine flies (*Ephydra cinerea*), beetles (*Tanarthrus occidentalis, Bembidion* sp.), moths (*Perizoma custodiata*), and lepidopteran caterpillars (Feeney and Maffei 1991). Opportunities for foraging are directly dependent on salinity levels. Specifically, salt ponds of medium salinity seem to provide the best quality foraging habitat (M. Kolar, San Francisco Bay National Wildlife Refuge, pers. comm. 2004).

3. Migration

While some western snowy plovers remain in their coastal breeding areas year-round, others migrate south or north for winter (Warriner *et al.* 1986, Page *et al.* 1995*a*, Powell *et al.* 1997). In Monterey Bay, California, 41 percent of nesting males and 24 percent of the females were consistent year-round residents (Warriner *et al.* 1986). At Marine Corps Base Camp Pendleton in San Diego County, California, about 30 percent of nesting birds stayed during winter (Powell *et al.* 1995, 1996, 1997). The migrants vacate California coastal nesting areas primarily from late June to late October (Page *et al.* 1995*a*). There is evidence of a late-summer (August/September) influx of western snowy plovers into Washington; it is suspected that these wandering birds are migrants (S. Richardson, Washington Department of Fish and Wildlife, pers. comm. 1998).

Most western snowy plovers that nest inland migrate to the coast for the winter (Page *et al.* 1986, 1995*b*). Thus, the flocks of non-breeding birds that begin forming along the U.S. Pacific coast in early July are a mixture of adult and hatching-year birds from both coastal and interior nesting areas. During migration and winter, these flocks range in size from a few individuals to up to 300 birds (Appendix B).

4. Wintering

a. Distribution and Abundance

In western North America, the western snowy plover winters (here defined as late October to mid-February) mainly in coastal areas from southern Washington to Central America (Page *et al.* 1995*a*). Both coastal and interior populations use coastal locations in winter. Small numbers of western snowy plovers occur at two locations on the Washington coast: Midway Beach (WA-4) (S. Richardson, pers. comm. 1998, J. Grettenberger, U.S. Fish and Wildlife Service, pers. comm. 2004), and Leadbetter Point (WA-5), Willapa Bay (Washington Department of Fish and Wildlife 1995), both in Pacific County. Increasing numbers of wintering western snowy plovers are being documented along the Washington coast, with 32 counted in 2005 (L. Kelly *in litt.* 2005). As many as 97 western snowy plovers were observed wintering on the Oregon coast in 2005 (L. Kelly *in litt.* 2005). During the survey period between 1990 and 2005, at least 9 Oregon locations (Appendix B) have been used by wintering plovers. Probably as many as 2,500 plovers overwinter along the mainland California coast, and hundreds more at San Francisco Bay and in the Channel Islands (Appendix B, Page *et al.* 1986). The majority of wintering western snowy plovers on the California coast are found from Bodega Bay, Sonoma County, southward (Page *et al.* 1986). Appendix B gives the range of years over which each state's data was collected as well as the minimum and maximum number of western snowy plovers inventoried.

Nesting western snowy plovers from the Oregon coast have wintered as far south as Monterey Bay, California; those from Monterey Bay in central California have wintered north to Bandon, Oregon, and south to Laguna Ojo de Liebre, Baja California, Mexico (Page *et al.* 1995*a*); and those from San Diego in southern

California have wintered north to Vandenberg Air Force Base in Santa Barbara County and south to Laguna Ojo de Liebre, Baja California, Mexico (Powell *et al.* 1995, 1996, 1997).

In winter, western snowy plovers are found on many of the beaches used for nesting, as well as some beaches where they do not nest (Appendix B). They also occur in man-made salt ponds and on estuarine sand and mud flats. In California, the majority of wintering western snowy plovers concentrate on sand spits and dune-backed beaches. Some also occur on urban and bluff-backed beaches, which are rarely used for nesting (Page *et al.* 1986). Pocket beaches at the mouths of creeks and rivers on otherwise rocky shorelines are used by wintering western snowy plovers south, but not north, of San Mateo County, California.

b. Site Fidelity

Western snowy plovers that breed on the coast and inland are very site faithful in winter (Point Reyes Bird Observatory unpublished data). For example, after 166 adults and 204 chicks were banded at Lake Abert, Oregon during summer, many were subsequently found along the California and Baja California, Mexico coasts. Of those for which a wintering location was identified, 67 percent of the adult males, 73 percent of the adult females, and 60 percent of the birds banded as chicks (immatures) were found at the same winter location in at least 2 consecutive years; and 33 percent of the males, 32 percent of the females, and 35 percent of the immatures for at least 3 years (Page *et al.* 1995*b*).

c. Behavior

Western snowy plovers are typically gregarious in winter. Although some individuals defend territories on beaches, most usually roost in loose flocks; frequently western snowy plovers also are observed foraging in loose flocks (Page *et al.* 1995*a*). Roosting western snowy plovers usually sit in small depressions in the sand, or in the lee of kelp, other debris, or small dunes (Page *et al.* 1995*a*). Sitting behind debris or in depressions provides some shelter from the wind and probably makes the birds more difficult for predators to detect. When roosting western snowy plovers are disturbed, they frequently run a few meters to a new

spot where they sometimes displace other individuals. Alternatively, the whole flock may fly to a new location.

C. POPULATION STATUS AND TRENDS

1. Historical Trends

Historical records indicate that nesting western snowy plovers were once more widely distributed and abundant in coastal Washington, Oregon, and California.

a. Washington Coast

In Washington, western snowy plovers formerly nested at five coastal locations (Washington Department of Fish and Wildlife 1995). Three of these sites have had active nesting in recent years, as summarized in Table 1. One new site was also recently discovered in 2006. Populations appear to have increased overall since the early 1990s, although consistent, intensive surveys have been conducted only since the mid-1990s. Quantitative comparisons prior to that are not possible because of the inconsistency in surveys. Estimated numbers of breeding adults (Table 1) substantially exceed window survey data (M. Jensen *in litt.* 2006), partially because of adverse weather during window survey periods in recent years.

i. Grays Harbor County

Copalis Spit (WA-1) held 6 to 12 western snowy plover pairs in the late 1950s or early 1960s (Washington Department of Fish and Wildlife 1995). No other information on breeding at Copalis Spit is available. Suitable habitat was judged capable of supporting four pairs in 1984 (Washington Department of Fish and Wildlife 1995). Periodic surveys since 1983 have revealed just a single western snowy plover (Washington Department of Fish and Wildlife unpubl. data). Two post season juvenile western snowy plovers were observed at Copalis Spit in 2001 (Sundstrom 2002*a*). There is no longer vehicle access to the site since the road washed out several years ago, which has reduced the potential for disturbance from recreational activities. Erosion caused by the northward shift of Connor

Creek has reduced the amount of habitat, but some suitable habitat remains at the end of the spit and the area has potential as a nesting site with habitat restoration and public education (U.S. Fish and Wildlife Service 2005, M. Jensen *in litt.* 2006).

Damon Point and Oyhut Wildlife Area (WA-2) lack western snowy plover records prior to 1971, but this is likely due to limited visitation rather than western snowy plover absence. Between 1971 and 1983, birders reported up to six western snowy plovers during infrequent visits-to Damon Point (Washington Department of Fish and Wildlife 1995). Western snowy plover research in 1985 and 1986 revealed up to 20 western snowy plovers and 8 nests at Damon Point (Anthony 1987). Although most of the locality is suitable habitat, increasing levels of public use have reduced the secure nesting areas to a small portion of the site that is difficult to access, and the breeding population has declined over the last two decades (M. Jensen *in litt.* 2006). From 1993 to 2006 the number of adults at Damon Point has ranged from 2 to 10 (Table 1). Only one nest was found in 2006 (Pearson *et al.* 2006).

Westport Spit (WA-3) held low numbers of western snowy plovers from before 1915 until at least 1968, and scientific collecting was concentrated there through 1934 (Washington Department of Fish and Wildlife 1995). A single nest, poorly documented, was reported in 1983 (Washington Department of Fish and Wildlife unpublished data). No other quantitative information on abundance or nesting is available for this site. Erosion of the site has rendered the beach too narrow to support successful nesting, and there is little opportunity for habitat restoration through beachgrass removal due to private ownership of upland dune habitat (M. Jensen *in litt.* 2006). Recreational use is also substantial. This location is no longer being surveyed due to lack of suitable habitat.

ii. Pacific County

Midway Beach (WA-4) and Cape Shoalwater once contained several hundred acres of suitable western snowy plover habitat, but the area lacks historical records of these birds except for specimens collected in 1914 and 1960 and labeled “Tokeland” (Washington Department of Fish and Wildlife 1995). In

recent years, Midway Beach has been accreting sand and creating high quality habitat. Recent nesting was first documented in 1998 (Richardson *et al.* 2000). Numbers of breeding adults have increased since 1998, and during 2003-2006 the numbers of adults during the breeding season have ranged from 23-33, with a peak number of 30 nests (M. Jensen *in litt.* 2006; Pearson *et al.* 2006). Approximately one third of the habitat is on State Park land with controlled access; on the privately owned land recreational disturbance is fairly high and contributes to high rates of nest failure.

In 2006, western snowy plovers were discovered nesting on Graveyard Spit in northern Willapa Bay, which is primarily on the Shoalwater Indian Reservation and State lands (M. Jensen *in litt.* 2006; Pearson *et al.* 2006). Three pairs of plovers used the spit in 2006 and produced three fledglings.

Leadbetter Point (WA-5) was rarely visited by western snowy plover observers prior to 1964. In the 1960s and 1970s, birders reported up to 35 western snowy plovers, with nesting confirmed in 1967 by the sighting of two chicks (Washington Department of Fish and Wildlife 1995). Western snowy plover numbers were estimated at up to 24 individuals and between 7 and 11 nests during surveys done between 1978 to 1997 (Widrig 1980, 1981; Willapa National Wildlife Refuge unpublished data; Williamson 1995, 1996, 1997). Numbers increased slightly from 1998-2006, with numbers ranging from 24 to 45 adults present (Table 1). The distribution of nesting by western snowy plovers has changed, however, with recent habitat loss from erosion on the tip of Leadbetter Point and shifting of nesting southwards. Since 2002 the refuge has cleared 25 hectares (63 acres) of non-native beachgrass and the habitat restoration site has been consistently used by nesting plovers. Western snowy plovers are also nesting in Leadbetter State Park and State-owned lands south of the Park. Use of predator exclosures at the refuge since 2004 has greatly improved hatching success in the habitat restoration area and outer beach. Gunpowder Sands Island became intertidal in 2001 and no longer is suitable for nesting western snowy plovers (K. Brennan *in litt.* 2006).

Table 1. Status of western snowy plovers at four nesting sites in Washington (Sundstrom-Bagley *et. al*. 2000; Jaques 2001; Sundstrom 2001, 2002*a*, 2002*b*, 2003, 2004, 2005; Brennan and Jaques 2002; Brennan 2003; Brennan and Fernandez 2004*a*, 2004*b*, 2006; Pearson *et al.* 2006).

Year	Estimated Number of Adults Present				
	Leadbetter Point	Midway Beach	Damon Point	Graveyard Spit	Total
1993	16	-	7	-	23
1994	13	-	6	-	19
1995	25	0	9	-	34
1996	19	0	4	-	23
1997	21	0	3	-	24
1998	45	6	5	-	56
1999	26	12	5	-	43
2000	25	21	4	-	50
2001	27	14	4	-	45
2002	32	23	4	-	59
2003	30	33	5	-	68
2004	24	19	10	-	53
2005	38	25	5	-	68
2006	39	23	2	6	70

b. Oregon Coast

In Oregon, western snowy plovers historically nested at over 20 sites on the coast. At present only seven core nesting sites are consistently used, with a few additional areas occupied during some years (Lauten *et al*. 2006*a*, 2006*b*). Annual window surveys of western snowy plovers in Oregon (Table 2), including both adults and young of the year, began in 1978, with counts ranging from a high of 139 at 13 sites (1981) to a low of 30 observed at 9 sites (1992). Populations reached a low from 1991 to 1993 with a mean of 33 individuals recorded annually. From 1994 to 2006 western snowy plover numbers have generally

Table 2. Number of adult western snowy plovers observed on window surveys of the Oregon coast during the breeding season (1978-2006). Window surveys record the number of birds seen during 1-day censuses in May to June (Lauten *et al.* 2006*a*, 2006*b*).

Year	Number	Year	Number
1978	93	1993	45
1979	100	1994	51
1980	80	1995	64
1981	139	1996	85
1982	78	1997	73
1983	52	1998	57
1984	46	1999	49
1985	48	2000	no surveys conducted
1986	73	2001	71
1987	61	2002	71
1988	53	2003	63
1989	58	2004	82
1990	59	2005	100
1991	35	2006	91
1992	30		

increased, with an average of 71 plovers observed. The increase in the numbers of plovers observed in recent years is believed to be related to intensive management that began at the time of Federal listing.

Since 1993, the population on the Oregon coast has been intensively monitored, with many of the adults and chicks being uniquely color-banded. The presence of marked birds has allowed for the development of two other means of estimating the population (Table 3, Lauten *et al.* 2006b). The number of western snowy plovers, as indicated by the three indices in Table 3, has increased between 1993 and 1997, declined in 1998/1999, then increased again through 2006. The trends

Table 3. Comparison of population estimates of adult western snowy plovers on the Oregon coast during the breeding season (1993 to 2005) based on three different measures of abundance (Lauten *et al.* 2006*a*, 2006*b*).

Year	Estimates		
	A	B	C
1993	45	55 to 61	72
1994	51	67	83
1995	64	94	120
1996	85	110 to 113	134 to 137
1997	73	106 to 110	141
1998	57	75	97
1999	45	77	95 to 96
2000	no survey	89	109
2001	71	79 to 80	111 to 113
2002	71	80	99 to 102
2003	63	93	102 to 107
2004	82	120	136 to 142
2005	100	104	153 to 158
2006	91	135	177 to 179

A = Window census.

B = Estimated number of breeding adults. This number is lower than those in column C because it is an estimate of the number of individual birds thought to be breeding birds.

C = Total number of individual adults present during breeding season (includes depredated adults).

for all three indices remained relatively consistent throughout that measurement period.

Management measures (Lauten *et al.* 2006a, 2006b) have included the use of exclosures to reduce predation, predator control measures, restoration of breeding habitat by removing European beachgrass (*Ammophila arenaria*), increased presence of law enforcement personnel, additional and improved signs, additional symbolic fencing (consisting of one or two strands of light-weight string or cable

tied between posts to delineate areas where pedestrians and vehicles should not enter), and increased efforts on public information and education.

c. California Coast

i. Coastwide Perspective

In California, there also has been a significant decline in breeding locations, especially in southern California. By the late 1970s, nesting western snowy plovers were absent from 33 of 53 locations with breeding records prior to 1970 (Page and Stenzel 1981). The first quantitative data on the abundance of western snowy plovers along the California coast came from window surveys conducted during the 1977 to 1980 breeding seasons by Point Reyes Bird Observatory (Page and Stenzel 1981). An estimated 1,593 adult western snowy plovers were seen on these pioneer surveys (Table 4). The surveys suggested that the western snowy plover had disappeared from significant parts of its coastal California breeding range by 1980. It no longer bred along the beach at Mission Bay or at Buena Vista Lagoon in San Diego County. In Orange County, the only remaining breeding location was the Bolsa Chica wetlands; historically, the western snowy plover was known to breed along the beach from Upper Newport Bay to Anaheim Bay. It was absent from Los Angeles County where it formerly nested along the shores of Santa Monica Bay. In Ventura County, it had ceased breeding on Ventura Beach (San Buenaventura Beach), and in Santa Barbara County on Carpinteria, Santa Barbara (East Beach), and Goleta Beaches. Nesting no longer occurred along the northernmost portion of Monterey Bay in Santa Cruz County or on Doran Beach at Bodega Harbor in Sonoma County.

Subsequent coast-wide surveys by Point Reyes Bird Observatory in 1989 and 1991 indicated a further decline in numbers of breeding adult western snowy plovers during the decade after the 1977 to 1980 survey. Along the mainland coast, including the shores of the Channel Islands, western snowy plover populations had declined by about 5 percent, and in San Francisco Bay by about 44 percent (Table 4).

Table 4. Number of adult western snowy plovers observed during breeding season window surveys of the California coast.

Location	1977/80	1989	1991	1995	2000	2002	2003	2004	2005	2006
Del Norte County	11	8	3	0	0	0	0	0	0	0
Humboldt County	54	32	30	19	39	49	38	37	32	49
Mendocino County	15	2	0	-	1	0	1	3	9	3
Sonoma County	0	10	9	3	0	0	0	0	5	0
Marin County	40	24	25	8	21	25	17	26	22	16
San Mateo County (incl. SF beaches)	4	8	1	-	4	3	4	17	3	7
Northern Santa Cruz County	25	19	22	26	19	9	2	2	3	4
Monterey Bay	146	146	119	125	120	270	279	331	297	317
Point Sur	3	4	-	-	8	5	6	5	7	13
Northern San Luis Obispo County			9	-	1	3	0	3	12	15
Morro Bay Area	80	126	87	85	113	150	172	268	259	167
Pismo Beach/Santa Maria River	45	123	246	124	81	170	137	167	200	211
Vandenberg AFB	119	115	242	213	106	179	256	420	259	245
Jalama Beach	0	1	1	0	0	0	0	0	0	0
Hollister Ranch			8	-	-	-	-	-	-	-
Coal Oil Point (Devereaux) vicinity			-	-	-	8	26	30	30	39
Oxnard Lowland	136	175	105	69	107	164	80	119	110	125
Channel Islands	(288)[1]	217	200	196	89	79	90	82	99	115
Orange County	19	21	5	9	27	38	31	31	66	62
Northern San Diego County	160	72	48	49	63	80	145	159	107	141
Mission Beach			-	-	-	-	-	1	0	-
San Diego Bay	60	36	31	33	73	61	76	76	30	81
Tijuana Estuary	37	21	4	10	8	16	12	14	6	14
Subtotal	**1,242**	**1,160**	**1,195**	**969**	**880**	**1,309**	**1,372**	**1,791**	**1,556**	**1,624**
S San Francisco Bay	351	216	176	-	96	78	72	113	124	99
Total	**1,593**	**1,376**	**1,371**	**-**	**976**	**1,387**	**1,444**	**1,904**	**1,680**	**1,723**

[1] 260 adults during the survey; 28 additional adults extrapolated for unsurveyed portions of Santa Rosa Island.

The more recent coast-wide surveys, during the summers of 1995, 2000, and 2002-2006, were accomplished through the collaboration of researchers studying western snowy plovers along the California coast. Between the 1977 to 1980 surveys and the 1995 survey, western snowy plovers apparently ceased nesting at Los Penasquitos, and Agua Hedionda Lagoons in northern San Diego County (A. Powell, pers. comm. 1998). Nesting has been absent or sporadic at San Elijo Lagoon; Año Nuevo State Beach and Pescadero State Beach in San Mateo County; Bolinas Lagoon in Marin County; the south and north spits of Humboldt Bay and Big Lagoon in Humboldt County; and the Lake Talawa region of Del Norte County (Point Reyes Bird Observatory, unpublished data).

By 2000 populations had declined further to 71 percent of the 1977-1980 levels along the California coast and 27 percent of the 1977-1980 levels in San Francisco Bay. However, since then populations have grown substantially, roughly doubling along the coast while fluctuating irregularly in San Francisco Bay (Table 4). Recent population increases along the coast have been associated with implementation of management actions for the benefit of western snowy plovers and California least terns, including predator management and protection and restoration of habitat.

ii. Regional Perspective

Del Norte, Humboldt, and Mendocino Counties - Numbers of western snowy plover breeding adults declined and then somewhat rebounded in this northern California region since the initial Point Reyes Bird Observatory survey in 1977. In this region where there were 80 adults counted in 1977, a low of 19 were found in 1995 and 52 in 2006. In 1996, breeding was documented on the gravel bars of the Eel River, Humboldt County, and this area has continued to be a successful nesting site for western snowy plover breeding (Colwell *et al.* 2002, 2005). Even with the nest success at the gravel bars there is still a reduction in western snowy plovers from 1977; Del Norte County has no breeding birds, and Mendocino County has very few.

San Francisco Bay - As indicated in Table 4, western snowy plover numbers in San Francisco Bay declined markedly between the initial survey in 1978 and follow-up surveys. Western snowy plover numbers steadily declined over 26 years,

reaching a low of 72 in 2003, followed by a moderate but irregular increase (124 in 2005 surveys; 99 in 2006).

Recent surveys in South San Francisco Bay (Strong and Dakin 2004, Strong *et al.* 2004, Tucci *et al.* 2006) indicate that the largest breeding populations are concentrated at Eden Landing Ecological Reserve/Baumberg North (CA-33), managed by California Department of Fish and Game. Other population centers occur at Oliver Salt Ponds (CA-31), managed by Hayward Area Recreation District and East Bay Regional Parks District; and at Dumbarton (CA-36), Warm Springs (CA-39), Alviso (CA-41), and Ravenswood (CA-44), managed by Don Edwards San Francisco Bay National Wildlife Refuge. Foraging and nesting activities are concentrated in specific salt ponds within these areas. Small numbers of western snowy plovers have been observed at Ponds 7 and 7A in Napa County (CA-25 and vicinity), the only currently known nesting site in the North Bay.

Sonoma, Marin, San Francisco, San Mateo, Santa Cruz, and Monterey Counties - Along the segment of coastline from Sonoma County to Monterey Bay, numbers of western snowy plover adults during window surveys declined from 215 in 1977 to 162 in 1995, and subsequently increased to a maximum of 376 in 2004. The numbers of adults breeding on the beaches and salt ponds of Monterey Bay, and the beaches of northern Santa Cruz County, has increased dramatically since management actions have been undertaken to increase nesting success (Neuman *et al.* 2004; G. Page *in litt.* 2004*b*)

San Luis Obispo, Santa Barbara, and Ventura Counties, including Channel Islands - There is no clear evidence of an overall decline in the number of breeding western snowy plovers for this region from 1978/1980 to the present. Numbers of adults fluctuated between a high of 1089 and a low of 497 between 1978 and 2006. While numbers for the region may not have changed overall, there have been definite changes at specific locations (Table 5). Most notable are the decline and loss of the population on San Miguel Island from 1978 /1980 to 2000, the decline at Santa Rosa Island from 1991 to 2006, and the sudden increase in numbers at Vandenberg Air Force Base between 2000 and 2004 and at Coal Oil Point Reserve between 2002 and 2006 (Table 4).

Table 5. Breeding season window surveys of western snowy plover adults at selected sites along the coast of San Luis Obispo, Santa Barbara, and Ventura Counties.

Location	Year												
	1978 -80	**1989**	**1991**	**1995**	**1996**	**1997**	**1998**	**2000**	**2002**	**2003**	**2004**	**2005**	**2006**
Atascadero Beach	0	17	2	38	28	23	26	5	19	23	21	21	24
Morro Bay Spit	80	94	69	34	40	39	55	87	93	114	203	205	120
Vandenberg AFB [1]	119	115	242	213	230	238	130	106	179	256	420	259	245
Ormond Beach	25	24	34	20	19	34	19	10	35	19	28	21	22
Naval Base Ventura County (Pt. Mugu)	82	81	59	40	49	26	47	81	85	51	75	83	79
Santa Rosa Island [2]	84	91	103	71	78	79	76	17	10	---	---	37	19
San Miguel Island [2]	133	36	19	9	3	5	1	0	0	0	0	---	0
San Nicolas Island [3]	71	90	78	116	104	91	90	72	69	90	79	62	96
Total	594	548	606	541	551	535	444	378	490	553	826	688	605

Unless footnoted, the source of all data is Point Reyes Bird Observatory.

[1] The source of this data is the U.S. Air Force (Phil Persons)

[2] The source of this data is the National Park Service

[3] The source of this data is the U.S. Navy

Los Angeles, Orange, and San Diego Counties - Western snowy plover numbers detected during window surveys declined from the 276 adults tallied during the 1978 Point Reyes Bird Observatory survey to 88 during the 1991 survey. Subsequently the population has increased to 298 in 2006.

2. Current Breeding Distribution

The current Pacific coast breeding range of the western snowy plover extends from Damon Point, Washington, to Bahia Magdelena, Baja California, Mexico. The population is sparse in Washington, Oregon, and northern California. In 2006, estimated populations were 70 adults along the Washington coast (Pearson *et al*. 2006), 177-179 adults along coastal Oregon (Lauten *et al.* 2006*b*), and 2,231 adults in coastal California and San Francisco Bay (window survey including correction factor: G. Page *in litt.* 2006, U.S. Fish and Wildlife Service 2006*a*). Approximately 7 percent of the California population was observed in San Francisco Bay, and 4 percent in northern California north of the Golden Gate bridge. Along the coast of Baja California, Mexico, most nesting western snowy plovers are associated with the largest wetlands, especially Bahia San Quintin, Laguna Ojo de Liebre, and Bahia Magdelena (Palacios *et al.* 1994). No recent quantitative data exist on the western snowy plover population in Baja California, but it is probably roughly similar in size to the U.S. Pacific coast population.

3. Habitat Carrying Capacity

There is no quantitative information on carrying capacity of beaches for western snowy plovers. Determining carrying capacity of beaches is confounded by human use that affects the numbers of snowy plovers using the beaches. Beaches vary substantially in their structure, width, vegetation, and level of human use, complicating such a measurement.

The maximum reported breeding density of western snowy plovers is associated with the Moss Landing Wildlife Area, where since 1995 Point Reyes Bird Observatory staff have conducted intensive management specifically for western snowy plovers. These measures include predator control, removal of excessive vegetation, and operation of water control structures to maintain desired water

levels. With extensive management of approximately 55 hectares (138 acres) of mostly dried ponds in the Moss Landing Wildlife Area, 25 active nests, 3 pairs within 5 days of initiating nests, and 10 broods have been documented simultaneously; thus a peak of 76 nesting adults was accommodated simultaneously by 55 hectares (138 acres) of playa, or 1.4 hectares (3.6 acres) per functional pair (some of the broods were only being cared for by males) (D. George, Point Reyes Bird Observatory, pers. comm.). However, the numbers of nesting western snowy plovers at the Moss Landing Wildlife Area cannot be applied to beach areas because of the physical differences between salt pond and beach habitats and because beach habitats are typically subject to much more human disturbance. Neither can these numbers necessarily be applied to other salt ponds (*e.g.*, San Francisco Bay) because habitat and management opportunities differ.

D. REASONS FOR DECLINE AND CONTINUING THREATS

Overall, western snowy plover numbers have declined on the U.S. Pacific coast over the past century (see Population Status and Trends section). The subspecies faces multiple threats throughout its Pacific coast range. The reasons for decline and degree of threats vary by geographic location; however, the primary threat is habitat destruction and degradation. Habitat loss and degradation can be primarily attributed to human disturbance, urban development, introduced beachgrass (*Ammophila* spp.), and expanding predator populations. Natural factors, such as inclement weather, have also affected the quality and quantity of western snowy plover habitat (U.S. Fish and Wildlife Service 1993*a*). The following discussion is organized according to the five listing criteria under section 4(a)(1) of the Endangered Species Act.

1. The Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

a. Shoreline Stabilization and Development

The wide, flat, sparsely-vegetated beach strands preferred by western snowy plovers are an unstable habitat, subject to the dynamic processes of accretion and erosion of sand, and dependent on natural forces for replenishment and renewal. These

habitats are highly susceptible to degradation by construction of seawalls, breakwaters, jetties, piers, homes, hotels, parking lots, access roads, trails, bike paths, day-use parks, marinas, ferry terminals, recreational facilities, and support services that may cause direct and indirect losses of breeding and wintering habitat for the western snowy plover.

Beach stabilization efforts may interfere with coastal dune formation and cause beach erosion and loss of western snowy plover nesting and wintering habitat. Shoreline stabilization features such as jetties and groins may cause significant habitat degradation by robbing sand from the downdrift shoreline (U.S. Fish and Wildlife Service 1996*a*). However, jetties also can redirect sand deposition, causing an increase in available habitat. Construction of homes, resorts, and parking lots on coastal sand dunes constitutes irrevocable loss of habitat for western snowy plovers. Urban development has permanently eliminated valuable nesting habitat on beaches in southern Washington (Brittell *et al.* 1976), Oregon (Oregon Department of Fish and Wildlife 1994), and California (Page and Stenzel 1981). In addition to causing direct loss of habitat, there are additional potential adverse impacts to western snowy plovers from urban development (Figure 5). Increased development increases human use of the beach, thereby increasing disturbance to nesting plovers. When urban areas interface with natural habitat areas, the value of breeding and wintering habitat to native 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 1996/1997). Beach raking removes habitat features for both plovers and their prey, and precludes nests from being established. Also, construction of residential development in or near western snowy plover habitat attracts predators, including domestic cats.

b. Resource Extraction

i. Sand Removal and Beach Nourishment

Sand is mined in coastal areas such as Monterey Bay. Mining sand from the coastal mid-dunes and surf zone can cause erosion and loss of western snowy plover breeding and wintering habitat. Sand removal by heavy machinery can disturb

Figure 5. New housing development next to beach at Monterey Bay, California (photo by Peter Baye, with permission).

incubating western snowy plovers, destroy their nests or chicks, and result in the loss of invertebrates and natural wave-cast kelp and other debris that western snowy plovers use for foraging. Mining of surface sand from the 1930s through the 1970s at Spanish Bay in Monterey County degraded a network of dunes by lowering the surface elevations, removing sand to granite bedrock in many locations, and creating impervious surfaces that supported little to no native vegetation (Guinon 1988).

Beach nourishment with sand can be beneficial for the western snowy plover if it results in an increase in habitat. However, unless beach nourishment projects are properly designed, they can result in changes to beach slope from redeposition of sediments by storm waves, and result in the loss of western snowy plover breeding and wintering habitat. For example, if an inappropriate size class of sand (*e.g.*, coarser-grained sand) and range of minerals are introduced that are different from the current composition of native sand on a beach, it can alter dune slope (making it steeper or narrower), affect mobility and color of sand, decrease the abundance of beach invertebrates, and facilitate establishment of invasive exotic plants that may

have a competitive advantage over native plants. Feeney and Maffei (1991) investigated the color hues of the ground surface within San Francisco Bay salt ponds used as western snowy plover nesting habitat. Predominant soils were silty clay with varying amounts of humus, salt crystals, and shell fragments. They found a strong similarity between the color of the substrate in habitat preferred by western snowy plovers and the color of western snowy plover mantles (upper parts).

ii. Dredging and Disposal of Dredged Materials

Dredging is detrimental to western snowy plovers when it eliminates habitat or alters natural patterns of beach erosion and deposition that maintain habitat. Disturbances associated with dredging, such as placement of pipes, disposal of dredged materials, or noise, also may negatively affect breeding and wintering western snowy plovers. Dredging also is detrimental when it promotes water-oriented developments that increase recreational access to western snowy plover habitat (*e.g.*, marinas, boat ramps, or other facilities to support water-based recreation). In some cases, however, dredged materials may provide important nesting habitat for western snowy plovers such as those at Coos Bay, Oregon (Wilson-Jacobs and Dorsey 1985). Western snowy plovers also have been observed using dredged material during the winter; however, these areas are not used nearly as often as the adjacent ocean beach (E.Y. Zielinski and R.W. Williams *in litt.* 1999).

iii. Driftwood Removal

Driftwood can be an important component of western snowy plover breeding and wintering habitat. Driftwood contributes to dune-building and adds organic matter to the sand as it decays (Washington Department of Fish and Wildlife 1995). Additionally, driftwood provides western snowy plovers with year-round protection from wind and blowing sand. Often, western snowy plovers build nests beside driftwood, so its removal may reduce the number of suitable nesting sites.

Driftwood removed for firewood or decorative items can result in destruction of nests and newly-hatched chicks that frequently crouch by driftwood to hide from predators and people. Chainsaw noise may disrupt nesting, and vehicles used to

haul wood may crush nests and chicks. Removal of driftwood has been documented as a source of nest destruction at Vandenberg Air Force Base where two nests were crushed beneath driftwood dragged to beach fire sites (Persons 1994). Also, driftwood beach structures built by visitors are used by avian predators of western snowy plover chicks such as loggerhead shrikes (*Lanius ludovicianus*) and American kestrels (*Falco sparverius*), and predators of adults such as merlins (*Falco columbarius*) and peregrine falcons (*Falco peregrinus*).

Although driftwood is an important component of western snowy plover habitat, too much driftwood on a beach, which may occur after frequent and prolonged storm events, can be detrimental if there is not sufficient open habitat to induce the birds to nest.

iv. Beach Fires and Camping

Beach fires and camping may be harmful to nesting western snowy plovers when valuable driftwood is destroyed, as described above. Camping near breeding locations can cause greater impacts due to the prolonged disturbance and increased chance for possible direct mortality from associated dogs and children (S. Richardson *in litt*. 2001). Nighttime collecting of wood increases the risk of stepping on nests and chicks, which are difficult to see even during daylight hours. Fires near a western snowy plover nest could cause nest abandonment due to disturbance from human activities, light, and smoke. Fires have the potential to attract large groups of people and result in an increase of garbage, which attracts scavengers such as gulls (*Larus* spp.) and predators such as coyotes (*Canis latrans*), American crows (*Corvus brachyrhynchos*), and common ravens (*Corvus corax*). Also, after fires are abandoned, predators such as coyotes may be attracted into the area by odors lingering from the fire, particularly if it was used for cooking. Occasionally fires escape into nearby driftwood; fire suppression activities may disturb and threaten western snowy plover nests and chicks.

v. Watercourse Diversion, Impoundment, or Stabilization

Water diversion and impoundment of creeks and rivers may negatively affect western snowy plover habitat by reducing sand delivery to beaches and degrading

water quality. Water diversions are a major threat to western snowy plovers when they impair hydrologic processes (such as migration of creek and river mouths) that maintain open habitat at river and creek mouths by retarding the spread of introduced beachgrass (*Ammophila* spp.) and other vegetation. Water diversion, impoundment, or stabilization activities could include construction of dams and irrigation, flood control, and municipal water development projects (Powell *et al.* 2002).

vi. Operation of Salt Ponds

Salt ponds of San Francisco Bay and San Diego Bay, which are filled and drained as part of the salt production process, provide breeding and wintering habitat for western snowy plovers. Dry salt ponds and unvegetated salt pond levees are used as western snowy plover nesting habitat. Ponds with shallow water provide important foraging habitat for western snowy plovers, with ponds of low and medium salinity providing the highest invertebrate densities. Ponds of high salinity have reduced invertebrate densities and therefore provide lower quality foraging habitat. Nesting western snowy plovers can be attracted to an area when ponds are drained during the breeding season, but flooding can then destroy the nests when the ponds are refilled. Also, human disturbance resulting from maintenance activities associated with the operation of commercial salt ponds can result in the loss of western snowy plovers and disturbance of their habitat. If conducted during the western snowy plover breeding season, reconstruction of salt pond levees could destroy western snowy plover nests. Maintenance activities that are conducted by vehicles, on foot, or through the use of dredging equipment could result in direct mortality or harassment of western snowy plovers (See Dredging, Pedestrian, and Motorized Vehicle sections).

c. Encroachment of Introduced Beachgrass and Other Nonnative Vegetation

One of the most significant causes of habitat loss for coastal breeding western snowy plovers has been the encroachment of introduced European beachgrass (*Ammophila arenaria*) and American beachgrass (*Ammophila breviligulata*). Foredunes dominated by introduced beachgrass have replaced the original low, rounded, open mounds formed by the native American dunegrass (*Leymus mollis*)

and other beach plants. Native dune plants do not bind sand like *Ammophila* spp., and thus allow for sand movement and regenerating open expanses of sand. However, *Ammophila* spp. forms a dense cover that excludes many native taxa. On beaches dominated by this invasive grass, species richness of vegetation is halved, in comparison with foredunes dominated by native dune grass (Barbour and Major 1990). Similarly, American beachgrass greatly depresses the diversity of native dune plant species (Seabloom and Wiedemann 1994).

European beachgrass was introduced to the west coast around 1898 to stabilize dunes (Wiedemann 1987). Since then, it has spread up and down the coast and now is found from British Columbia to Ventura County in southern California. This invasive species is a rhizomatous grass that sprouts from root segments, with a natural ability to spread rapidly. Its most vigorous growth occurs in areas of wind-blown sand, primarily just above the high-tide line, and it thrives on burial under shifting sand. In 1988, European beachgrass was considered a major dune plant at about 50 percent of western snowy plover breeding areas in California and all of those in Oregon and Washington (J. Myers *in litt.* 1988).

American beachgrass is native to the East coast and Great Lakes region of North America. The densest populations of American beachgrass on the Pacific coast are currently located between the mouth of the Columbia River and Westport, Washington. Like European beachgrass, American beachgrass is dominant on the mobile sands of the foredune and rapidly spreads through rhizome fragments. American beachgrass occurs along the entire coast of Washington, ranging from Shi Shi Beach, Washington, in the north, to Sand Lake, Oregon, in the south, although its frequency decreases markedly at the northern and southern limits of this range. Currently, American beachgrass is the dominant introduced beachgrass species in much of the western snowy plover range in the State of Washington (Seabloom and Wiedemann 1994).

Stabilizing sand dunes with introduced beachgrass has reduced the amount of unvegetated area above the tideline, decreased the width of the beach, and increased its slope (Wiedemann 1987). These changes have reduced the amount of potential western snowy plover nesting habitat on many beaches and may hamper brood movements. In Oregon, the beachgrass community may provide habitat for western

snowy plover predators (*e.g.*, skunks [*Mephitis* spp.], weasels [*Mustela* spp.], coyotes [*Canis latrans*], foxes [*Urocyon cinereoargenteus* and *Vulpes vulpes*.], 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; K. Palermo, U.S. Forest Service, pers. comm. 1998).

In areas with European beachgrass, it has caused the development of a vegetated foredune that effectively blocks movement of sand inland and creates conditions favorable to the establishment of dense vegetation in the deflation plain, which occurs behind the foredunes (Wiedemann *et al.* 1969). In natural sand dunes, deflation plains consist of open sand ridges and flat plains at or near the water table. Thus, in areas with European beachgrass, the open features that characterize western snowy plover breeding habitat are destroyed. The establishment of European beachgrass has also caused sand spits at the mouths of small creeks and rivers to become more stable than those without vegetation because of the creation of an elevated beach profile. This elevated profile, in effect, reduces the scouring of spits during periods of high run-off and storms. A secondary effect of dune stabilization has been human development of beaches and surrounding areas (Oregon Department of Fish and Wildlife 1994). This development, in turn, has reduced available beach habitat and focused human activities on a smaller area that must be shared with western snowy plovers and other shorebirds.

On the Oregon coast, the establishment of European beachgrass has produced dramatic changes in the landscape (Oregon Department of Fish and Wildlife 1994). The spread of this nonnative species was greatly enhanced by aggressive stabilization programs in Oregon in the 1930s and 1940s (Wiedemann 1987). European beachgrass spread profusely along the Washington coast, and was well established by the 1950s (Washington Department of Fish and Wildlife 1995). In 1988, the spread of beachgrass was termed an “increasing threat” to traditional western snowy plover nesting areas at Leadbetter Point, Washington, having become established where absent only 4 years earlier (Willapa National Wildlife Refuge 1988).

In California, there are many beaches where European beachgrass has established a foothold. These beaches include the dunes at Lake Earl, Humboldt Bay (from

Trinidad to Centerville Beach), MacKerricher State Beach/Ten Mile Dunes Preserve, Manchester State Beach, Bodega Bay, Point Reyes National Seashore, Golden Gate National Recreation Area, Monterey Bay, Morro Bay Beach, Guadalupe-Nipomo Dunes, and Vandenberg Air Force Base (A. Pickart *in litt.* 1996). Chestnut (1997) studied the spread of European beachgrass at the Guadalupe-Nipomo Dunes in San Luis Obispo County. He documented an increase in beachgrass from approximately 8 to 109 hectares (20 to 270 acres) between 1969 and 1997, and found that its rapid spread through native vegetation posed a serious threat to nesting western snowy plovers and rare plants.

In addition to the loss of nesting habitat, introduced beachgrass also may adversely affect western snowy plover food sources. Slobodchikoff and Doyen (1977) found that beachgrass markedly depressed the diversity and abundance of sand-burrowing arthropods at coastal dune sites in central California. Because western snowy plovers often feed on insects well above the high-tide line, the presence of this invasive grass may also result in loss of food supplies for plovers (Stenzel *et al.* 1981).

In some areas of California, such as the Santa Margarita River in San Diego County, and the Santa Clara and Ventura Rivers in Ventura County, giant reed (*Arundo donax*) has become a problem along riparian zones. During winter storms, giant reed is washed downstream and deposited at the river mouths where western snowy plovers nest (Powell *et al.* 1997). Large piles of dead and sprouting giant reed eliminate nesting sites and increase the presence of predators, which use it as perches and prey on rodents in the piles of vegetation.

Other nonnative vegetation that has invaded coastal dunes, thereby reducing western snowy plover breeding habitat, includes Scotch broom (*Cytisus scoparius*), gorse (*Ulex europaeus*), South African iceplant (*Carpobrotus edulis*), pampas grass (*Cortaderia jubata* and *Cortaderia selloana*) and iceplant (*Mesembryanthemum* sp.); shore pine (*Pinus contorta*) is a native plant species that has invaded coastal dunes and resulted in similar impacts to western snowy plovers (Schwendiman 1975, California Native Plant Society 1996, Powell 1996). Many nonnative weed species also occur on and along San Francisco Bay salt pond levees, resulting in unsuitable nesting habitat for western snowy plovers (J. Albertson *in litt.* 1999).

d. Habitat Conversion for Other Special Status Species

It is not known whether western snowy plovers historically nested in San Francisco Bay prior to the construction of salt evaporator ponds beginning in 1860 (Ryan and Parkin 1998). However, western snowy plovers have wintered on the San Francisco Bay since at least the late 1800's, as indicated by a specimen dated November 8, 1889, in the Califomia Museum of Vertebrate Zoology (Grinnell *et al.* 1918). It is possible that natural salt ponds in the vicinity of San Lorenzo once supported nesting birds, but insufficient data exist to assess this possibility (U.S. Fish and Wildlife Service 1992). Today, however, the San Francisco Bay recovery unit supports an important western snowy plover source population, representing approximately 5 to 10 percent of the total breeding population. Feeney and Maffei (1991) observed a sizable population of western snowy plovers at the Baumberg and Oliver salt ponds during the breeding and nonbreeding seasons, suggesting that these ponds are important to western snowy plovers throughout the year. They suspected that these ponds are used by western snowy plovers as both a pre-breeding and post-breeding staging area, based on the high numbers of plovers in mid-February and in late August/September, respectively.

As part of the Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California (U.S. Fish and Wildlife Service, in preparation), extensive tidal marsh restoration is identified as a recovery action for listed and other sensitive species of tidal salt marshes including the California clapper rail (*Rallus longirostris obsoletus*) and salt marsh harvest mouse (*Reithrodontomys raviventris*). A large area of San Francisco Bay salt ponds, especially within the South Bay, are proposed for tidal marsh restoration for the benefit of federally listed tidal marsh species. Salt ponds are large, persistent hypersaline ponds that are intermittently flooded with South Bay water. Some of these ponds currently provide valuable breeding and wintering habitat for western snowy plovers. However, they occur within the historical areas of tidal salt marsh, which once dominated San Francisco Bay. Endangered tidal marsh species would benefit from conversion of these ponds back to salt marsh; however, western snowy plovers would lose suitable nesting and wintering areas.

The Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California will focus primarily on management of tidal marsh species, but will also provide for some areas to be maintained as managed ponds that would provide habitat for western snowy plovers and California least terns (*Sternula antillarum browni*). The South Bay Salt Pond Restoration Project (Philip Williams & Associates *et al.* 2006) has identified sites on National Wildlife Refuge and California Department of Fish and Game lands with potential for salt marsh restoration and managed ponds under a range of alternatives; the projected area of managed ponds ranges from 647 to 3,035 hectares (1,600 to 7,500 acres). Six of the plover locations identified in Appendices B and L (CA-33, CA-34, CA-39, CA-40, CA-41, CA-44) occur within the South Bay Salt Pond Restoration Project area. These six locations comprise about 60 percent of the western snowy plover locations in San Francisco Bay by area, and currently support over 90 percent of the western snowy plover population in San Francisco Bay (Strong *et al.* 2004, Tucci *et al.* 2006). In particular, several salt ponds at Eden Landing (location CA-33 and vicinity) currently support the largest population of western snowy plovers in San Francisco Bay. Distribution of plover populations and nesting sites within San Francisco Bay can fluctuate with salt pond management and availability of appropriate habitat, such that some locations identified in Appendix L are not currently occupied and other locations not mapped in Appendix L may nonetheless support breeding birds as management practices change. Thus the boundaries of San Francisco Bay locations as mapped in Appendix L reflect current and historical conditions and should be considered as flexible in the context of planning for future tidal marsh restoration. Specific localities to be managed for plovers should be coordinated with tidal marsh restoration in an integrated fashion, and thus may not be identical with the current or historical localities identified in this recovery plan.

Thus intensive management of designated ponds within the South Bay Salt Pond Restoration Project area will be crucial to achieving success in meeting western snowy plover recovery goals in San Francisco Bay. However, establishing western snowy plover populations at a variety of sites in San Francisco Bay, both within and outside the South Bay Salt Pond Restoration Project area, is advisable to minimize their vulnerability to loss (L. Trulio *in litt.* 2007). Potential western snowy plover habitat in San Francisco Bay outside of the South Bay Salt Pond Restoration Project area includes several sites around Alameda, Napa County, Hayward Shoreline, and

Crissy Field. In addition, large salt pond tracts in the South Bay remain under the ownership of Cargill; certain areas are still managed for salt production and could incidentally provide habitat for western snowy plovers, while approximately 600 hectares (1,400 acres) of ponds near Redwood City are no longer in salt production and provide an opportunity for significantly increasing western snowy plover habitat through active management. If these locations can be managed to encourage western snowy plover nesting, they may contribute substantially to meeting the overall goal of 500 breeding birds in San Francisco Bay. Western snowy plover management targets for the South Bay Salt Pond Restoration Project should take into account the habitat quality and management potential of plover habitat elsewhere in San Francisco Bay to meet overall goals for the recovery unit.

Don Edwards San Francisco Bay National Wildlife Refuge is currently planning pilot studies to assess how best to manage salt ponds for high densities of breeding western snowy plovers. Special management for western snowy plover may include intensive control of avian predators (*e.g.*, California gull colonies, ravens); active management of water levels to control vegetation, maintain optimal salinity, and produce brine flies; timing of inundation to avoid flooding nests; and reconfiguration of shallow salt ponds with isolated islands and furrowed areas. Locations of managed salt ponds should be planned to minimize the proximity of western snowy plover populations to landfills, gull colonies, and areas with high predator densities. Intensive management of salt ponds for western snowy plovers generally appears feasible, and plovers have been observed to opportunistically disperse among sites and use habitat that becomes suitable (V. Bloom *in litt.* 2005), so we expect relocation of plover nesting concentrations away from tidal marsh restoration areas to be possible, but management success should be carefully evaluated. Those alternatives with greater acreages of tidal marsh restoration (e.g., Alternative C at 90 percent tidal habitat) would require correspondingly more intensive management and reconfiguration of the remaining salt ponds (Philip Williams & Associates *et al.* 2006), and should be implemented gradually in conjunction with evaluation of management effectiveness for western snowy plovers.

Thus, we believe tidal marsh restoration can be compatible with the recovery of western snowy plovers and should not preclude meeting a goal of 500 breeding

birds in San Francisco Bay. As described below under Recovery Action 2.6, occupied salt ponds should initially be conserved. Salt marsh restoration in occupied plover habitat, particularly at densely populated sites, should be phased in after intensive adaptive management of other compensating salt pond habitat has demonstrated success in increasing plover populations. Thus habitat quality should be continually assessed so that overall western snowy plover populations in San Francisco Bay are not adversely affected by the restoration project and can increase to meet the management goal for this recovery unit.

In southern California, unless carefully planned, conversion of western snowy plover habitat to tidal salt marsh may result in loss of western snowy plover habitat. The light-footed clapper rail (*Rallus longirostris levipes*) inhabits coastal tidal marshes from Santa Barbara County south to Baja California, Mexico. Several locations in Ventura, Orange, and San Diego Counties provide nesting and/or wintering habitat for western snowy plovers, but also provide high quality light-footed clapper rail habitat or represent high priority tidal marsh restoration sites in the recovery plan for the light-footed clapper rail (U.S. Fish and Wildlife Service 1985). These sites include Bolsa Chica, Agua Hedionda Lagoon, San Elijo Lagoon, San Dieguito Lagoon, and Los Penasquitos Lagoon. The Bolsa Chica wetlands were opened to tidal action in 2006, in a project combining tidal restoration work with construction of islands and sand flats for nesting of shorebirds and California least terns.

2. Overutilization for Commercial, Recreational, Scientific, or Education Purposes

Biologists and agency personnel monitor western snowy plovers to assess population status and evaluate management techniques. Additionally, nest searches at some sites allow for placement of predator exclosures that aid in hatching success. Measures to minimize disturbance from these activities include: time limits for surveys, exclosure construction and sign/rope maintenance; conducting walking surveys where feasible; and limited entries.

Egg collecting has been observed at several California nesting colonies (Stenzel *et al.* 1981, Warriner *et al.* 1986). Occasionally recreational birdwatchers also may

harass western snowy plovers. The significance of these factors to nesting success is uncertain but probably relatively minor.

Qualified individuals may obtain permits to conduct scientific research and population census activities on western snowy plovers under section 10(a)(1)(A) of the Endangered Species Act. Specific activities that may be authorized include: population censuses and presence/absence surveys; monitoring of nesting activity; capturing, handling, weighing, measuring, banding, and color-marking of young and adults on breeding and wintering grounds; radio-telemetry studies; translocation studies; genetic studies; contaminant studies; behavioral, ecological, and life history studies; and placing predator exclosures around active nests. Short-term impacts of these activities may include harassment and possible accidental injury or death of a limited number of individual western snowy plovers. The long-term impacts will be to contribute to recovery of the species by facilitating development of more precise scientific information on status, life history, and ecology (U.S. Fish and Wildlife Service 1993*b*).

Banding birds with metal and plastic bands to identify individuals and to monitor bird populations is a common practice. However, a number of leg injuries to western snowy plovers, possibly resulting from banding, have been reported (G. Page *in litt.* 2005*b*). These injuries include swelling and abrasion of legs possibly from sand or other particles becoming lodged between the bands and the leg. Some banding injuries appear to have resulted in foot loss and in a few instances, death of the bird. Similar injuries have been observed in piping plovers (*Charadrius melodus*) banded on the Atlantic coast and interior U.S., and resulted in a moratorium on banding of that species (Lingle *et. al.* 1999, U.S. Fish and Wildlife Service 1996*a*, U.S. Fish and Wildlife Service 2002). Despite leg injuries, several piping plovers were observed to successfully breed and fledge young (Lingle *et. al.* 1999). However, these injuries may contribute directly or indirectly to mortalities or reduce breeding performance. It should be noted that incidents of foot loss in Pacific coast western snowy plovers usually appear to result from fine fibers wrapping around the bird's ankle, and have occurred in unbanded as well as banded individuals (J. Watkins, pers. comm. 2006). Despite risk of injuries, banding remains the best technique to study population traits such as survival, recruitment, and dispersal, and may be the most effective way to monitor populations of the

western snowy plover to determine effectiveness of management strategies. Currently the percentage of banded birds range-wide that become injured from banding and the impacts of banding injuries on populations of the western snowy plover are unknown; a study was initiated in 2005 by Point Reyes Bird Observatory to assess the effectiveness of alternative banding techniques in reducing injuries and band loss (G. Page *in litt.* 2005*b*).

Concerns that color bands increase the vulnerability of western snowy plovers to predation by reducing effectiveness of camouflage do not appear to be supported by existing evidence. Because western snowy plovers crouch and flatten to the sand at the approach of avian predators, color bands are typically hidden from sight; terrestrial predators are evaded by running or taking flight at their approach (J. Watkins, pers. comm. 2006).

3. Disease or Predation

West Nile virus, a mosquito-borne disease which can infect birds, reptiles, and mammals, has spread rapidly across the United States from the initial introduction in New England (National Audubon Society 2006). The disease has killed birds of various species in all coastal California counties since its arrival in the state in 2003 (U.S. Geological Survey 2006). In 2004 to 2006 the disease was reported from two coastal counties (Lane and Lincoln) in Oregon but has not been reported from any coastal counties in Washington (U.S. Geological Survey 2006). The deadliness of the disease varies by species; however, the virus has been identified in dead piping plovers (*Charadrius melodus*) and killdeer (*C. vociferus*), both closely related to the western snowy plover (Center for Disease Control 2004).

Since 2004 numerous western snowy plovers in southern California have been found dead or exhibited neurological signs consistent with avian botulism (M. Long *in litt.* 2006). Confirmation of disease diagnosis is currently pending availability of specimens for autopsy. We are currently coordinating with the USGS National Wildlife Health Center to better understand the causes of these mortalities and to develop a program for treatment of ill birds diagnosed with botulism. Additionally, 32 western snowy plovers died in 2006 from unknown causes in San Diego County (U.S. Navy *in litt.* 2007).

Predator density is a significant factor affecting the quality of western snowy plover nesting habitat (Stenzel *et al.* 1994). Predation can result in the loss of adults, chicks, or eggs; separation of chicks from adults is also caused by the presence of predators. Powell *et al.* (2002) found that predation accounted for most nest failures in 1994, 1996, and 1997, in San Diego County, California. Western snowy plovers generally cannot defend themselves or their nests against predation but must rely on antipredator adaptation, 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). In natural ecosystems, there is a co-evolution of the predator-prey relationship, where prey species slowly evolve with evading behavior as predator species slowly evolve effective prey-capturing behavior. However, when exotic predators are introduced into the ecosystem and thrive there, they frequently occur in much higher densities and possess more effective strategies than native predators and, hence, usually have a more severe effect.

Predation, by both native and nonnative species, has been identified as a major factor limiting western snowy plover reproductive success at many Pacific coast sites. Known mammalian and avian predators of western snowy plover eggs, chicks, or adults include the following native species: gray foxes (*Urocyon cinereoargenteus*), Santa Rosa Island foxes (*Urocyon littoralis santarosae*), coyotes, striped skunks (*Mephitis mephitis*), spotted skunks (*Spilogale putorius*), raccoons, California ground squirrels (*Citellus beecheyi*), long-tailed weasels (*Mustela frenata*), American crows, common ravens (*Corvus corax*), ring-billed gulls (*Larus delawarensis*), California gulls (*Larus californicus*), western gulls (*Larus occidentalis*), glaucous-winged gulls (*Larus glaucescens*), gull-billed tern (*Gelochelidon nilotica*), American kestrels (*Falco sparverius*), peregrine falcons (*Falco peregrinus*), northern harriers (*Circus cyaneus*), loggerhead shrikes, merlins (*Falco columbarius*), great horned owls (*Bubo virginianus*), burrowing owls (*Speotyto cunicularia*), great blue herons (*Ardea herodias*); and the following nonnative species: eastern red foxes (*Vulpes vulpes regalis*), Norway rats (*Rattus norvegicus*), Virginia opossums (*Didelphis marsupialis*), domestic and feral dogs (*Canis familiaris*), and cats (*Felis domesticus*). Loss or abandonment of eggs due to

predation by fire ants and Argentine ants (*Iridomyrmex humilis*) has also been observed (Fancher *et al.* 2002, Powell *et al.* 2002).

In Oregon, nest predation by corvids (common ravens and American crows) is the major cause of nest failures. Of 63 unexclosed nests in 2005, corvid predation accounted for 22 nest failures, by comparison with 14 failures due to mammalian or unknown predators and 10 due to abandonment (Lauten *et al.* 2006*a*). Exclosures were effective in protecting nests against this threat (0 of 83 exclosed nests failed due to nest predation).

American crows have been consistently documented as a major predator on western snowy plover nests along the California and Oregon coasts (Page 1990; Persons and Applegate 1997; T. Applegate, Bioresources, pers. comm. 1999; M. Stern, The Nature Conservancy, pers. comm. 1999). At Coal Oil Point, American crows were the most frequent predator on western snowy plover nests and experimentally placed quail eggs (Lafferty *et al.* 2006). Populations of American crows have increased in the San Francisco Bay and central California coast over the past several decades, and are positively associated with human population density (Leibezet and George 2002).

Common ravens are known predators of western snowy plover eggs (Wilson-Jacobs and Dorsey 1985, Point Reyes Bird Observatory unpublished data, George 1997, Stein 1993, Point Reyes Bird Observatory unpublished data, J. Albertson *in litt.* 1999, Point Reyes Bird Observatory unpubl. data, Stern *et al.* 1991). Ravens have consistently been the most significant nest predator at Point Reyes, accounting for 69 percent of all predation events over 5 years and destroying approximately 50 percent of nests (Hickey *et al.* 1995). Hatching success at Point Reyes National Seashore increased after exclosures were used to protect western snowy plover nests from ravens in 1996. Approximately 12 percent of nests in San Diego County were destroyed by ravens (Powell *et al.* 1996, Powell *et al.* 1997). Raven populations in coastal California have significantly increased in recent decades (Leibezet and George 2002), and as their range expands they are becoming increasingly significant as a nest predator on western snowy plovers; ravens were observed to destroy nests in Monterey Bay for the first time in 2002 and 2003 (G. Page *in litt.* 2004*b*). In northern California ravens are the single most limiting factor on western snowy

plover reproduction (Colwell *et al.* 2006). Ravens also prey on western snowy plover chicks, but not nearly to the extent that they do on eggs. However, at Point Reyes raven predation primarily affected chicks after exclosures were erected to protect snowy plover eggs (S. Allen *in litt.* 2004).

Gulls pose a special threat to breeding western snowy plovers because they not only depredate nests and chicks, but also usurp and trample western snowy plover nesting habitat and crush eggs (Persons and Applegate 1997, Point Reyes Bird Observatory unpublished data, Widrig 1980, J. Albertson *in litt.* 1999, Page *et al.* 1983).

The first time a gull-billed tern was found in San Diego County, California, was in 1985. Two years later they were nesting in south San Diego Bay (Unitt 2004). Since then, the nest colony has steadily increased with an estimated 52 pairs in 2006 (Patton 2006a). Gull-billed terns have become a concern to managers of beach-nesting birds in the region. Gull-billed terns were first documented taking California least terns (presumably chicks) in south San Diego Bay in 1992 (Caffrey 1993). Patton (2006a) summarizes recent incidents of gull-billed tern predation on both terns and western snowy plovers. He notes roughly 20 to 60 California least terns and 1 to 4 western snowy plover depredations by gull-billed terns and a greater number was suspected. Although the documented number of gull-billed tern depredations on western snow plovers is considerably lower than on California least terns, it is difficult to know the full extent of gull-billed tern impacts (Patton 2006b), especially for the plovers whose nests are more dispersed and less easily monitored.

Unlike management of other avian predators, management of gull-billed terns is problematic. The local subspecies of gull-billed tern, *G. n. vanrossemi*, is limited to western North America (Molina and Erwin 2006, but see Unitt 2004). The subspecies nests in scattered, localized colonies and "[i]n 2003 and 2005, the entire North American population of *vanrossemi* gull-billed terns ranged from about 533 to 810 pairs" (Molina and Erwin 2006). This means that this predator is considerably rarer than the listed bird species upon which it preys (California least terns and western snowy plovers), which poses a conundrum for managers of western snowy plovers and California least terns (Unitt 2004). Because of the gull-

billed tern's status, lethal predator control has not been used on this species since 1999 (Unitt 2004). Gull-billed terns will likely become a greater source of management concern as the local population of this species grows. Gull-billed terns have been observed at other locations of beach-nesting birds farther north from San Diego Bay, including Camp Pendleton, San Diego County (Foster 2005); Bolsa Chica, Orange County (Hamilton and Willick 1996), and Venice Beach, Los Angeles County (McCaskie and Garrett 2005).

Loggerhead shrikes are not known to take western snowy plover eggs, but do prey upon chicks and locally can have substantial effects on fledging success (Warriner *et al.* 1986, D. George *in litt.* 2001, Page *et al.* 1997, George 1997, Page 1988, Feeney and Maffei 1991).

Although not known to be predators of western snowy plover eggs, American kestrels are predators of chicks and possibly adults (D. George, pers. comm. 1998). Fledging success increased from 9 to 64 percent after a kestrel unexpectedly disappeared from a western snowy plover nest site in Moss Landing Wildlife Area (Page *et al.* 1998). In 1997, a merlin was suspected of taking 13 banded adults within the period of a few days at Salinas River National Wildlife Refuge. Also, western snowy plover chicks and adults are among the avian prey of the peregrine falcon (B. Walton, University of California Santa Cruz, pers. comm. 1998; D. George, pers. comm. 1998; Feeney and Maffei 1991). Northern harriers are effective predators of western snowy plover chicks and adults. In 1987, a harrier was observed hunting on the islands in the Salinas River where only approximately one third of the hatched chicks reached fledging age (Point Reyes Bird Observatory unpubl. data). At the Moss Landing Wildlife Area, fledging success dropped from 61 to 23 percent after a harrier began foraging there (Page *et al.* 1997). A northern harrier was seen capturing 2 to 4 western snowy plover chicks at Moss Landing salt ponds in 2000 (D. George *in litt.* 2001).

In recent decades, alien eastern red foxes have become a serious new predator of endangered and threatened animals in coastal habitats (Jurek 1992, Golightly *et al.* 1994, Lewis *et al.* 1993). Nonnative red foxes were imported into the southern Sacramento Valley, primarily for hunting and fur farming purposes, as early as the 1870s and experienced explosive spread in the 1970s and 1980s (Jurek 1992, Lewis

et al. 1993, 1995). The red fox now occurs throughout a significant portion of coastal California, including Marin, San Mateo, Santa Cruz, Monterey, San Luis Obispo, Santa Barbara, Ventura, Orange, and Los Angeles Counties (California Department of Fish and Game 1994). It also occurs at Monterey Bay (G. Page *in litt.* 1988) and San Francisco Bay (Harding *et al.* 1998), including the additional San Francisco Bay area counties of Napa, Solano, Contra Costa, Alameda, and Santa Clara (California Department of Fish and Game 1994). Red foxes also are present in some areas of coastal Oregon where western snowy plovers breed (D. George *in litt.* 2001, Lauten *et al.* 2006*b*).

Red foxes have been identified as a significant predator of western snowy plover eggs in the Monterey Bay area, where they are suspected of also preying on adults and chicks. On Monterey Bay beaches, red fox depredation of western snowy plover eggs resulted in a decline in clutch hatching rate of 30 percent from 1984 to 1990. After exclosures and mammalian predator control came into use to protect nests around Monterey Bay, annual clutch hatching rates have climbed from 43 to 68 percent (Neuman *et al.* 2004).

Predation of western snowy plover nests and chicks by red fox have been documented at Bandon Beach, New River and other portions of OR-15 on the Oregon coast. Biologists have documented red fox tracks around western snowy plover nest exclosures and have followed fox tracks back to dens located within western snowy plover nest areas. As part of the emergency response to the New Carissa oil spill in February 1999, a predator program was implemented. Animal and Plant Health Inspection Service (APHIS) Wildlife Services Division personnel removed 17 red fox from the New River area over a 3 month period (S. Richardson *in litt.* 2001). Ongoing predator management since 2002 has removed an average of 15 foxes per year from Bandon Beach/New River (Lauten *et al.* 2006*b*).

The U.S. Department of Agriculture, Wildlife Services Branch, has been involved in predator damage management for protection of threatened and endangered species for over 10 years in California. The management of nonnative red foxes has become a controversial issue in many areas of California, particularly in coastal habitats near urban areas (California Department of Fish and Game 1994). In November 1998, California voters approved Proposition 4, which banned the use of

leghold traps in California. In February 1999, the U.S. District Court issued a Preliminary Declaratory Relief Order, which allows the use of padded leghold traps on Federal and non-Federal lands for the purpose of protecting threatened or endangered species. Trapping of nonnative and native predators of western snowy plovers will therefore not be affected by Proposition 4 (J. Albertson *in litt.* 1999).

Coyotes are known predators of western snowy plover eggs in the Pismo Beach/Santa Maria River area of San Luis Obispo County (T. Applegate, pers. comm. 1996). They are the main nest predator of eggs on Vandenberg Air Force Base where they were the cause of 43 percent of all clutch losses attributed to predators from 1994 to 1997 (Persons and Applegate 1997). At Vandenberg Air Force Base, coyotes may be attracted to marine mammal carcasses on the beach early in the western snowy plover nesting season (Page and Persons 1995). Coyotes also have been identified as predators of western snowy plover nests at Mono Lake, California (Page *et al.* 1983).

Striped skunks have been recorded as predators of western snowy plover eggs (Hickey *et al.* 1995, George 1997, Page *et al.* 1997, Hutchinson *et al.* 1987, Stein 1993, Stern *et al.* 1991). Skunks were believed to be the main cause of nest loss on Morro Bay Spit in 1987, the only year that the reproductive success of western snowy plovers has been monitored at that location (Hutchinson *et al.* 1987). Persons and Ellison (2001) reported that the striped skunk was the predominant predator of nests at Morro spit, destroying 87 percent of depredated nests in 2000.

Domestic and feral cats are widespread predators. The threat of predation of western snowy plovers by cats increases when housing is constructed near western snowy plover breeding habitat. As natural-appearing beaches continue to be surrounded by urban areas, western snowy plovers will increasingly be subjected to this predator in the future. Predation by cats is difficult to measure because of the difficulty in finding evidence of bird remains, but they are known to take western snowy plover adults and eggs (B. Farner, pers. comm. *in* Powell and Collier 1994; Page 1988; D. George *in litt.* 2001).

Predation, while predominantly a natural phenomenon, is exacerbated through the introduction of nonnative predators and unintentional human encouragement of

larger populations of native predators. Elevated predation pressures result from landscape-level alterations in coastal dune habitats which, in turn, now support increased predator populations within the immediate vicinity of nesting habitat for western snowy plovers. Urbanization benefits red fox population growth by eliminating coyotes, which are the red fox's most common native predator and competitor; by providing ready sources of food, water and denning sites; and by aiding dispersion of foxes into new areas. Red foxes disperse readily in urban areas because there are no predators besides the domestic dog. Red foxes traverse most urban habitats, and readily cross busy highways and travel long distances underground through culverts (Lewis *et al.* 1993). Other predators, such as corvids, attracted by the presence of human activities (*e.g.*, improper disposal of trash), may frequent beaches in increasing numbers. Gulls have greatly expanded their range and numbers, especially along the United States portion of the Pacific coast, as a result of human-supplied food sources (trash, fish offal, and dumps). Thousands of California gulls now breed in the southern part of San Francisco Bay, where only a few were present in the early 1980s (J. Albertson *in litt.* 1999). This population growth is attributed largely to the increase in landfills along the Bay within the last 20 years. Also, crows and ravens forage at landfills. Buick and Paton (1989) found that losses of hooded plover (*Charadrius rubricollis*) nests with human footprints around them were higher than at those without footprints, suggesting "that scavenging predators may use human footprints as a visual cue in locating food." Beach litter and garbage also attract predators such as skunks and coyotes (*e.g.*, N. Read *in litt.* 1998). Unnatural habitat features such as landscaped vegetation (*e.g.*, palm trees), telephone poles, transmission towers, fences, buildings, and landfills near western snowy plover nesting areas attract predators and provide them with breeding areas (*e.g.*, J. Buffa *in litt.* 2004). These alterations all combine to make the coastal environment more conducive to various native and nonnative predators that adversely affect western snowy plovers.

Substantial evidence exists that human activities are affecting numbers and activity patterns of predators on western snowy plovers. For example, increased depredation of western snowy plover nests by ravens at the Oliver Brothers salt pond, California, may be an indirect adverse impact of nearby installation of light structures by the California Department of Transportation and high-tension power lines by the Pacific Gas and Electric Company, thereby creating corvid nesting sites

(G. Page, Point Reyes Bird Observatory, pers. comm. 1997). Raven nests have also been discovered by National Wildlife Refuge biologists in transmission towers near other snowy plover nesting areas managed by the Don Edwards San Francisco Bay National Wildlife Refuge in Warm Springs, Alviso, and Mountain View (J. Buffa *in litt.* 2004). On the Oregon coast, predation risk by mammals has increased as a result of the spread of European beachgrass, Scotch broom, and shore pine, which has transformed vast areas of open sand into dense grass-shrub habitat, providing excellent habitat for native and nonnative mammalian predators, such as skunks, raccoons, foxes, and feral cats (Stern *et al.* 1991). At Vandenberg Air Force Base, coyote predation can be exacerbated by human presence when trash or debris is left behind (N. Read *in litt.* 1998).

Signing and fencing of restricted areas on the beach may provide perches for avian predators of western snowy plover adults or chicks (Hallett *et al.* 1995). Although signs and fences are important conservation tools in many areas, land managers need to be aware that modifications to them may be necessary to deter predators in some circumstances.

4. The Inadequacy of Existing Regulatory Mechanisms

The western snowy plover is protected by the Federal Migratory Bird Treaty Act (16 U.S.C. 703 *et seq.*) and, in each state, by State law as a nongame species. The western snowy plover's breeding habitat, however, receives only limited protection from these laws (*e.g.*, the Migratory Bird Treaty Act prohibition against taking "nests"). Listing of the western snowy plover under State endangered species laws generally provides some protection against direct take of birds, and may require State agencies to consult on their actions, but may not adequately protect habitat. State regulations, policies, and goals include mandates both for protection of beach and dune habitat and for public recreational uses of coastal areas; consequently they may conflict with protection of western snowy plovers in some cases. Section 404 of the Clean Water Act (33 U.S.C. 1251 et seq.) and section 10 of the Rivers and Harbors Act (33 U.S.C. 403) are the primary Federal laws that could provide some protection of nesting and wintering habitat of the western snowy plover that is determined by the U.S. Army Corps of Engineers (Corps) to be wetlands or historic navigable waters of the United States. These laws, however, would apply to only a

small fraction of the nesting and wintering areas of the western snowy plover on the Pacific coast. Aside from the Migratory Bird Treaty Act, western snowy plovers have no protection status in Mexico.

To effectively recover the western snowy plover, it is necessary to develop participation plans among cooperating agencies, landowners, and conservation organizations to assure protection and appropriate management of breeding, wintering, and migration areas. Since listing of the western snowy plover in 1993, several local working groups have been developed and local governments and State and Federal agencies have cooperated extensively to implement a wide variety of western snowy plover conservation actions. These partners continue to work to implement appropriate management of coastal areas for recovery of the western snowy plover. These conservation efforts and the environmental policies of State and Federal agencies are described in greater detail in the Conservation Efforts section, below.

For additional discussion of regulatory mechanisms and management actions taken by California State Parks and other entities, see U.S. Fish and Wildlife Service (2006a).

5. Other Natural or Manmade Factors Affecting Their Continued Existence

a. Natural Events

Western snowy plover breeding and wintering habitat is subject to constant change from weather conditions. Stenzel *et al.* (1994) reported that the quality and extent of western snowy plover nesting habitat is variable in both the short- and long-term. Coastal beaches increase in width and elevation during the summer through sand deposition, making marginal beaches more suitable for nesting later in the season. Over the longer term, an increase or decrease in habitat quality may occur after several years of winter storms. Based on the amount of flooding, the availability of dry flats at the edges of coastal ponds, lagoons, and man-made salt evaporators also varies within and between seasons. Therefore, the number of western snowy plovers breeding in some areas may change annually or even over one breeding season in response to natural alterations in habitat availability (Stenzel *et al.* 1981).

Because most western snowy plover nesting areas occur on unstable sandy substrates, nest losses caused by weather-related natural phenomena commonly occur. High tides and strong winds cause many nest losses. Events such as extreme high tides (Wilson 1980, Stenzel *et al.* 1981), river flooding (Stenzel *et al.* 1981), and heavy rain (Wilson 1980, Warriner *et al.* 1986, Page 1988) have been reported to destroy or wash away nests. The annual percentage of total nest losses attributed to weather-related phenomenon has reached 15 to 38 percent at some locations (Wilson 1980, Warriner *et al.* 1986, Page 1988).

Stormy winters can adversely affect the western snowy plover. It is suspected that the severe storms occurring during the El Niño atmospheric and oceanic phenomenon of the winter of 1997/1998 caused a 10 to 30 percent decline in the 1998 western snowy plover breeding population, depending on the coastal region. In all monitored recovery units, the number of breeding birds in 1998 was lower than in the 1997 nesting season. Additionally, a very wet spring resulted in a later than normal breeding initiation and fewer nesting attempts.

The western snowy plover population naturally varies, both spatially and temporally, because of natural changes in weather and habitat conditions from year to year. However, as described above, human influences over the past century (*e.g.*, habitat destruction, invasion of introduced beachgrass, and elevated predation levels) have reduced the western snowy plover's ability to respond to these natural perturbations.

b. Disturbance of Breeding Plovers by Humans and Domestic Animals

The coastal zone of the United States, including both open coastal areas and inland portions of coastal watersheds, is home to over one-third of the U.S. human population, and that proportion is increasing (U.S. Fish and Wildlife Service 1995*a*). The southern California coastal area, which constitutes the central portion of the western snowy plover's coastal breeding range, attracts large crowds on a regular basis (Figure 6). The increasing level of human recreation was cited as a major threat to the breeding success of the Pacific coast population of the western snowy plover at the time of listing (U.S. Fish and Wildlife Service 1993*a*).

Figure 6. Recreationists at Salt Creek Beach, California (photo by Ruth Pratt, with permission).

i. Pedestrians

Pedestrians (*e.g.*, beach walkers and joggers) can cause both direct mortality and harassment of western snowy plovers. Pedestrians on beaches may crush eggs or chicks and chase western snowy plovers off their nests. Separation of western snowy plover adults from their nests and broods can cause mortality through exposure of vulnerable eggs or chicks to heat, cold, blowing sand, and/or predators. Pedestrians have been known to inadvertently step on eggs and chicks, deliberately take eggs from nests, and remove chicks from beaches, erroneously thinking they have been abandoned. People also may cause broods of western snowy plovers to run away from favored feeding areas. These effects are described in more detail below. Trash left on the beach by pedestrians also attracts predators. In addition to public pedestrians, military personnel using the beach for maneuvers, boat launches, and landings have the potential to similarly cause adverse impacts to western snowy plovers.

Beach-related recreational activities that are concentrated in one location (*e.g.*, sunbathing, picnicking, sandcastle building, birding, and photography) can negatively affect incubating adult western snowy plovers when these activities occur too close to their nests. Recreational activities that occur in the wet sand area (*e.g.*, sand sailing) can adversely affect western snowy plovers when they disturb plover adults or broods, which feed at the edge of the surf along the wrack line. Recreational activities that occur in or over deep water (such as the beach- and water-oriented activities of surfing, kayaking, wind surfing, jet skiing, and boating, and the coastal-related recreational activity of hang gliding) may not directly affect western snowy plovers; however, they can potentially be detrimental to western snowy plovers when recreationists use the beach to take a break from these activities, or as access, exit, or landing points.

Concentrations of people may deter western snowy plovers and other shorebirds from using otherwise suitable habitats. Anthony (1985) found that intensive human activity at Damon Point had a "bracketing effect" on the distribution of nesting western snowy plovers, confining their breeding activity to a section of the spit and precluding their regular use of otherwise suitable habitat. Fox (1990) also found that western snowy plovers avoided humans at Damon Point, and the presence of fishermen and beachcombers kept them hundreds of yards away from potential habitat. Because early-nesting western snowy plovers have narrower beaches from which to select nest locations, recreational use may be more concentrated in the limited habitat available. Also, repeated intrusions by people into western snowy plover nesting areas also may cause birds to move into marginal habitats where their chances of reproductive success are reduced. Studies of the Atlantic coast population of the piping plover (*Charadrius melodus*), an eastern species with habitat requirements very similar to the snowy plover, indicate that some piping plovers that nest early in the season are forced to move elsewhere when human use becomes too intense (Cairns and McLaren 1980). These authors concluded that piping plovers that nest early, before beaches become heavily used for recreation, "cannot predict and avoid reproductive failure in habitats that otherwise appear suitable to them." Burger (1993) observed that piping plovers, in response to human disturbance, spent more energy on vigilance and avoidance behavior at the expense of foraging activity, and sometimes abandoned preferred foraging habitat.

Page *et al.* (1977) observed western snowy plovers' response to human disturbance at two coastal beaches where normal beach use ranged from light to heavy. The study included 156 hours of observation at 15 western snowy plover nests. At Point Reyes, they found that pedestrians disrupt incubation of nests. When humans approached western snowy plovers, adults left their nests 78 percent of the time when people were within 50 meters (164 feet) and 34 percent of the time when people were over 100 meters (328 feet). They also found that western snowy plovers' reaction to disturbance by humans varied, ranging from one bird remaining off the nest for less than 1 minute when a person walked within 1 meter (3 feet) of the nest on a heavily-used beach to another western snowy plover leaving the nest when three people were 200 meters (656 feet) away on a less-used beach. They noted that "birds exposed to prolonged human activity near the nest seemed to become accustomed to it." It has been speculated that predators of western snowy plovers may benefit from a decline in wariness by western snowy plovers nesting on beaches that are subject to ongoing high levels of human disturbance (Persons and Applegate 1997).

Lafferty (2001) observed western snowy plovers' response to people, pet dogs, equestrians, crows and other birds. Observations were made at Devereux Slough in Santa Barbara County, Santa Rosa Island, San Nicolas Island, and Naval Base Ventura County (Point Mugu). This study found that western snowy plover are most frequently disturbed when approached closely (within 30 meters) by people and animals. The most intense disturbance (causing the western snowy plover to fly away) were in response to crows, followed by horses, dogs, humans, and other birds. Lafferty (2001) created a management model based on his findings and estimated flight response disturbances under different scenarios. The model predicted a reduced disturbance response for buffer zones of 20 to 30 meters.

Fahy and Woodhouse (1995) quantified the levels of recreational disturbance, their effect on western snowy plovers, and the effectiveness of the Linear Restriction Program at Ocean Beach, Vandenberg Air Force Base in 1995. Under this program signs directed visitors not to cross from the outer beach into the Linear Restriction area (inland of mean high tide mark, in dune habitat used by western snowy plovers). Seventy percent of all disturbances were in compliance with restriction warning signs. The disturbance types that were most and least frequently in

compliance with the boundary were joggers or walkers and stationary visitors, respectively. The closer the disturbance occurred to the plover, the more severe the plover response. All-terrain vehicles caused the most significant alert and flight behaviors by western snowy plovers, even though they were in compliance with the Linear Restriction. The disturbance types that caused incubating western snowy plovers to flush from their nests most frequently were joggers and walkers, followed by joggers or walkers with dogs off leash, and stationary visitors. The disturbance types that kept incubating western snowy plovers off their nests for the longest period of time were stationary visitors and surf fishermen, probably because of the duration of these stationary disturbances that occurred close to nests. Weekends accounted for 60 percent of all disturbances. The enforcement personnel appeared to have a limited presence; their presence was documented during only 14 percent of all identified disturbances.

Hoopes *et al.* (1992) quantified human use and disturbance to piping plovers in Massachusetts during the 1988 and 1989 nesting seasons. They found pedestrians caused piping plovers to flush or move at an average distance of 23 meters (75 feet). Pedestrians within 50 meters (164 feet) of the birds caused piping plovers to stop feeding 31 percent of the time.

Point Reyes Bird Observatory found that management actions that included exclusion zones around nesting areas, seasonal closure to dogs, and active weekend docent programs reduced mortality of chicks and eggs during the weekend such that the weekend and weekday mortality was the same (Peterlein and Roth 2003).

At the Pajaro River mouth in California, at least 14 percent of western snowy plover clutches were destroyed by being driven over, stepped on, or deliberately taken by people (Warriner *et al.* 1986). Since exclosures have been used to protect nests at the Pajaro River mouth and other locations at Monterey Bay, a few nests have still been deliberately destroyed by vandals in most years (Point Reyes Bird Observatory unpublished data). At South Beach, Oregon, the number of western snowy plovers declined from 25 in 1969 to 0 in 1981 when a new park was constructed next to the beach and the adjacent habitat became more accessible to vehicles and people (Hoffman 1972 *in* Oregon Department of Fish and Wildlife 1994).

At Vandenberg Air Force Base, western snowy plover monitoring during 1993 at South Beach (where recreational use was high) and North Beach (where recreational use was low) found the rate of nest loss caused by humans differed markedly: 24.3 percent of South Beach nests were lost compared to only 3.0 percent of North Beach nests (Persons 1994). Persons and Applegate (1997) reported that "rates of reproductive success, combined for 1994 through 1997, were substantially higher on North Beach than on South Beach." This difference occurred despite the fact that nesting habitat was posted as off-limits during the nesting season in 1994. However, at that time restrictions were new and not strictly enforced (R. Dyste *in litt*. 2004). Since 2000, public access has been restricted and fully enforced by Vandenberg Air Force Base personnel. Additionally, Santa Barbara County-supported volunteer docents were present at Surf Station (within Vandenberg Air Force Base) during the 2001-2003 plover breeding seasons when the beach was open for public access. In 2003, plover monitors did not document the loss of any nests within Surf Station Beach as a result of trampling by humans (R. Dyste *in litt*. 2004).

Loss of western snowy plover chicks also may occur because of human activities. The number of young produced per nesting attempt increased from 0.75 in disturbed habitat to 2.0 for nests free of disturbance at Willapa National Wildlife Refuge, Washington (Saul 1982). At Vandenberg Air Force Base, the 1997 fledging success of western snowy plovers was 33 to 34 percent on North Beach where recreational activity is restricted and only 12 percent on South Beach where recreational use is high (Persons and Applegate 1997). In 1999 and 2000, Ruhlen *et al*. (2003) found that increased human activities on Point Reyes beaches had a negative effect on western snowy plover chick survival. In both 1999 and 2000, western snowy plover chick loss was about three times greater on weekends and holidays than on weekdays. In most coastal areas, beach visitation in summer months is much higher on weekends and holidays than on weekdays.

Flemming *et al*. (1988) measured the effects of human disturbance on reproductive success and behavior of piping plovers in Nova Scotia. To assess human disturbance, they recorded positions of people, pedestrian tracks, and vehicle tracks, then defined classes based on visits per week. They found significantly fewer young survived in areas of high versus low disturbance; humans elicited a

significantly higher response level from adult piping plovers than did predators or nonpredatory species; chicks fed less and were brooded less when humans were within 160 meters (525 feet); and chick peck rate during feeding was lower when humans were present. They speculated that because chicks shifted from feeding and energy conservation activities to vigilance and cryptic predator avoidance behaviors, their energy reserves would be depleted, making them more susceptible to predators and inclement weather. They postulated that a decline in piping plover abundance in Nova Scotia could be caused by human disturbance altering chick behavior. Fewer chicks survived to 17 days in areas heavily disturbed by humans.

Schultz and Stock (1993) studied the effects of tourism on colonization, distribution, and hatching success of Kentish plovers (*Charadrius alexandrinus alexandrinus*), a Eurasian subspecies of the snowy plover, at the Wadden Sea in Germany. They measured disturbance intensity by counting and mapping tourists on 50 days from April to July, during times of peak human activity (1500 to 1600 hours) and in intervals of 30 minutes throughout other days. An index of person-hours per area per day was calculated. They found that Kentish plovers did not colonize heavily-disturbed areas and that resting and sunbathing people were apparently more disruptive than walking people because the latter generally followed the high-tide line. Clutch losses were lowest in areas with little disturbance and highest in areas with heavy disturbance. They indicated that hatching success in highly disturbed areas, even with optimal habitat, is as low as in poor habitat with a low level of disturbance.

ii. Dogs

Dogs on beaches can pose a serious threat to western snowy plovers during both the breeding and nonbreeding seasons. Unleashed pets, primarily dogs, sometimes chase western snowy plovers and destroy nests. Repeated disturbances by dogs can interrupt brooding, incubating, and foraging behavior of adult western snowy plovers and cause chicks to become separated from their parents. Pet owners frequently allow their dogs to run off-leash even on beaches where it is clearly signed that dogs are not permitted or are only permitted if on a leash. Enforcement of pet regulations on beaches by the managing agencies is often lax or nonexistent.

A number of examples of disruptive ways that dogs affect western snowy plovers have been noted at beaches in Monterey County (Marina State Beach), Santa Cruz County (Laguna, Scott Creek, and Seabright Beaches) and San Mateo County (Half Moon Bay and Pacifica Beaches) (D. George, pers. comm. 1997). Incubating birds have been flushed from nests by dogs, including nests located inside areas protected by symbolic fencing. Dogs also have displaced adults from nests with newly-hatched chicks. Roosting and feeding flocks, as well as individual birds, have been deliberately and persistently pursued by dogs. At Laguna Creek Beach, Zmudowski State Beach, and Salinas River State Beach, dogs partially or entirely destroyed western snowy plover nests which were in several cases, protected with symbolic fencing (D. George, pers. comm. 1997; Point Reyes Bird Observatory unpublished data; G. Page, pers. comm. 1998). Feral dogs are suspected to have disturbed western snowy plover nests and chicks on San Francisco Bay salt ponds (J. Albertson *in litt.* 1999).

Even when not deliberately chasing birds, dogs on a beach may disturb western snowy plovers and other shorebirds that are roosting or feeding. Page *et al.* (1977) found that westem snowy plovers flushed more frequently and remained off their nests longer when a person was accompanied by a dog than when alone. They collected data during 156 hours of observation at 15 nests at Point Reyes, California, and found the following distances at which western snowy plovers flushed from their nests as a result of disturbance by people with dogs. Within 50 meters (164 feet), people with dogs caused flushing 100 percent of the time. At a distance of over 100 meters (328 feet), people with dogs caused flushing 52 percent of the time (Page *et al*. 1977). Fahy and Woodhouse (1995) found that joggers or walkers with off-leash dogs caused a significantly greater number of avoidance responses from western snowy plovers than other types of disturbances at Ocean Beach, Vandenberg Air Force Base, California. Lafferty's (2001) management model predicted that intense disturbances could be dramatically reduced by removing dogs.

At wintering sites such as Ocean Beach in San Francisco, California, off-leash dogs have caused frequent disturbance and flushing of western snowy plovers and other shorebirds. Off-leash dogs chase wintering western snowy plovers at this beach and have been observed to regularly disturb and harass birds (P. Baye, U.S. Fish and

Wildlife Service, pers. comm. 1997). Observations by National Park Service volunteers suggest that unleashed pets represent the most significant recreational threat to wintering western snowy plovers and migratory shorebirds at Ocean Beach, because of the prolonged and repeated disturbance created when they chase birds (Hatch 1997). In 1995 and 1996, during 45 hour-long observations of wintering flocks of western snowy plovers at Ocean Beach, western snowy plovers responded by moving in 73 percent of 74 instances when dogs with or without people approached to within 15 meters (50 feet) (Golden Gate National Recreation Area unpublished data). When shorebirds are flushed, they must spend more energy on vigilance and avoidance behaviors at the expense of foraging and resting activity (Burger 1993, Hatch 1997). Disruption of foraging and roosting may result in decreased accumulation of energy reserves necessary for shorebirds to complete the migration cycle and successfully breed (Burger 1986, Pfister *et al.* 1992). Dog disturbance at wintering and staging sites, therefore, may adversely affect individual survivorship and fecundity, thereby affecting the species at the population level.

iii. Motorized Vehicles

Unrestricted use of motorized vehicles on beaches is a threat to western snowy plovers and their habitat. Motorized vehicles may affect remote stretches of beach where human disturbance would be slight if access were limited to pedestrians. The magnitude of this threat is variable, depending on level of use and type of terrain covered. Use of motor vehicles on coastal dunes may also be destructive to dune vegetation, especially sensitive native dune plants.

Driving vehicles in breeding habitat may cause destruction of eggs, chicks, and adults, abandonment of nests, and considerable stress and harassment to western snowy plover family groups (G. Page, pers. comm. 1997; J. Myers *in litt.* 1988; J. Price *in litt.* 1992; Stern *et al.* 1990; Casler *et al.* 1993; S. Richardson, pers. comm. 1998; Widrig 1980). In addition to recreational vehicles, vehicles used for military activities have also caused western snowy plover mortality (Powell *et al.* 1995, 1997; Persons 1994).

Driving motor vehicles at night seems to be particularly hazardous to western snowy plovers. Drivers of all-terrain vehicles at night have run over and killed

western snowy plover adults at Vandenberg Air Force Base, and State park ranger patrol vehicles have crushed western snowy plover chicks at Oceano Dunes State Vehicular Recreation Area during night patrols (R. Mesta *in litt.* 1998).

On the Eel River gravel bars, vehicle use (including motorcycles, ATVs, and full-size 4x4s) has resulted in the crushing of nests and disturbance to nesting plovers (Colwell *et al.* 2006).

Western snowy plover adults and chicks have been observed using tire tracks and human footprints for loafing at Camp Pendleton and Naval Amphibious Base Coronado (Powell and Collier 1994). This behavior increases their chances of being run over. Western snowy plover chicks also may have difficulty getting out of tire ruts, thereby increasing their likelihood of being run over. Their cryptic coloring and habit of crouching in depressions like tire tracks makes western snowy plover chicks especially vulnerable to vehicular traffic. In Massachusetts, between 1989 and 1997, a total of 25 piping plover chicks and 2 adults were found dead in off-road vehicle tire ruts on the upper beach between the mean high tide line and the foredune (U.S. District Court of Massachusetts 1998).

Hoopes *et al.* (1992) found off-road vehicles caused piping plovers to flush or move at an average distance of 40 meters (131 feet). Off-road vehicles within 50 meters (164 feet) of the birds caused piping plovers to stop feeding 77 percent of the time. While most responses by piping plovers to off-road vehicles resulted in movement by the birds, they observed three instances where the plovers "froze" in response to the off-road vehicles. Both types of responses have a negative impact on plovers through either disturbance, interruption of feeding behavior, or increasing the risk that piping plovers will be hit or crushed by vehicles.

At wintering sites, disturbance from motorized vehicles may harass western snowy plovers and disrupt their foraging and roosting activities, thereby decreasing energy reserves needed for migration and reproduction. When motorcycles, most of which were in the wet sand zone, were driven at high speed along Ocean Beach in San Francisco, Hatch (1997) observed that western snowy plovers and other shorebirds were continually disturbed and often took flight.

iv. Beach Cleaning

Removal of human-created trash on the beach is desirable to reduce predation threats by eliminating food for predators of western snowy plovers; however, the indiscriminate nature of mechanized beach-cleaning adversely affects western snowy plovers and their habitat. Mechanized beach cleaning can be dangerous to western snowy plovers by crushing their clutches and chicks or causing prolonged disturbance from the machine's noise. Also, this method of beach cleaning removes the birds' natural wrackline (area of beach containing seaweed and other natural wave-cast organic debris) feeding habitat, reducing the availability of food. Kelp and driftwood, with their associated invertebrates, are regularly removed and the upper layer of sand is disturbed. Beach grooming also alters beach topography, removes objects associated with western snowy plover nesting, and prevents the establishment of native beach vegetation (J. Watkins *in litt.* 1999). In all of Los Angeles County and parts of Ventura, Santa Barbara, and Orange Counties, California, entire beaches are raked on a daily to weekly basis. Large rakes, with tines 5 to 15 centimeters (2 to 6 inches) apart, are dragged behind motorized vehicles from the waterline to pavement or to the low retaining wall bordering the beaches (Stenzel *et al.* 1981). Even if human activity was low on these beaches, grooming activities completely preclude the possibility of successful western snowy plover nesting (Powell 1996).

v. Equestrian Traffic

Most equestrian use on beaches is directed to wet-sand areas. However, during high tide periods, horseback riders on the beach sometimes enter coastal dunes or upper beach areas (Figure 7), where they may crush clutches or disturb western snowy plovers (Point Reyes Bird Observatory unpublished data, Page 1988, Persons 1995, Craig *et al.* 1992, Woolington 1985).

Figure 7. Equestrians on beach (photo by U.S. Forest Service, with permission).

vi. Fishing

Impacts on western snowy plover nesting may be associated with surf fishing and shellfish harvesting in and near western snowy plover habitat. The improper disposal of offal (waste parts of fish), bait, and other litter attracts crows, ravens, and gulls, which are predators of western snowy plover eggs and chicks. Also, western snowy plovers may become entangled in discarded fishing lines (G. Page, pers. comm. 1998).

Surf fishing is a commercial enterprise in many coastal locations, including the ocean smelt fishery in northern California (C. Moulton *in litt.* 1997). Recreational surf fishing occurs throughout the California coast. In Humboldt County, California, Redwood National and State Parks have proposed allowing beach vehicle use, by annual permit, for commercial fishing and tribal fishing/gathering on Gold Bluffs Beach, Freshwater Spit, and Crescent Beach (J. Watkins *in litt.* 1999). In the State of Washington, the most popular season for surf fishing is April through July (Washington Department of Fish and Wildlife 1995). At present, demand for

surf perch fishing is relatively low in Oregon. However, the Oregon Department of Fish and Wildlife is promoting a surf perch fishery to lessen the demand for anadromous fishing. This fishery would increase vehicle driving to remote and relatively undisturbed sites used by western snowy plovers (K. Palermo *in litt.* 1998*a*).

Because the earliest western snowy plover clutches in Washington are laid between mid-April and mid-May, harvesting of razor clams during the mid-March to mid-May clamming season may have adverse impacts on prospecting or nesting western snowy plovers. Clammers near nesting areas may disturb adults and chicks; human activity in feeding areas may restrict western snowy plover foraging activity, and increased motorized traffic may increase the risk of nest and chick loss (Washington Department of Fish and Wildlife 1995). However, observations of western snowy plover and human activities during the spring 1995 razor clam season showed clamming had no visible impact on western snowy plovers where clamming intensity was low (Kloempken and Richardson 1995). Instances of trespassing into the western snowy plover protection area were noted; however, movement of the western snowy plover protection area boundary about 327 meters (1,073 feet) west of its previous location seemed to benefit the birds by providing more space between them and pedestrian and vehicular disturbances.

vii. Fireworks

Fireworks are highly disturbing to western snowy plovers. All western snowy plovers flushed from Coal Oil Point Reserve during a nearby July 4, 2005, fireworks display (C. Sandoval, University of California Santa Barbara, pers. comm. 2005). At Del Monte Beach, California, a western snowy plover chick hatched on July 4, 1996, within an area demarcated by symbolic fencing, and was abandoned by its parents after a fireworks display. Disturbance from the noise of the pyrotechnics is exacerbated by disturbance caused by large crowds attracted to fireworks events. California Department of Parks and Recreation staff estimated that 6,000 people visited Del Monte Beach on that day. Because of the extensive disturbance, the adult western snowy plovers left the nest site with two chicks, abandoned the third chick, and were not seen again (K. Neuman, California Department of Parks and Recreation, pers. comm. 1997). During July 4, 1992,

observations of piping plovers that nest on the Breezy Point Cooperative and adjacent beaches of Gateway National Recreation Area in Queens, New York, the birds were disturbed by fireworks displays (Howard *et al.* 1993). Management recommendations for this area included prohibition of fireworks in or near the fenced and posted nesting and brood-rearing areas.

viii. Kite Flying and Model Airplanes

Biologists believe plovers perceive kites as potential avian predators (Hoopes *et al.* 1992, Hatch 1997). The reaction of western snowy plovers to kites at Ocean Beach in San Francisco, California, "ranged from increased vigilance while roosting in close proximity to the kite flying, to walking or running approximately 10 to 25 meters (33 to 82 feet) away and resting again while remaining alert" (Hatch 1997). It is expected that stunt-kites would cause a greater response from western snowy plovers than traditional, more stationary kites. Stunt kites include soaring-type, two-string kites with noisy, fluttering tails, which often exhibit rapid, erratic movements.

Hoopes *et al.* (1992) found that piping plovers are intolerant of kites. Compared to other human disturbances (i.e., pedestrian, off-road vehicle, and dog/pet), kites caused piping plovers to flush or move at a greater distance from the disturbance, to move the longest distance away from the disturbance, and to move for the longest duration. Piping plovers responded to kites at an average distance of 85 meters (279 feet); moved an average distance of over 100 meters (328 feet); and the average duration of the response was 70 seconds.

It is expected that model airplanes may also have a detrimental impact to western snowy plovers because western snowy plovers may perceive them as potential predators (Hatch 1997).

ix. Aircraft Overflights

Low-flying aircraft (*e.g.*, within 152 meters (500 feet) of the ground) can cause disturbances to breeding and wintering western snowy plovers. Hatch (1997) found that all types of low-flying aircraft potentially may be perceived by western snowy

plovers as predators. She also found that the general response of roosting western snowy plovers to low-flying aircraft at Ocean Beach, San Francisco, California, was to increase vigilance and crouch in depressions on the beach, whereas foraging western snowy plovers frequently took flight. Plovers may, however, become acclimated to aircraft overflights in some instances, since at Naval Air Station North Island they chose to nest repeatedly within military airfield boundaries on runway ovals next to busy military runways (S. Vissman, U.S. Fish and Wildlife Service, pers. comm. 1997). Federal Aviation Regulations, Part 91, General Operating and Flight Rules, require that over open water, aircraft may not be operated closer than 152 meters (500 feet) to any person, vessel, vehicle, or structure. Emergency operations, including those by Coast Guard helicopters, are exempted from these rules. However, helicopters may be operated at less than 152 meters (500 feet) if the operation is conducted without hazard to people or property on the surface (U.S. Federal Aviation Administration 1997). Helicopters can cause excessive noise, which can also disturb western snowy plovers, even at an altitude of 152 meters (500 feet) (Howard *et al.* 1993; J. Watkins *in litt.* 1999; D. Stadtlander, pers. comm. 1999). At Marine Corps Base Camp Pendleton, California, where military training can require aircraft (especially helicopters) to fly at very low elevations, the Marine Corps minimizes impacts to western snowy plovers and California least terns by requiring aircraft to stay at least 91 meters (300 feet) above the ground over tern and plover nesting areas during the nesting season (U.S. Marine Corps 2006).

x. Special Events

Special events which attract large crowds, such as media events, sporting events, and beach clean-ups, have a potential for significant adverse impacts when held in or near western snowy plover habitat. An example is the National Marine Debris Monitoring Program, implemented by the U.S. Environmental Protection Agency in conjunction with the National Oceanic and Atmospheric Administration, National Park Service, and the U.S. Coast Guard. This year-round program uses volunteers (including high school students) to document and collect trash and marine debris on coastal transects within western snowy plover nesting and wintering habitat. Potential threats from crowds of people attracted to special events are similar to those previously identified for pedestrians, including direct mortality and harassment of western snowy plovers.

xi. Coastal Access

Expanding public access to the coast (*e.g.*, State Coastal Trails) for recreation (*e.g.*, walking, hiking, biking) may adversely affect western snowy plovers and their breeding or wintering habitat. Expanded coastal access brings significantly greater numbers of people to the beach and other coastal habitats, exacerbating potential conflicts between human recreational activities and western snowy plover habitat needs (see Pedestrian section). Expanded coastal access may exceed the threshold of beach visitors that public resource agencies (*e.g.*, State Parks and National Park Service) can effectively manage while also meeting their responsibilities to protect natural resources.

Bicycles are known to adversely affect western snowy plovers nesting on levees and roads near San Francisco Bay salt ponds within the Don Edwards San Francisco Bay National Wildlife Refuge. Many of these levees are closed to human access, but some bicyclists trespass onto closed levees. In 1998, one western snowy plover nest, located on the main access road to the Refuge, was run over by a bicycle as biologists were putting up a barrier to protect it (J. Albertson *in litt.* 1999).

xii. Livestock Grazing

Western snowy plover nests have been trampled by cattle, causing both direct mortality of eggs and flushing of adults from the nests (U.S. Fish and Wildlife Service *in litt.* 1995). Additionally, feral pigs (*Sus scrofa*) may trample western snowy plover habitat and disturb nesting western snowy plovers (R. Klinger, The Nature Conservancy, pers comm. 1998, D. George *in litt.* 2001). Cow and horse manure can introduce seeds of non-native plants into the dunes.

c. Oil Spills

The Pacific Coast population of the western snowy plover is vulnerable to oil spills. Western snowy plovers forage along the shoreline and in sea wrack (seaweed and other natural wave-cast organic debris) at the high-tide line and are thus at risk of direct exposure to oil during spills. The loss of thermal insulation is considered to be the primary cause of mortality in oiled birds (National Research Council 1985,

Leighton 1991). Oiled feathers lose their ability to keep body heat in and cold water out, causing reduced insulation, increased metabolic rate, and hypothermia. Ingestion of oil may lead to physiological changes in birds, including pathological effects on the alimentary tract, blood, adrenal glands, kidneys, liver, and other organs (Fry and Lowenstine 1985, Khan and Ryan 1991, Burger and Fry 1993). Exposure of adult birds to oil also may impair reproduction, including reductions in egg laying and hatchability (Ainley *et al.* 1981, Fry *et al.* 1986) and reductions in survival and growth of chicks (Trivelpiece *et al.* 1984). Oil transferred to eggs from plumage or feet of incubating birds can kill embryos (Albers 1977, Albers and Szaro 1978, King and Lefever 1979). Oiled shorebirds may spend more time preening and less time feeding than unoiled birds, such that their body condition and ability to migrate to breeding grounds and reproduce may be impaired (Evans and Keijl 1993, Burger 1997).

Oil spills may result in contamination or depletion of western snowy plover food sources. Elevated concentrations of total petroleum hydrocarbons have been found in the sand crab (*Emerita analoga*), a potential western snowy plover food item, following a southern California oil spill (J.E. Dugan, unpublished data). Oil or other chemicals washed onto mudflats or sand beaches may result in reduction in the availability of invertebrate prey (Kindinger 1981). Elimination of shorebird food resources on intertidal flats of the Saudi Arabian Gulf coast as a result of the large oil spills associated with the 1991 Gulf War led to drastic reductions in the number of shorebirds supported by this habitat (Evans *et al.* 1993). Disturbance and other adverse impacts to western snowy plovers also may occur during oil clean-up activities if response teams are not careful when driving heavy equipment and vehicles or traversing on foot through western snowy plover habitat.

During the 1990s, at least six oil spill incidents in California and one in Oregon resulted in adverse impacts to western snowy plovers. The U.S. Coast Guard and various other State and Federal agencies and the responsible parties responded to these spills. One of these incidents occurred between 1984 and 1998 at Unocal's Guadalupe Oil Field in San Luis Obispo, California contaminated western snowy plover habitat with toxic hydrocarbons. In 1993, oil spilled from a ruptured oil transfer line into McGrath Lake, Ventura County, California and then flowed into the Pacific Ocean. Western snowy plover habitat and prey were contaminated with

oil and wintering western snowy plovers were displaced during the cleanup activities (S. Henry *in litt.* 1998, McGrath Oil Spill Restoration Scoping Document 1995). In 1996, the SS Cape Mohican discharged fuel oil into the San Francisco Drydock Shipyard, California, where it spread throughout the central bay and into the Pacific Ocean, oiling western snowy plovers and their beach habitat (Cape Mohican Trustee Council 2002, Point Reyes Bird Observatory unpublished data). In 1997, a pipeline extending between an offshore oil platform (Platform Irene) and the mainland ruptured near Pedernales Point, Santa Barbara County, California, oiling western snowy plovers and wrack where western snowy plovers were seen feeding (Applegate 1998, Ford 1998, Lockyer *et al.* 2002). In 1997 and 1998, large numbers of tarballs became stranded on beaches at Point Reyes National Seashore and resulted in oiling of snowy plovers and their habitat. Subsequent tarball incidents in 2001 and 2002 resulted in identification of the source of the tarballs as the SS Jacob Luckenbach, an oil tanker that sank in 1953 (Carter and Golightly 2003, Point Reyes Bird Observatory unpublished data, Hughes 2003). In 1999, the dredge M/V Stuyvesant spilled fuel oil into the Pacific Ocean off Humboldt Bay, California (U.S. Coast Guard 2001), resulting in oiling of western snowy plovers and their habitat (LeValley *et al.* 2001).

In February 1999, the freighter New Carissa went aground near the North Jetty of Coos Bay, Oregon, breaking apart and spilling 25,000 to 70,000 or more gallons of oil into coastal water. (U.S. Bureau of Land Management 2001). The incident oiled approximately 52 snowy plovers, representing at least 60 percent of the Oregon wintering population of western snowy plover (Stern *et al.* 2000). In Washington, the 1988 Nestucca oil spill and the 1991 Tenyo Maru oil spill may also have affected western snowy plovers or their habitats, although impacts are not as well documented as in the above cases (Larsen and Richardson 1990).

In addition to catastrophic spills like those described above, chronic oil pollution may affect western snowy plovers. Surveys of beached birds have shown that small-volume, chronic oil pollution is an ongoing source of avian mortality in coastal regions (Burger and Fry 1993). Dead oiled birds and tarballs are found regularly on Pacific coast beaches in the absence of reported oil spills (Roletto *et al.* 2000). Potential sources of chronic oiling include natural seeps, bilge water pumping, sunken vessels, urban runoff, and small or unreported spills from vessels,

tankers, pipelines, and offshore oil platforms. Elevated concentrations of total petroleum hydrocarbons have been found in the sand crab *(Emerita analoga*), a potential western snowy plover food item, in the vicinity of natural oil seeps (Dugan *et al.* 1997).

Intensive oil spill cleanup operations, including use of vehicles to deploy beach booms, move personnel, and remove debris, cause disturbance to nesting and foraging activities of western snowy plovers. These temporary impacts are offset by restoration of habitat and cleaning affected birds.

d. Contaminants

The most likely route of exposure of western snowy plovers to contaminants other than spilled oil is through the diet. Western snowy plovers feed on aquatic and terrestrial insects, and the bioaccumulation of environmental contaminants on western snowy plover nesting and wintering grounds may adversely affect their health and reproduction. Organochlorines are known to have caused reduced avian egg production, aberrant incubation behavior, delayed ovulation, embryotoxicosis, and mortality of chicks and adults (Blus 1982). Selenium has caused decreased hatchability of avian eggs, developmental abnormalities, altered nesting behavior, and embryotoxicosis in birds in field and laboratory studies (Ohlendorf *et al.* 1986, Heintz *et al.* 1987). Mercury can cause decreased hatchability of avian eggs (Connors *et al.* 1975), boron has been shown to reduce hatchability of waterfowl eggs in laboratory experiments (Smith and Anders 1989), and arsenic may also adversely affect avian reproduction (Stanley *et al.* 1994).

Hothem and Powell (2000) analyzed 23 western snowy plover eggs collected from 5 sites (Camp Pendleton Marine Corps Base, Batiquitos Lagoon, Naval Amphibious Base Coronado, Sweetwater Marsh National Wildlife Refuge, and Tijuana Estuary) in southern California from 1994 to 1996 for metals and trace elements, and 20 eggs for organochlorine pesticides and metabolites. All eggs were either abandoned or failed to hatch. Organochlorines, including dieldrin, o,p'-DDD, o,p'-DDE, o,p'-DDT, p,p'-DDD, p,p'-DDE, p,p'-DDT, oxychlordane, and trans-nonachlor were found above the detection limits in western snowy plover eggs. Median DDE and PCB concentrations were less than those normally associated with eggshell

thinning. deformities, or other detrimental effects on birds. Twelve metals and trace elements (arsenic, boron, chromium, copper, iron, magnesium, manganese, mercury, nickel, selenium, strontium and zinc) were detected in at least 90 percent of the samples, but generally at background levels. Mean concentrations of all contaminants were below those that would adversely affect reproduction.

Concentrations of mercury in western snowy plover eggs that failed to hatch at Point Reyes National Seashore were five to ten times higher than the mercury concentrations in the five Southern California locations studied by Hothem and Powell (Schwarzbach *et al.* 2003). The mean mercury concentration of 1.07 micrograms/gram (1.07 parts per million), wet weight, in western snowy plover eggs from Point Reyes National Seashore is probably high enough to account for egg failure through direct toxic effects to western snowy plover embryos (Schwarzbach *et al.* 2003). Because only failed and abandoned eggs were taken rather than randomly collected eggs, the extent of mercury contamination of the entire breeding western snowy plover population at Point Reyes can not be reliably assessed from these data; however, the data from the 2000 field season would suggest that about one fifth of the nests appeared to be at risk from adverse effects of mercury (Schwarzbach *et al.* 2003).

e. Litter, Garbage, and Debris

Placement of litter, garbage, and debris in the coastal ecosystem can result in direct harm to western snowy plovers and degradation of their habitats. Litter and garbage feed predators and encourage their habitation at higher levels than would otherwise occur along the coast, making predators a greater threat to western snowy plovers. For example, as noted previously, the California gull (*Larus californicus*) has become far more prevalent in the South San Francisco Bay area. Currently, the estimated 25,000 California gulls in this area feed in landfills and forage in salt marshes using habitat that once supported the western snowy plover (J. Albertson, pers. comm. 2005).

Marine debris and contaminated materials on the beach also adversely affect western snowy plovers. Marine debris is attributed to both ocean and shoreline sources. Ocean sources of marine debris and contamination include fishing boats,

ships, and cruise lines. Cruise line debris may include small plastic shampoo, conditioner, hand lotion, and shoe polish containers, plastic cups, and balloons (Center for Marine Conservation 1995). Shoreline debris is usually from land sources. Western snowy plovers may become entangled in discarded fishing line, fishing nets, plastic rings that hold together six-packs of canned drinks, and other materials on the beach. Containers of contaminated materials (*e.g.*, motor oil, cleaning fluid, and syringes) can introduce toxic chemicals to the beach. The National Marine Debris Monitoring Program, headed by the U.S. Environmental Protection Agency, was established to clean and track sources of marine debris in coastal areas. This monitoring program, while beneficial to western snowy plovers in the long-term, could potentially adversely affect nesting western snowy plovers since the program is conducted year-round. Similarly, the annual spring SOLV beach cleanup held on the Oregon Coast in late March and the annual Coastal Cleanup Day held on the California coast in September are two organized beach events that are poorly timed with respect to prospecting and nesting western snowy plovers. These programs could greatly improve western snowy plover habitat if timed appropriately.

f. Water Quality and Urban Run-off

Many coastal beaches used as habitat by western snowy plovers contain channelized streams or outfalls receiving run-off from urban, industrial, and agricultural areas. Nonpoint sources of water pollution (including hydrocarbons, heavy metals, and household chemicals) could end up at coastal beaches used as western snowy plover foraging areas. In 1995, three dead male western snowy plovers (all banded and local breeders) were found in an area containing local outfalls, including an outfall connected to a sewage treatment plant at Monterey Bay. By the beginning of the next breeding season, it was discovered that another male western snowy plover from this area disappeared and possibly died. Factors unrelated to the outfall have not been ruled out in the disappearance of this bird. One of the birds was analyzed through necropsy and found to have an enlarged liver, but it could not be determined whether there was a relationship between the mortality and the outfall (Point Reyes Bird Observatory unpublished data).

g. Management for Other Special Status Species

In several instances fencing used to enclose California least tern colonies has caused mortality of western snowy plover chicks that have become entangled within the fence mesh (Powell and Collier 1995, Powell *et al.* 1995), or prevented western snowy plover chicks from following their parents to feeding areas by blocking their movement (Powell *et al.* 1996). These issues have largely been resolved by utilizing fencing with a mesh size of less than 0.64 centimeter (0.25 inch), tightening gaps in fencing seams, and installing "gates" in tern fencing (Foster 2005). Monitoring and minimization measures to avoid these impacts continue to be implemented in coordination with the appropriate Fish and Wildlife Offices. Increasing density and abundance of California least terns within colonies may also result in western snowy plovers being displaced a short distance, but the benefits of tern management for western snowy plovers appear to outweigh such conflicts.

At the Channel Islands and other lands managed by the National Park Service and the Department of the Navy, a decline of western snowy plovers may be caused by disturbance and habitat loss resulting from the large increase in numbers of marine mammals on beaches (U.S. Fish and Wildlife Service *in litt.* 1995, U.S. Department of the Navy *in litt.* 2001). Breeding pinnipeds, including northern elephant seals (*Mirounga angustirostris*), northern fur seals (*Callorhinus ursinus*) and California sea lions (*Zalophus californianus*) at San Miguel Island and San Nicolas Island, have occupied western snowy plover nesting habitat. Beach-cast dead whales have, on occasion, posed threats to nesting western snowy plovers. At Point Reyes beaches, large, whole carcasses have washed ashore and other agencies such as the National Marine Fisheries Service have sought to collect them for scientific purposes. They also attract people who are curious about whales. These activities could potentially cause direct mortality and disturbance to western snowy plovers. In addition, mammal carcasses attract scavengers such as gulls, ravens, crows, and coyotes that are potential predators to western snowy plovers.

E. IMPLICATIONS FOR THE COASTAL BEACH-DUNE ECOSYSTEM

The western snowy plover lives in an ecosystem that has been significantly degraded. Environmental stressors (*i.e.*, development, human recreation, degraded

water quality, etc.) have adversely affected the biological diversity of the coastal dune ecosystem. Many of the characteristics that attract people to coastal areas make these areas prime habitat for fish and wildlife resources. Although they comprise less than 10 percent of the Nation, coastal ecosystems are home to over one-third of the United States human population, nearly two-thirds of the Nation's fisheries, half of the migratory songbirds, and one-third of our wetlands and wintering waterfowl (U.S. Fish and Wildlife Service 1995*a*). The coasts also provide habitat for 45 percent of all threatened and endangered species, including three-fourths of the federally-listed birds and mammals (U.S. Fish and Wildlife Service 1995*a*). Proper stewardship of this unique ecosystem is needed to maintain its ecological integrity while meeting its human demands.

1. Description of Coastal Beach-Dune Ecosystem

The coastal beach-dune ecosystem may include several features such as beaches, foredunes, deflation plains, blow-outs, and reardunes. The beach includes the expanse of sandy substrate between the tide line and the foredune or, in the absence of a foredune, to the furthest inland reach of storm waves. Beach steepness, height, and width are affected by wave height, tidal range, sand grain size, and sand supply. The beach has high exposure to salt spray and sand blast and contains a shifting, sandy substrate with low water-holding capacity and low organic matter content. Dunes include sandy, open habitat, extending from the foredune to typically inland vegetation on stabilized substrate. Major differences occur between beach and dune in salt spray, soil salinity, and air and soil temperatures (Barbour and Major 1990).

Coastal dunes generally consist of three primary zones (Powell 1981). The foredunes are the line of dunes paralleling the beach behind the high tide line. Foredunes are characterized by unstabilized sand and a simple community of low-growing native dune plant species, such as American dunegrass (*Leymus mollis*). Foredunes also support a rich community of sand-burrowing insects (Powell 1981). Behind the foredunes is the deflation plain, which is at or near the water table and is characterized by a mixture of water tolerant plants and dune species. Deflation plains are also called dune hollows and can be invaded by hydrophilic (having a strong affinity for water) trees, shrubs, or herbs (*e.g.*, species of *Carex, Juncus, Salix, Scirpus*) (Barbour and Major 1990). The inner zone of coastal dunes consists

of stabilized dunes, which are dominated by woody perennial plants (Powell 1981). Beach flora can also colonize inland dune areas, where the sand is actively moving (Barbour and Major 1990).

Barren dunes, receiving sand from the beach and losing it to wind erosion, are mobile. Older, more inland dunes are stabilized by a nearly continuous plant cover; these dunes are referred to as stable dunes or fixed dunes. Localized openings in the plant cover, which permit wind erosion, are called blowouts, but they are not deep enough to allow invasion by mesophytes (plants growing in moderately moist environments). The innermost ridge of sand is generally high and is called a precipitation ridge; sand is blown over the ridge and down the slipface, continuing the process of dune advance (Barbour and Major 1990). The conditions necessary for dune growth at the coast are partly climatic, but more important is the occurrence of strong onshore winds, abundant sand supply, and vegetation that traps sand. Low, near-shore slopes with a large tidal range providing wide expanses of sand that dries at low tide are ideal for dune growth (Pethick 1984).

Very few coastal dunes are "natural," because they have been extensively altered over time by humans for agriculture, mineral extraction, military training, and recreation (Carter 1988). Before the introduction of European beachgrass, foredunes were low and rose gradually, and a large number of native species shared this habitat. They were composed of a series of dunes alternating with swales oriented perpendicular to the coast and aligned with prevailing onshore winds. Since the introduction of European beachgrass, most systems have been replaced by a steep foredune that gives way inland to a series of dunes and swales oriented parallel to the coast (Barbour and Major 1990).

Western snowy plovers use the beach and mobile dunes as nesting habitat. Other habitat features that occur within or adjacent to the coastal beach-dune ecosystem, and serve as important foraging habitat for the western snowy plover, include river, stream, and creek mouths, river bars, lagoons, and tidal and brackish-water wetlands.

2. Sensitive Species of the Coastal Beach-Dune Ecosystem

Along with the western snowy plover, many other sensitive species inhabit the coastal beach-dune ecosystem and adjacent habitats. Appendix E contains a list of, and brief species accounts for, sensitive species associated with this ecosystem and adjacent habitats. We recognize these fish and wildlife species as endangered, threatened, candidate species, or species of concern. This list includes a number of sensitive species recognized by the states of California, Oregon, and Washington. This appendix also describes several marine mammals associated with the coastal beach-dune ecosystem and protected under the Marine Mammal Protection Act of 1972 (16 U.S.C. 1361 *et. seq.*), as amended.

Some of these sensitive species have many threats in common with the western snowy plover. Habitat loss and degradation from shoreline development and beach stabilization, invasion of exotic species, and crushing by off-road vehicles are cited as major factors contributing to the status and listing of these species. European beachgrass is a current or potential threat to six federally-listed endangered plants that occur in coastal dunes of California: beach layia (*Layia carnosa*), Howell's spineflower (*Chorizanthe howellii*), Monterey spineflower (*Chorizanthe pungens* var. *pungens*), Menzies' wallflower (*Erysimum menziesii*), Monterey gilia *(Gilia tenuiflora* ssp. *arenaria*), and Tidestrom's lupine (*Lupinus tidestromii*) (Pickart 1997). European beachgrass is also a current and potential threat to native and sensitive plants in Washington and Oregon, including the pink sand-verbena (*Abronia umbellata* ssp. *breviflora*), which is classified as endangered in the State of Oregon. Equestrian use has also been identified as a threat to several endangered plant species, including the endangered Howell's spineflower, Menzies' wallflower, Monterey gilia, and the coastal dunes milk vetch (*Astragalus tener* var. *titi*). Off-road vehicles are cited as threats to several sensitive plant and animal species, including the endangered beach layia, Menzies' wallflower, Monterey gilia, Tidestrom's lupine, Hoffman's slender-flowered gilia (*Gilia tenuiflora* var. *hoffmanii*), and Smith's blue butterfly (*Euphilotes enoptes smithi*); the federally endangered La Graciosa thistle (*Cirsium longholepis*), and the following species considered to be of Federal concern: beach spectacle pod (*Dithyrea maritima*) and Morro blue butterfly (*Icaricia icarioides morroensis*).

The precarious status of these species is a symptom of a highly stressed ecosystem. Remedial efforts aimed at restoration of the natural processes that maintain this ecosystem, rather than single-species "fixes," are likely to have the greatest and most successful long-term benefits. Important components of ecologically-sound coastal beach-dune ecosystem management include (1) removal of exotic, invasive vegetation; (2) management of human recreation to prevent or minimize adverse impacts on dune formation, vegetation, invertebrate and vertebrate fauna; and (3) efforts to counter the effects of human-induced changes in the types, distribution, numbers, and activity patterns of predators. Implementation of more ecosystem-oriented approaches to western snowy plover protection would provide important benefits to other sensitive species within the coastal dune ecosystem and merits serious consideration.

Some western snowy plover recovery efforts implemented to date (*e.g.*, removal of European beachgrass) support the natural functions of the coastal dune ecosystem. Furthermore, many protection efforts for western snowy plovers should benefit other sensitive beach species, such as California least terns, and vice versa. Many of the same predators that take western snowy plover eggs also prey on California least tern eggs. The relatively low rate of predation of western snowy plover nests in San Diego County has been attributed to predator control programs to benefit California least terns and other species, funded primarily by the Department of Defense and National Wildlife Refuge System (Powell *et al.* 1995). These programs are implemented under contract with the U.S. Department of Agriculture, Wildlife Services branch. Control of ants at California least tern colonies probably also benefits western snowy plovers nesting nearby. Opportunities also may exist for reestablishment of special status plant species that occur in coastal dunes, including Menzies' wallflower, beach spectacle pod, Tidestrom's lupine, beach layia, and pink sand verbena.

Some conflicts have occurred in management of western snowy plovers and California least terns in southern California, including harm to western snowy plover chicks due to entanglement in the mesh of California least tern fencing as described above. These problems have now largely been minimized with the use of new methods and materials, however such management measures should continue

to be coordinated to meet the habitat needs of both western snowy plovers and California least terns.

Potential conflicts also exist between native dune restoration and western snowy plover habitat. Revegetation efforts could result in too much cover, thereby reducing the amount of suitable breeding habitat available for western snowy plovers.

Conflicting habitat requirements for western snowy plovers and pinnipeds have also occurred on lands where marine mammals haul out or breed on beaches that would otherwise be suitable for nesting western snowy plovers (U.S. Fish and Wildlife Service *in litt.* 1995, U.S. Department of the Navy *in litt.* 2001). Where this conflict continues to occur, coordination with land management agencies and NOAA's National Marine Fisheries (NMFS) may be helpful to identify methods for modifying or discouraging use by breeding pinnipeds during the western snowy plover nesting season.

Although some management measures may benefit a broad array of sensitive species within the coastal dune ecosystem (*i.e.*, control of *Ammophila*, access restrictions, and integrated predator management programs), some single-species protection measures for the western snowy plover, such as exclosures, are needed. Although exclosures can be risky to nesting western snowy plovers in some situations (see Lauten *et al.* 2006), they can be an effective way to protect nests against heavy recreational use and predation, especially where reductions in predator numbers would otherwise be temporary and difficult to achieve or would have adverse ecological effects.

F. CONSERVATION EFFORTS

Western snowy plover recovery efforts have accelerated since this population was federally listed as a threatened species in 1993. Current breeding and wintering site protection efforts are documented in Appendix C (Summary of Current and Additional Needed Management Activities). The most common management strategies include protection of nests with predator exclosures; signing and symbolic fencing of nesting areas; restrictions on motorized vehicles in the vicinity of western

snowy plover nests and broods; restrictions on dogs (even though enforcement of dogs on-leash has been problematic); and public information and outreach. These strategies are effective means of improving western snowy plover reproductive success.

1. Conservation Planning on Federal and State Lands

The direction of land management on Federal lands is often outlined in management plans or agency regulations that provide objectives and guidelines for western snowy plovers. These plans include the Naval Base Coronado Integrated Natural Resources Management Plan (U.S. Navy 2001), Camp Pendleton Integrated Natural Resources Management Plan (U.S. Marine Corps 2006), San Diego Bay National Wildlife Refuge Comprehensive Conservation Plan (U.S. Fish and Wildlife Service 2006*c*), Oregon Dunes National Recreation Area Management Plan (U.S. Forest Service 1994), the Coos Bay Shorelands Final Management Plan (U.S. Bureau of Land Management 1995*a*), the New River Area of Critical Concern Management Plan (U.S. Bureau of Land Management 1995*b*), the Draft Snowy Plover Management Plan for Ocean Beach, Golden Gate National Recreation Area (Hatch 1997), and the Western Snowy Plover Management Plan for the Point Reyes National Seashore (White and Allen 1999).

Wildlife protection, especially the preservation, restoration, and enhancement of threatened and endangered species and migratory birds, is the primary goal of national wildlife refuges, as stated in the National Wildlife Refuge System Administration Act of 1997 (16 U.S.C. 668dd *et. seq.*). Western snowy plover habitat on national wildlife refuges has been accorded intensive protection, including (1) integrated predator management and (2) closures during the nesting season where appropriate, to minimize adverse effects of disturbance. Consistent with requirements of the National Wildlife Refuge System Administration Act and the Refuge Recreation Act of 1962, as amended (16 U.S.C. 460k *et. seq.*) regarding compatibility of refuge activities, western snowy plover nesting areas within some national wildlife refuges are closed to public use during the breeding season. Western snowy plover use areas within some national wildlife refuges (such as Salinas River National Wildlife Refuge) are closed to public use year-round.

Additionally, the Department of Defense manages for western snowy plovers on military installations through actions associated with section 7 of the Endangered Species Act and through conservation planning efforts (*e.g.*, Programmatic Activities and Conservation Plans in Riparian and Estuarine/Beach Ecosystems on Marine Corps Base Camp Pendleton, 1995; see also Federal Regulatory Program, below). This includes avoidance and minimization measures, which have resulted in individual military installations placing limits on or otherwise restricting military activities and implementing management actions to specifically benefit western snowy plovers, such as monitoring, predator control, habitat improvement, and research. This management, in conjunction with other factors such as habitat availability and restricted public access, has allowed certain Department of Defense lands to significantly contribute to regional western snowy plover populations.

The *Washington State Recovery Plan for the Western Snowy Plover* recommends strategies to recover this species, including protection of the population, evaluation, and management of habitat, and initiation of research and education programs (Washington Department of Fish and Wildlife 1995).

The State of Oregon's *Conservation Program for the Coastal Population of the Western Snowy Plover*, required by the Oregon Endangered Species Act and adopted by the Oregon Fish and Wildlife Commission (Oregon Revised Statutes 496.171 through 496.192), requires a variety of actions to protect this subspecies. These actions include: (a) protecting all existing western snowy plover sites from negative impacts; (b) monitoring impacts and responding to damaging activities (*e.g.*, urban development and recreation disturbance) to minimize or eliminate their effects to western snowy plovers; (c) maintaining a long-term monitoring program to track numbers, distribution, and nesting success; (d) habitat management, such as local control of European beachgrass and maintaining predator protection measures to maximize breeding success for as long as deemed necessary; (e) conducting additional research to maintain and recover western snowy plovers; and (f) enhancing information availability, education, and awareness of western snowy plovers and their requirements for survival and recovery (Oregon Department of Fish and Wildlife 1994).

The California Public Resources Code (Section 5019.71) allows designation of natural preserves, the most protective designation given to a part of any California State Park system unit. The purpose of natural preserves is to preserve such features as rare or endangered plant and animal species and their supporting ecosystems, and representative examples of plant or animal communities existing in California prior to the impact of civilization. The Pajaro Rivermouth Natural Preserve, Wilder Creek Natural Preserve, and Salinas Rivermouth Natural Preserve were designated by the California State Park and Recreation Commission in recognition of the need to protect western snowy plovers. In addition, Section 5019.62 of the California Resources Code allows the designation of State seashores to preserve the outstanding values of the California coastline and provide for public enjoyment of those values. Within the state of California, the following California State seashores containing western snowy plover habitats have been established: Del Norte State Seashore; Clem Miller State Seashore; Sonoma Coast State Seashore; Año Nuevo State Seashore; Monterey Bay State Seashore; San Luis Obispo State Seashore; Point Mugu State Seashore; Capistrano Coast State Seashore; and San Diego Coast State Seashore. Under the California Public Resources Code, the California Department of Parks and Recreation has the authority to identify additional lands appropriate for inclusion in California State seashores and recommend land acquisition for these purposes.

Special management actions for western snowy plovers are conducted within the portions of California State Seashores that are owned by the California Department of Parks and Recreation. An example is the Monterey State Seashore, where the California Department of Parks and Recreation has conducted intensive management activities for western snowy plovers since 1991. Strategies include resource management, interpretation, law enforcement, and park operations. Resource management actions include monitoring, predator trapping, and use of exclosures, symbolic fences, and signage, and consideration of snowy plovers during planning recreational access and trails in San Francisco Bay. Interpretative efforts include informational signage at nesting areas, information brochures, small handout cards with photographs and information on western snowy plovers, several annual public outreach programs (*e.g.*, slide programs and field trips), and actions to engage community support for the western snowy plover guardian program (*i.e.*, recruitment, training, and scheduling for volunteer presence in sensitive habitat).

Enforcement actions include verbal warnings, written warnings, citations, and arrests as necessary. Key enforcement concerns include dogs off-leash and off-road vehicles, which are prohibited on all beaches. Operational management includes a permit process that screens special events to avoid the nesting season in sensitive areas, and regulation of recreational use of beaches to avoid sensitive areas (*i.e.*, kite flying, hang gliding, fishing, etc.). Other management actions on California Department of Parks and Recreation property within some other State seashores are shown in Appendix C.

2. Conservation Efforts on Federal and State Lands

a. Exclosures, Symbolic Fencing, and Signs

Since 1991, one of the primary techniques to protect nesting western snowy plovers has been the use of exclosures (Appendix F). 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 (Figure 8). Exclosure designs are described in Appendix F; modifications to exclosure design in response to site specific predator conditions may be appropriate on a case by case basis but should be coordinated in advance with the Fish and Wildlife Service.

Nests protected from predators by exclosures have consistently had increased nest success (White and Hickey 1997, Stern *et al.* 1991, Craig *et al.* 1992, Mabee and Estelle 2000, U.S. Fish and Wildlife Service 2002, Lauten *et al.* 2006). At some locations in Oregon and California, exclosures are designed with tops consisting of parallel lengths of nylon seine lines spaced approximately 15 centimeters (6 inches) apart -or- mesh netting with a minimum spacing of approximately 10 centimeters (4 inches), designed to discourage entry by avian predators. At Eden Landing State Ecological Reserve in San Francisco Bay, nest predation decreased from 32 percent in 2000 to 3 percent in 2001, largely due to a switch from string tops to net tops on exclosures (Marriott 2001).

Figure 8. Erecting western snowy plover exclosure (photo by Sue Powell, with permission).

Although exclosures are contributing to improved productivity and population increases in some portions of the western snowy plover's Pacific coast range, problems have been noted in some localities. Potential risks associated with exclosures include vandalism, disturbance of the birds by curiosity seekers, and use of exclosures as predator perches. Over time, exclosures may provide a visual cue to predators, making it easier for them to target adults, chicks, and eggs, and requiring predator management. On several occasions depredations of adult western snowy plovers have been documented in or near exclosures, and efforts have been made to establish exclosures later in the season after the peak migration of raptors (Brennan and Fernandez 2004, Lauten *et al.* 2006). Also, predator exclosures may be impractical where western snowy plovers nest within California least tern colonies or other instances where such exclosures may conflict with the needs of other threatened or endangered species.

Symbolic fencing also is used to passively protect western snowy plover nests, eggs, and chicks during nesting season. This fencing consists of one or two strands of

light-weight cord or cable strung between posts to delineate areas where humans (*e.g.*, pedestrians and vehicles) should not enter (Figure 9). It is placed around areas where there are nests or unfledged chicks, and is intended to prevent accidental crushing of eggs, flushing of incubating adults, and, if large enough, to provide an area where chicks can rest and seek shelter when large numbers of people are on the beach. Directional signs (regarding closed areas, nesting sites, etc.) also are used within western snowy plover habitats and near protective fencing to alert the public and other beach users of the sensitivity of western snowy plover nesting and wintering areas. Installation of symbolic fencing at Coal Oil Point Reserve (CA-88) in conjunction with a docent program has allowed management of

Figure 9. Symbolic fencing on beach at Monterey Bay, California (photo by Ruth Pratt, with permission).

recreational use and resulted in successful re-establishment of a breeding population of western snowy plovers at the site (Lafferty *et al.* 2006).

Additionally, land managers may prevent or restrict access to areas used by nesting western snowy plovers. For example, military installations often curtail or redirect training activities near western snowy plover nesting areas and some State parklands

and recreation areas restrict public access in certain areas during the breeding season.

b. Law Enforcement

Management agencies recognize that law enforcement is needed for protection measures to be effective. Though a majority of beach visitors respect restrictions to protect western snowy plovers, there will always be a certain percentage who do not. Enforcement of western snowy plover area restrictions shows that managers are serious about compliance. In Oregon, biologists have established a working relationship with a variety of law enforcement agencies who have jurisdiction in western snowy plover habitat. Their goal is to increase awareness, gain advice, increase communication and coordination to alleviate jurisdictional conflicts, and train officers on how to minimize disturbance while patrolling western snowy plover habitat. Conflicting priorities and personnel turnover require perseverance to maintain effective working relationships across law enforcement jurisdictions.

c. Predator Control

Lethal and nonlethal means of predator control have been used with mixed success to protect western snowy plovers on Pacific beaches. Nonlethal methods include litter control at campgrounds (to reduce available food sources), exclosures and fencing, and trapping and relocation. Lethal methods include reducing local populations of avian predators by addling (*i.e.* killing the developing chick within the egg) of raptor and corvid eggs, trapping and euthanizing nonnative mammalian predators, and killing individual predators upon which nonlethal methods have proven ineffective.

On the Oregon Coast, snowy plover predator control has historically been in the form of nest exclosures and site specific lethal control. The use of nest exclosures, adaptively modified in response to predator behavior, has been very successful in increasing hatching success. However, because in some cases predation on adults has been linked to the presence of exclosures, their use is presently targeted to specific instances where it appears most beneficial, and the program is working toward elimination of exclosure use (Lauten *et al*. 2006a, 2006b).

In 2002, Federal and State agencies approved an integrated predator management program to improve western snowy plover nesting and fledging success in Oregon. The decision followed public review and comment on an analysis of the effects of the proposed predator control methods and alternatives to protect the western snowy plover in Oregon (U.S. Department of Agriculture 2002). To date lethal predator control has been implemented at selected plover breeding sites along the Oregon Coast at Coos Bay North Spit, Bandon Beach, New River, Siltcoos, Overlook, Tahkenitch, and Tenmile, resulting in an overall positive effect on western snowy plover productivity (Lauten *et al.* 2006*a*, 2006*b*).

Another form of predator control is fencing, which is used on the south spoils area of Coos Bay, North Spit, where the U.S. Bureau of Land Management, U.S. Army Corps of Engineers, and Oregon Department of Fish and Wildlife have fenced 8 hectares (20 acres) of western snowy plover nesting habitat. This wire mesh fence was installed to exclude mammalian predators, especially skunks, and to discourage human disturbance from off-highway vehicle use. The original fence, constructed in 1991, suffered from the effects of weathering and although it continued to deter vehicles, it was no longer an effective barrier to predators. In 1998, the U.S. Army Corps of Engineers and U.S. Bureau of Land Management jointly constructed a new fence and removed the old fence. The new fence matched the design of the 1991 fence (5-centimeter by 5-centimeter (2-inch by 2-inch) mesh fence material with an effective fence height of about 1.2 meters (4 feet) after burial of the bottom). However, the new fence has increased the protected area from 8 hectares (20 acres) to 28 hectares (71 acres), and includes both the south spoils area and the 1994 Habitat Restoration Area (E.Y. Zielinski and R.W. Williams *in litt.* 1999).

At the Don Edwards San Francisco Bay National Wildlife Refuge, fences are sometimes constructed across salt pond levees to block access by terrestrial predators (J. Albertson *in litt.* 1999). However, fences are not feasible in many areas, and do not restrict aerial predators.

Exclosures are much more effective when used in conjunction with an integrated predator management program that includes selective removal of non-native predators and other individual problem predators. Otherwise, exclosures may promote better hatching success, but not fledging success if predators such as red fox

(*Vulpes vulpes*) focus on adults protecting the nest or newly-hatched chicks that leave the exclosure to feed. These measures are also much more effective where combined with other access restrictions to increase survival of clutches and broods. Trapping the nonnative red fox has been credited with substantially increased western snowy plover abundance and productivity at Salinas River National Wildlife Refuge (E. Fernandez, U.S. Fish and Wildlife Service, pers. comm. 1998). At the Don Edwards San Francisco Bay National Wildlife Refuge, predation on western snowy plovers and California clapper rails by red foxes prompted the initiation of a predator management program targeting red foxes, feral cats, skunks, and raccoons, in conjunction with use of western snowy plover nest exclosures (J. Albertson *in litt.* 1999, Strong *et al.* 2004). This ongoing program has resulted in improved nest success. Use of exclosures has subsequently been discontinued due to the success of the trapping program and incidents of nest abandonment at exclosures. At Eden Landing Ecological Reserve selective removal of problem corvids and their nests has also been practiced by USDA Wildlife Services since 2004 (Tucci *et al.* 2006).

The U.S. Air Force has used electric fencing around the California least tern colony at Purisima Point, Vandenberg Air Force Base, California, where western snowy plovers also nest and winter. The electrified portion of this fence is approximately 273 meters (300 yards) long and 1.2 meters (4 feet) high. The electric fence contains six strands of electrified wire placed approximately 10.2 centimeters (4 inches) apart. This fence is generally effective at keeping out mammalian predators of California least terns. It has also incidentally protected a small population of western snowy plovers by deterring western snowy plover predators.

Proposals have been developed to test a conditioned taste aversion technique on predators of piping plovers (*i.e.*, red fox) by using quail eggs treated with the chemical emetine (McIvor 1991). The purpose of this technique is to condition foxes to avoid eating plover eggs, expecting that if foxes eat treated quail eggs prior to the nesting season and become sick, they might develop a conditioned aversion to eating plover eggs. This technique requires that the predator consumes the needed dose that will produce short-term illness but no mortality. Due to uncertainty in effectiveness, at this point in time we do not advocate this taste aversion technique. Proposals to test conditioned taste aversion techniques on predators of piping plovers on the east coast have not been implemented due to difficulties obtaining permission

to field test emetine (A. Hecht, U.S. Fish and Wildlife Service, pers. comm. 1996). Avery *et al.* (1995) found that deployment of quail eggs treated with the chemical methiocarb might be a useful means of reducing predation of California least terns by ravens and crows. However, subsequent tests of aversion methods have proven to be unsuccessful (E. Copper and B. Foster *in litt.* 2001).

With proper research, techniques that have been used to deter predators of other wildlife species may prove beneficial to western snowy plovers. Strategic placement of crow and gull carcasses around the perimeter of a California least tern colony has been used at Vandenberg Air Force Base (Persons and Applegate 1996), however, this method may not be effective for more loosely colonial species such as snowy plover (J. Buffa *in litt.* 2004). Moreover, the presence of gull carcasses could prove counterproductive by attracting mammalian predators (N. Read, U.S. Air Force, pers. comm. 1998).

In 1999 Vandenberg Air Force Base initiated studies of coyote ecology and movements, with the goal of developing non-lethal alternatives for reducing coyote predation on western snowy plover. Although results are preliminary, in 2001 beach access restrictions and regular pick-up of trash, in combination with availability of alternative prey such as rabbits, may have contributed to the lowest incidence of coyote predation ever recorded at Vandenberg Air Force Base, even though evidence of coyote presence continued to be observed on a daily basis.

For top-level predators such as coyotes, western snowy plover nests are not a primary food source. Vandenberg Air Force Base has avoided large-scale coyote removal to prevent exacerbated predation on listed species from mesopredators such as racoons, and to prevent expansion of non-native predators such as feral cats and red foxes into western snowy plover nesting areas (N. Read Francine *in litt.* 2001).

d. European Beachgrass Control

Experiments to find cost-effective methods to control or eradicate European beachgrass are ongoing. Control methods employed in various situations have included foredune grading and foredune breaching with front-end loaders and bulldozers, subsoiling with a winged subsoiler (essentially a heavy duty three-point

plow), discing with a standard farm tractor and disk, burning, saltwater irrigation, spraying of herbicide, and hand-pulling. Herbicide treatment is not always possible, however, when rare or federally-listed plants are present. In these cases hand-pulling or other mechanical removal may need to be employed. At Point Reyes National Seashore mechanical and hand-removal were used to remove non-native beach grass on 12 hectares (30 acres) with immediate beneficial response by nesting snowy plovers (Peterlein and Roth 2003). Some control methods are only suitable for the inland sites. Areas containing heavy growth of European beachgrass and woody vegetation are prescribed-burned prior to using heavy equipment. Areas are leveled to allow discing for maintenance. In some areas, oyster shell hash provided by a local oyster grower has been distributed after vegetation has been removed. Effectiveness of the various control methods varies, though some form of maintenance may always be required. Maintenance is critical and achieved through multiple treatments over a succession of years. Discing requires maintenance twice per year to keep beachgrass from reestablishing. Comparatively, yearly maintenance in portions of some restoration sites may not be needed after employing several years of bull-dozing, herbicides, or hand-pulling following initial mechanical removal.

Since 1994, multiple projects have been conducted in Oregon to control beachgrass on existing nest sites and to clear and maintain additional areas. These Habitat Restoration Areas (HRAs) are essential for the recovery of the western snowy plover. Three significant HRAs established on the Oregon Coast between 1994 and 2002 include the Dunes Overlook (Oregon Dunes National Recreation Area), Coos Bay North Spit, and New River. Other habitat restoration areas have recently been established or are planned at Baker Beach (140 acres), Tenmile Creek (200 acres) and Bandon Beach State Natural Area (30 acres). HRAs accounted for 34 percent of nests (Table 6) and 43 percent of fledglings (Table 7) found on the Oregon Coast between 1999 and 2004.

The Oregon Dunes National Recreation Area contains about 2,428 hectares (6,000 acres) of European beach grass and now has few remaining examples of intact native plant communities (Pickart 1997). Habitat restoration was initiated in the summer of 1998 and by 2002, the U.S. Forest Service had treated 24 hectares (60 acres) of the 208 hectares (516 acres) of habitat planned for restoration. Prior to 1999, no western

snowy plovers were found at the Overlook site, but after habitat was restored, western snowy plovers began nesting there successfully (Table 6, Table 7).

The U.S. Forest Service employs a combination of mechanical, manual, and herbicide treatments to control European beachgrass. Mechanical treatment consists of scalping off the top 1 meter (3 feet) of beachgrass and then burying it in an adjacent trench with a minimum covering of l meter (3 feet) of sand. Moderate to heavy resprouting occurs with this method, requiring manual or chemical follow-up treatment. Other mechanical treatments have consisted of placement of dredged material on the beachgrass and scalping the top half of foredunes to remove beachgrass and allow for inland sand movement and tidal action to maintain open dunes (K. Palermo *in litt.* 1998*b*).

Herbicide treatments have been conducted as a primary control method and as follow-up to mechanical control. In recent years, from 2 to 26 hectares (5 to 65 acres) of beachgrass were sprayed with an herbicide treatment of 8 percent Rodeo and nonionic surfactant (spray-to-wet) at three locations. Employees found that a follow-up application within 2 weeks of the first application was critical to obtain optimum coverage and initial die-off rates (90 percent). Additionally, herbicide treatments were most effective when conducted consecutively over 2 to 3 years depending on density. Beachgrass control at the Oregon Dunes is still considered experimental. Preliminary results suggest that maintenance will always be necessary (K. Palermo *in litt.* 1998*b*).

Table 6. Total number of nests at habitat restoration areas on the Oregon Coast 1994-2004 (J. Heaney, pers. comm. 2003; C. Burns, pers. comm.; M. VanderHeyden, pers. comm.; Castelein *et. al.* 2002; Lauten *et al.* 2006).

Site Name	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	**Total Nests**
Baker Beach									0	1	0	1
Dunes Overlook						2	8	15	8	9	14	56
Coos Bay North Spit	4	3	2	3	7	12	22	13	15	11	16	108
Bandon State NRA										4	17	21
New River						2	4	10	7	5	6	34

Table 7. Total number of fledged young at habitat restoration areas on the Oregon Coast 1994-2004. Includes fledglings from broods from undiscovered nests (J. Heaney, pers. comm. 2003; C. Burns, pers. comm; M. VanderHeyden pers. comm.; Castelein *et. al.* 2002; Lauten *et al.* 2006).

Site Name	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	**Total Nests**
Baker Beach									0	0	0	0
Dunes Overlook						3	5	2	2	3	6	21
Coos Bay North Spit	7	2	1	1	1	23	6	6	8	14	22	91
Bandon State NRA										4	15	19
New River						2	1	3	3	7	5	21

On Coos Bay North Spit, the Bureau of Land Management has cleared and maintained approximately 67 hectares (166 acres) of vegetation dominated by European beachgrass, shore pine, Sitka spruce, and Scotch broom. The objective is to remove predator cover, remove encroaching beachgrass, and expand the existing habitat. The goal is to create an area for western snowy plovers to nest that is large enough to lessen possible detection of nests and chicks by predators. Nest sites used by western snowy plovers on the North Spit include both beach habitat and inland areas of previous dredged material deposition. Many of the cleared areas were used almost immediately by nesting western snowy plovers or for brood rearing activities. Prior to 1994, western snowy plovers were not nesting in these areas, but after 1994, the Coos Bay North Spit became the most productive western snowy plover nesting sites on the Oregon Coast (Table 6, Table 7) (M. VanderHeyden, Bureau of Land Management, pers. comm.).

At the Coos Bay North Spit, an inmate crew from the Shutter Correctional Facility, hired by the U.S. Bureau of Land Management, hand pulled European beachgrass on approximately 6 hectares (15 acres) of the south spoil area. The 4-month project cost $11,500; most of these costs covered the crew supervisor's salary and transport vehicle charges. Another European beachgrass removal project around the south spoil areas of the Coos Bay North Spit, included burning European beachgrass, followed by scarification using a bulldozer in March 1994. By August, most of the area had resprouted (Oregon Department of Fish and Wildlife 1996). New beachgrass sprouts are relatively easy to remove. However, initial and maintenance work can be costly and labor intensive. At the Coos Bay North Spit, eradication of European beachgrass using 91.4 centimeters (36 inches) of sprayed seawater was attempted in 1996. The saltwater application was not effective because desiccated sand layers did not allow seawater penetration to the grass's root zone. Future experimentation using wetting agents to achieve water penetration on small-scale applications could demonstrate potential applicability of this technique (G. Dorsey, U.S. Army Corps of Engineers, pers. comm. 1997).

The New River Spit is another key nesting area for the western snowy plover that is managed by the Coos Bay U.S. Bureau of Land Management. Each year since 1998, the U.S. Bureau of Land Management has used heavy equipment (i.e., front-end loader, bulldozer) to remove European beachgrass from in and around a target

restoration site. Typically, the bulldozer is used to push the beachgrass into depressions and bury it under several feet of sand, or to push sand and beachgrass out into the surf zone. Just over two miles of foredune have been lowered and select areas along the foredune have been removed to allow ocean surf to overwash into interior portions of the spit. The overwashing aids in scouring vegetation and appears to self-maintain portions of the overwashes throughout the restoration area. By 2002, approximately 48 hectares (120 acres) of foredune and overwash were cleared of beachgrass (Jim Heaney, Bureau of Land Management, pers. comm. 2003).

Work at Lanphere-Christensen Dune Preserve in Humboldt County, California, showed that hand pulling can eliminate European beachgrass, but 3 years of multiple maintenance treatments were required (Pickart and Sawyer 1998). Use of heavy equipment (*e.g.*, "V" ripper) and herbicides may be more cost-effective; however, resprouting of the grass occurs, necessitating follow-up, manual pulling for long-term beachgrass removal (A. Pickart, The Nature Conservancy, pers. comm. 1997).

The effective strategy used by the California Department of Parks and Recreation to remove beachgrass at Marina Dunes and Salinas River State Beaches, Monterey Bay, included multiple herbicide applications of 10 percent Round-Up. Approximately 25 patches of beachgrass covering a total of approximately 0.5 hectare (1.3 acres) have been treated along a 6.4-kilometer (4-mile) section of beach. Each patch of beachgrass was sprayed every 3 months over a 3-year period. All treated sites were marked so that they could be easily located and monitored for regrowth and spread. Current plans include beachgrass removal on approximately 30 hectares (75 acres) at Zmudowski State Beach at the Pajaro River mouth (D. Dixon *in litt.* 1998).

Western snowy plover habitat restoration efforts at the Leadbetter Point Unit of the Willapa National Wildlife Refuge began in 2002 and continue. American beachgrass and some European beachgrass have been mechanically removed, clearing approximately 25 hectares (63 acres) as of 2006. In addition, cuts have been made through the foredune and oystershell placed to cover 11 hectares (28 acres) within the restored area (K. Brennan *in litt.* 2006).

Pickart (1997) suggested that chemical treatment of European beachgrass is likely to be the most cost-effective method used to date. Herbicides that have been used for

this purpose are glyphosates (trade names Rodeo and Round-Up). The most effective period for herbicide treatment of beachgrass is during its flowering stage (Wiedemann 1987); plants should be treated during periods of active growth (Pickart 1997). However, potential adverse biological impacts to other native plants and animals must be considered when using herbicides, and selective spraying may be difficult in some areas. Chemical treatment in active western snowy plover nesting areas may need to be limited to the period outside the breeding season in certain areas to avoid disturbing nesting western snowy plovers.

Additional management options for beach and dune erosion control are needed. Beachgrass continues to be used because it has been tried successfully in the past, nursery stock is available, and field planting technology is well known. However, negative aspects of its monoculture are recognized. Proper planting and management of a mixture of native vegetation, together with the provision of walkways for pedestrian traffic and the elimination of horse traffic, cattle grazing, and off-road vehicles, may result in stabilization as effective as beachgrass, yet there has been minimal experimentation with this technique (Barbour and Major 1990).

e. Off-Road Vehicle Restrictions and Management

Management strategies to reduce off-road and other vehicle impacts have been implemented at some western snowy plover breeding areas. At Pismo/Oceano Dunes State Vehicular Recreation Area, California, management strategies include fenced-off nesting areas; placement of exclosures around nests; restrictions on vehicle speed and access areas; and requirements that car campers remove all trash. At Pismo/Oceano Dunes State Vehicle Recreation Area, the California Department of Parks and Recreation, Off-Road Vehicle Division, has developed an interim management plan, which is adapted annually in coordination with us to address what effects current management measures have on hatching rates and fledging success, as well as recruitment into the western snowy plover population (California Department of Parks and Recreation 2005). The Off-Road Vehicle Division of the California Department of Parks and Recreation is now funding the development of a habitat conservation plan (in anticipation of applying for a section 10(a)(1)(B) permit under the Endangered Species Act) for the Pismo/Oceano Dunes State Vehicular Recreation

Area and other State parks within the San Luis Obispo Coast District of the California Department of Parks and Recreation.

The conservation issues for western snowy plovers and California least terns at the Pismo/Oceano Dunes State Vehicular Recreation Area are directing the development of the habitat conservation plan, but other species also will be covered. This plan will evaluate the effects that recreation and park management activities are having on the covered species.

On Camp Pendleton, the Marine Corps conducts its vehicle operations in and near nesting areas in ways that minimize impacts to western snowy plovers. Under the Marine Corps' Base Regulations all training activities, including vehicle training, are prohibited within 300 meters of fenced nesting areas during the breeding season (1 March to 15 September). Further, amphibious vehicles are directed to transit adjacent to nesting areas with tracks in the ocean whenever possible (U.S. Marine Corps 2006).

On the Don Edwards San Francisco Bay National Wildlife Refuge, part of the main access road (Marshlands Road) is closed to motorized vehicles from April 1 to August 31, to protect western snowy plovers nesting near the roadway. Highway traffic cones and ribbons are installed to discourage vehicle access to nesting areas on roads and levees (J. Albertson *in litt.* 1999).

In 1995, after the Oregon Dunes National Recreation Area completed its management plan, the U.S. Forest Service petitioned the Oregon Parks and Recreation Department to close several kilometers of beach that had been open to vehicles. Resulting closures reduced conflicts between off-highway vehicles and nonmotorized recreationists, western snowy plovers, and other wildlife (E.Y. Zielinski and R.W. Williams *in litt.* 1999).

Leadbetter State Park (immediately to the south of Willapa National Wildlife Refuge) is closed to beach driving from April 15 to the day after Labor Day. The entire beach along Willapa National Wildlife Refuge is closed to driving year round, except during razor clam openers (K. Brennan *in litt.* 2006). Diligent surveillance and enforcement by applicable agencies is extremely important due to the potential for violations.

f. Population Monitoring

Western snowy plover researchers in Washington, Oregon and California conduct intensive population monitoring programs. Tasks include some or all of the following: (1) conducting winter and breeding season window surveys; (2) banding adults and chicks; (3) determining nest success; (4) determining fledging success, (5) monitoring and documenting brood movements; and (6) collecting general observational data on predators.

The Point Reyes Bird Observatory has been monitoring the distribution and breeding success of western snowy plovers since 1977. Monitoring at Vandenberg Air Force Base has been conducted by Point Reyes Bird Observatory and SRS Technologies. Additionally, Santa Barbara County-supported volunteer docents stationed at Surf Station, within Vandenberg Air Force Base, keep tallies of numbers of visitors, violations prevented, and predators seen (R. Dyste *in litt.* 2004). The U.S. Geological Survey Biological Resources Division monitored western snowy plovers in San Diego County from 1994 to 1998. Teams led by Elizabeth Copper, Robert Patton, Shauna Wolf, and Brian Foster have monitored western snowy plovers in San Diego County since 1999 for military installations. The Oregon Natural Heritage Program and The Nature Conservancy have conducted western snowy plover monitoring since 1990 in Oregon. The Point Reyes Bird Observatory, Oregon Natural Heritage Program, and U.S. Geological Survey, Biological Resources Division, also band western snowy plovers at some locations (Figure 10). The California Department of Parks and Recreation conducts annual monitoring throughout the state and at the Pismo/Oceano Dunes State Vehicular Recreation Area (J. Didion *in litt.* 1999). Mad River Biologists and Humboldt State University are currently conducting intensive population monitoring in northern California. Department of Defense installations continue to maintain long-term programs for monitoring and management of western snowy plover populations and predators in San Diego and Ventura Counties, including programs at Camp Pendleton, Naval Amphibious Base Coronado, Naval Radio Receiving Facility Imperial Beach, North Island, and San Clemente Island.

Figure 10. Banding a western snowy plover chick (photo by Bonnie Peterson with permission)

g. Salt Pond Management

Intensive management at the Moss Landing Wildlife Area has made a major contribution to western snowy plover breeding success in the Monterey Bay area. Management by Point Reyes Bird Observatory staff, in coordination with the California Department of Fish and Game, has been ongoing since 1995. Management activities include draw-down of water levels in part of the salt ponds at the beginning of the nesting season to provide dry sites for nests, and flooding of remnant wet areas twice per month through the nesting season to maintain foraging habitat for adults and their young. Predator control is conducted by the U.S. Department of Agriculture, Wildlife Services Branch.

The Don Edwards San Francisco Bay National Wildlife Refuge manages a former salt pond called the "Crescent Pond" (within location CA-36, mapped in Appendix L) for western snowy plovers by reducing the water levels prior to the breeding season. In the early 1990s, this pond was mostly unvegetated salt flat, but since then native pickleweed (*Salicornia virginica*) has slowly increased on the site, making the areas

less valuable for western snowy plover nesting habitat. The Refuge has begun to conduct winter flooding in the Crescent Pond to reduce vegetative cover and improve western snowy plover nesting habitat.

The 2003 acquisition of Cargill's West Bay, Alviso, and Baumberg Salt Ponds in the South Bay by California Department of Fish and Game and Don Edwards San Francisco Bay National Wildlife Refuge will greatly further the goal of achieving 810 hectares (2,000 acres) of ponds managed for western snowy plover habitat (see Recovery Action 2.6). The Refuge's long-term management plans for these areas will include management that is compatible with western snowy plover and will coordinate with the recovery goals of this Recovery Plan (J. Albertson, pers. comm. 2005). Many of the salt ponds are currently used for breeding and wintering by western snowy plovers. San Francisco Bay Bird Observatory is assisting the Refuge with salt marsh management and western snowy plover monitoring.

h. Habitat Acquisition

Acquisition and management of key sites is an important conservation effort. In October 1998, The Nature Conservancy transferred the approximately 193-hectare (483-acre) Lanphere-Christensen Dunes Preserve (part of Mad River Mouth and Beach, California, CA-7) to us for conservation purposes. The area will be managed by the Humboldt Bay National Wildlife Refuge for natural resources, including the western snowy plover. In October 1998, the Port of San Diego announced an agreement enabling approximately 560 hectares (1,400 acres) of Western Salt Company land (CA-131) to be managed by the San Diego National Wildlife Refuge. The salt ponds are a western snowy plover nesting and wintering area. As noted above, Cargill's transfer of the West Bay, Alviso, and Baumberg salt ponds, including 6,110 hectares (15,100 acres), to California Department of Fish and Game and Don Edwards San Francisco Bay National Wildlife Refuge was completed in 2003; portions of this area will be managed as western snowy plover habitat.

i. Use of Volunteers

Volunteers contribute to the conservation of western snowy plovers and their habitat at many beach locations, including Morro Bay and Oceano Dunes State Vehicular

Recreation Area, Point Reyes National Seashore, and Golden Gate National Recreation Area. Volunteers and docents assist public land managers in many ways (Appendix K), including informing park visitors about threats to the western snowy plover, reducing human and pet disturbances, and assisting with direct habitat enhancement (*e.g.*, manual removal of European beachgrass; Figure 11). In 1998, the Western Snowy Plover Guardian Program was developed to assist the conservation and recovery of western snowy plovers in Monterey Bay. This program is mainly a volunteer effort by local citizens who assist in protecting western snowy plovers through monitoring, reporting, and educational activities (D. Dixon *in litt.* 1998).

Figure 11. High school students removing European beachgrass (photo by Kerrie Palermo, with permission).

j. Public Outreach and Education

Public land managers and private conservation organizations have produced public educational materials, including brochures, posters, flyers, and informational/interpretative signs regarding western snowy plovers (Appendix K). Environmental education/interpretation is recognized by land management agencies as an important tool that supports their mission of resource stewardship. Increased

understanding and appreciation of natural resources (specifically threatened and endangered species) often results in increased public support. This support is not easily measured and when the audience is children, results may not be seen until they reach adulthood. However, those agencies conducting western snowy plover education to date have found a positive response by individuals. In Oregon, on-site monitors of the U.S. Forest Service (Oregon Dunes National Recreation Area) and U.S. Bureau of Land Management report a willingness of the majority of contacted individuals to comply with restrictions after better understanding the reasons for them.

The La Purisima Audubon Society, Santa Barbara County, produced an educational video about the western snowy plover and the California least tern in 1999. It was distributed to public schools and museums within Santa Barbara County in 2000.

k. Section 6 Cooperative Agreements

Section 6 of the Endangered Species Act allows us to enter into cooperative agreements with states that establish and maintain active programs for the conservation of listed species. Through funding under section 6, those states assist the recovery of endangered and threatened species and monitor their status. Between 2000 and 2006, traditional section 6 funds have been used for creation of a docent program at Silver Strand State Beach in California ($8,300); development of a water management plan at Moss Landing Wildlife Area, California ($4,886); surveillance and protection of snowy plover nests on California beaches ($92,000); and surveys, nest monitoring, protecting nests with exclosures, collecting data on human uses of beaches, and encouraging beach uses compatible with snowy plovers in Oregon ($64,386) and Washington ($48,677). HCP Planning grants were used for development of a habitat conservation plan to address management of beach use by the Oregon Parks and Recreation Department ($103,950) and development of an Environmental Impact Statement for this Habitat Conservation Plan ($200,000). A Recovery Land Acquisition grant ($307,000) supported purchase of a conservation easement on 89 hectares (220 acres) of western snowy plover habitat along 3.7 kilometers (2.3 miles) of the Elk River Spit.

3. Conservation Efforts on Private Lands

Private landowners interested in conservation efforts for western snowy plovers and coastal dune habitats have made important contributions to recovery efforts for coastal dune species. At Ormond Beach, California, Southern California Edison has enhanced approximately 60 hectares (150 acres) of degraded wetlands and coastal dune habitat for several special status species, including the western snowy plover and California least tern (D. Pearson, Southern California Edison, pers. comm. 1996).

4. Federal Regulatory Program

a. Critical Habitat

On March 2, 1995, we published a proposed rule to designate critical habitat for western snowy plover at 28 areas along the coast of California, Oregon, and Washington (U.S. Fish and Wildlife Service 1995*b*). At that time, critical habitat was proposed to fulfill an outstanding requirement under section 4 of the Endangered Species Act to highlight important habitat areas on which activities that require Federal actions need to be evaluated under section 7 of the Endangered Species Act. A funding moratorium by the U.S. Department of the Interior for listing actions was in place during the period April 1995 to April 1996. We subsequently acknowledged a serious backlog of listing actions and the need to prioritize them (U.S. Fish and Wildlife Service 1996*b*). Hence, we developed guidance for assigning relative priorities to listing actions conducted under section 4 of the Endangered Species Act during fiscal years 1998 and 1999 (U.S. Fish and Wildlife Service 1998). Designation of critical habitat was placed in the lowest priority (Tier 3). Under this guidance, we placed higher priority on listing imperiled species that currently have limited or no protection under the Endangered Species Act than on devoting limited resources to the process of designating critical habitat for currently-listed species. In addition, we found that because the protection afforded by critical habitat designation applies only to Federal actions, such designation provides little or no additional protection beyond the "jeopardy" prohibition of section 7 of the Endangered Species Act, which also applies only to Federal actions (U.S. Fish and Wildlife Service 1998).

In December 1995, legal challenges by the Environmental Defense Center, Santa Barbara, California, against the U.S. Department of the Interior to finalize designation of critical habitat for the western snowy plover were overruled by the California District Court (U.S. District Court, Central District of California 1995). At that time, the Court's order was based on its decision that lack of funding prevented the Secretary of the Interior from taking final action on proposals for designating critical habitat. However, on November 10, 1998, the U.S. District Court for the Central District of California ruled that the Secretary of the Interior must publish a final designation of critical habitat for the western snowy plover before December 1, 1999 (U.S. District Court, Central District of California 1998).

A final rule designating critical habitat was published on December 7, 1999 (U.S. Fish and Wildlife Service 1999). In May of 2002 the Coos County Board of County Commissioners, Friends of Oceano Dunes, and Concerned Citizens for western Lane County filed a complaint asking for invalidation of the rule. The United States moved for voluntary remand to reconsider the economic analysis and for partial vacatur of the existing designation. On July 19, 2003, the District Court for the District of Oregon granted the United States' motion, ordering the Service on remand to consider the economic impact analysis and ensure that the new rule is based on the best scientific evidence available. This Order was converted to Judgment on July 2, 2003. Based on the potential for harm to the population, at the Service's request the court left most of the established units in place during the redesignation process, but vacated two units in southern California and two units in Washington.

On December 17, 2004, we published a new proposal to designate critical habitat for the Pacific coast distinct population segment of the western snowy plover (U.S. Fish and Wildlife Service 2004*b*). The final rule to designate critical habitat was published on September 29, 2005 (U.S. Fish and Wildlife Service 2005). This rule designated critical habitat in 32 units, compared to 28 units in the 1999 critical habitat final rule, but covers only 4,921 hectares (12,145 acres) compared to 7,881 hectares (19,474 acres) in the 1999 rule. Of the 32 units, 23 are in California, 5 are in Oregon, and 3 are in Washington. Of the total acreage, 1,002 hectares (2,478.5 acres), or 20 percent, are on Federal lands; 2620.5 hectares (6,474 acres), or 53 percent, are on land owned by States or local agencies; and 1294.5 hectares (3,191 acres), or 26 percent, are privately-owned.

It is important to understand what critical habitat means and how it differs from this recovery plan. Section 3 of the Endangered Species Act defines critical habitat to mean: (i) the specific areas within the geographical area occupied by the species at the time it is listed on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed, upon determination that such areas are essential for the conservation of the species. The term "conservation" is defined in section 3 as "the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary." Therefore, critical habitat is to include biologically suitable areas necessary to recovery of the species.

Section 7 of the Endangered Species Act requires Federal agencies to consult with us to evaluate the effects that any activities they fund, authorize, or carry out may have on designated critical habitat. Agencies are required to ensure that such activities are not likely to adversely modify (*e.g.*, damage or destroy) critical habitat. Because the issuance of permits under section 10(a)(1)(B) of the Endangered Species Act constitutes a Federal action or connection and is subject to an internal section 7 consultation, habitat conservation plans developed for actions on private lands must also analyze the potential for adverse modification of critical habitat. Accordingly, where Federal activities may affect western snowy plover critical habitat, we will consult with Federal agencies under section 7 to ensure that these actions do not adversely modify critical habitat.

Critical habitat designation does not create a wilderness area, preserve, or wildlife refuge, nor does it close an area to human access or use. It applies only to activities sponsored at least in part by Federal agencies. Such federally-permitted land uses as grazing and recreation may take place if they do not adversely modify critical habitat. Designation of critical habitat does not constitute a land management plan, nor does it signal any intent of the government to acquire or control the land. Therefore, if there is no Federal involvement (*e.g.*, Federal permit, funding, or license), activities of a private landowner, such as farming, grazing, or constructing a home, generally are not affected by a critical habitat designation, even if the landowner's property is within

the geographical boundaries of critical habitat (U.S. Fish and Wildlife Service 1993*c*). Without a Federal connection to a proposed action, designation of critical habitat does not require that landowners of State or other non-Federal lands do anything more than they would otherwise do to avoid take of listed species under provisions of section 9 of the Endangered Species Act.

By comparison, a recovery plan delineates site-specific management actions that we believe are required to recover and/or protect listed species, establishes objective, measurable criteria for downlisting or delisting the species, and estimates time and cost required to carry out these actions. A recovery plan is not a regulatory document and does not obligate cooperating or other parties to undertake specific tasks or expend funds.

Critical habitat designation is not necessarily intended to encompass a species' entire current range. Recovery plans, however, address all areas determined to be important for recovery of listed species and identify needed management measures to achieve recovery. Because critical habitat designations may exclude areas based on factors such as economic cost, approved or pending management plans, or encouragement of cooperative conservation partnerships with landowners, the areas identified in recovery plans as important for recovery of the species may not be identical to designated critical habitat. The recovery units described in this recovery plan include but are not restricted to the 32 areas designated as critical habitat: Damon Point, Midway Beach, Leadbetter Point, Bayocean Spit, Baker/Sutton Beaches, Siltcoos to Tenmile, Coos Bay North Spit, and Bandon to Floras Creek in Recovery Unit 1; Lake Earl, Big Lagoon, McKinleyville area, Eel River area, MacKerricher Beach, and Manchester Beach in Recovery Unit 2; Point Reyes Beach, Limantour Spit, Half Moon Bay, Santa Cruz Coast, Monterey Bay Beaches, and Point Sur Beach in Recovery Unit 4; San Simeon Beach, Estero Bay, Devereaux Beach, Oxnard Lowlands in Recovery Unit 5; and Zuma Beach, Santa Monica Bay, Bolsa Chica area, Santa Ana River Mouth, San Onofre Beach, Batiquitos Lagoon, Los Penasquitos, and South San Diego in Recovery Unit 6. Implementation of the recovery actions in this recovery plan (*e.g.*, monitoring, habitat improvement, nest protection, recreation management) may not be limited to designated critical habitat areas.

b. Section 9 Take Prohibitions

Section 9 of the Endangered Species Act of 1973, as amended, prohibits any person subject to the jurisdiction of the United States from taking (i.e., harassing, harming, pursuing, hunting, shooting, wounding, killing, trapping, capturing, or collecting) listed wildlife species. It is also unlawful to attempt such acts, solicit another to commit such acts, or cause such acts to be committed. Regulations implementing the Endangered Species Act (50 CFR 17.3) further define "harm" to include significant habitat modification or degradation that results in the killing or injury of wildlife by significantly impairing essential behavioral patterns including breeding, feeding, or sheltering. "Harass" means an intentional or negligent act or omission that creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns, which include, but are not limited to, breeding, feeding, or sheltering.

As an example under the authority of section 9 of the Endangered Species Act, on May 15, 1998, we received preliminary injunctive relief against the Town of Plymouth, Massachusetts, because their beach management failed to prevent take (killing) of a piping plover chick by an off-road vehicle (U.S. District Court for Massachusetts 1998). The judge's order prohibited off-road vehicle traffic through the piping plover's nesting season unless the town implemented specific management measures to preclude take, including twice-daily monitoring of nests and a 400-meter (1,148-foot) buffer of protected habitat for newly-hatched chicks.

The proposed special rule under section 4(d) of the Endangered Species Act (U.S. Fish and Wildlife Service 2006b) would exempt most recreational and commercial activities within a county from section 9 prohibitions on take of western snowy plovers, if documentation of conservation actions was provided and populations within the county met targets based on the Management Goal Breeding Numbers in Appendix B of the recovery plan. Research and monitoring actions would continue to require recovery permits under section 10(a)(1)(A) of the Endangered Species Act.

c. Section 10 Permits

Section 10 of the Endangered Species Act and related regulations provide for permits that may be granted to authorize activities otherwise prohibited under section 9, for scientific purposes or to enhance the propagation or survival of a listed species (i.e., section 10(a)(1)(A) permits). These permits have been granted to certain biologists of conservation organizations (*e.g.*, Point Reyes Bird Observatory and Oregon Natural Heritage Program) and Federal and State agencies to conduct western snowy plover population monitoring and banding studies and construct predator exclosures. It is also legal for employees or designated agents of certain Federal or State agencies to take listed species without a permit if the action is necessary to aid sick, injured, or orphaned animals or to salvage or dispose of a dead specimen.

Section 10(a)(1)(B) of the Endangered Species Act also allows permits to be issued for take of endangered and threatened species that is "incidental to, and not the purpose of, carrying out an otherwise lawful activity" if we determine that certain conditions have been met. An applicant for an incidental take permit must prepare a habitat conservation plan that specifies the impacts of the take, the steps the applicant will take to minimize and mitigate the impacts, funding that will be available to implement these steps, alternative actions to the take that the applicant considered, and the reasons why such alternatives are not being utilized. Conditions that we must meet include a determination: (1) whether the taking will be incidental, (2) whether the applicant will minimize and mitigate the impacts of such taking to the maximum extent possible, (3) that adequate funding for the recovery will be provided, (4) that the taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild, and (5) of any other measures that we may require as being necessary or appropriate for the recovery plan. Section 10(a)(1)(B) of the Endangered Species Act provides for permits that have the potential to contribute to conservation of listed species. Such permits are intended to reduce conflicts between the conservation of listed species and economic activities, and to develop partnerships between the public and private sectors.

d. Section 7 Requirements and Consultations

Section 7(a)(1) of the Endangered Species Act requires all Federal agencies to "utilize their authorities in furtherance of the purposes of [the] Act by carrying out programs for the conservation of endangered species and threatened species". Hence, Federal agencies have a greater obligation than do other parties, and are required to be pro-active in the conservation of listed species regardless of their requirements under section 7(a)(2) of the Act. Section 7(a)(2) of the Endangered Species Act requires Federal agencies to consult with us prior to authorizing, funding, or carrying out activities that may affect listed species. Section 7 obligations have caused Federal land management agencies to implement western snowy plover protection measures that go beyond those required to avoid take; for example, eradicating European beachgrass and conducting research on threats to western snowy plovers. Other examples of Federal activities that may affect western snowy plovers along the Pacific coast, thereby triggering a section 7 consultation, include permits for sand management activities or major restoration projects that affect coastal processes or that are targeted to protect other species on Federal lands such as dune plants (National Park Service, U.S. Department of the Interior); disposal of dredged materials (U.S. Army Corps of Engineers); military training (U.S. Department of Defense); and funding to public agencies for projects to repair beach facilities, such as public access paths (Federal Emergency Management Agency).

e. Other Federal Regulations, Executive Orders, and Agreements

Section 404 of the Clean Water Act, as amended, and section 10 of the Rivers and Harbors Act of 1899 are the primary Federal laws that could provide some protection of nesting and wintering habitat of the western snowy plover that is determined by the U.S. Army Corps of Engineers (Corps) to be wetlands or historic navigable waters of the United States. Excavation or placement of any fill material (including sand) below the high tide line, as defined under 33 CFR, Section 328.3(d), Definition of Waters of the United States, also requires a permit from the U.S. Army Corps of Engineers.

Executive Order 11644, Use of Off-Road Vehicles on Public Lands, and Executive Order 11989, Off-Road Vehicles on Public Lands, pertain to lands under custody of

the Secretaries of Agriculture, Defense, and Interior (except for Native American Tribal lands). Executive Order 11644 requires administrative designation of areas and trails where off-road vehicles may be permitted. Executive Order 11989 states that "... the respective agency head shall, whenever he determines that the use of off-road vehicles will cause or is causing considerable adverse effects on the soil, vegetation, wildlife, wildlife habitat ... immediately close such areas or trails to the type of off-road vehicles causing such effects, until such time as he determines that such effects have been eliminated and that measures have been implemented to prevent future recurrence". Compliance with this executive order would promote prohibitions or restrictions on off-road vehicles so that they are not allowed to adversely affect sensitive habitats used by western snowy plovers.

Executive Order 11988, Floodplain Management, and Executive Order 11990, Protection of Wetlands, provide protective policies that apply to western snowy plover habitats. Executive Order 11988 mandates that all Federal agencies avoid direct or indirect support of floodplain development wherever there is a practicable alternative. Executive Order 11990 mandates that all Federal agencies shall "provide leadership and shall take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands..." Compliance with Executive Order 11988 would promote protection of beach and dune habitats through restrictions on development within floodplains. Application of Executive Order 11990 would promote protection of wetland habitats used by western snowy plovers.

Executive Order 13112, Invasive Species, directs Federal agencies to prevent the introduction of invasive species; control their populations in a cost-effective and environmentally sound manner; monitor invasive species; restore native species and habitat conditions in ecosystems that have been invaded; conduct research and develop technologies to prevent their introduction; and promote public education on invasive species and the means to address them. This executive order also requires that a Federal agency "not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species..." Compliance with this executive order would enhance western snowy plover habitats through (1) avoidance of use, approval, or funding the planting of invasive species

like European beachgrass; and (2) active programs to remove this invasive species and restore coastal dune habitats with native plant species.

The Fish and Wildlife Coordination Act (16 U.S.C. 661-667e), as amended, requires that whenever a proposed public or private water development project is subject to Federal permit, funding, or license, the conservation of fish and wildlife resources shall be given equal consideration. This Act also requires that project proponents shall consult with us and the State agency responsible for fish and wildlife resources. Compliance with the Fish and Wildlife Coordination Act highlights the importance of considering and providing for the habitat needs of fish and wildlife resources when reviewing projects that would adversely affect these resources.

The National Environmental Policy Act of 1969, (42 U.S.C. 4321-4347), as amended, requires that each Federal agency prepare an environmental impact statement on the potential environmental consequences of major actions under their jurisdiction. Environmental impact statements must include the impacts on ecological systems, any direct or indirect consequences that may result from the action, less environmentally damaging alternatives, cumulative long-term effects of the proposed action, and any irreversible or irretrievable commitment of resources that might result from the action. Compliance with the National Environmental Policy Act highlights the need to disclose, minimize, and mitigate impacts to biological resources, including western snowy plovers.

The Coastal Zone Management Act of 1972 (16 U.S.C. 1451-1464), as amended, established a program for states to voluntarily develop comprehensive programs to protect and manage coastal resources. To receive Federal approval and funding under this Act, states must demonstrate that they have programs and enforceable policies that are sufficiently comprehensive and specific to regulate land uses, water uses, and coastal development, and must have authorities to implement enforceable policies. Local coastal plans, local comprehensive plans, and implementing measures by coastal planning jurisdictions pursuant to the Coastal Zone Management Act should be developed, updated, and implemented with protective measures for western snowy plovers.

Western snowy plovers are protected under the Migratory Bird Treaty Act of 1918 (16 U.S.C. 703-712), as amended. Under the Migratory Bird Treaty Act, prohibited acts include pursuing, hunting, shooting, wounding, killing, trapping, capturing, or collecting any migratory bird, nest, or eggs without a permit from the U.S. Fish and Wildlife Service.

5. State Regulatory Protection, Policies, and Agreements

In Washington, Oregon, and California, each state holds title to, and has regulatory jurisdiction over, the coastal intertidal zone. In Washington, the area between mean high tide to extreme low tide is the seashore conservation area under the authority of the Washington State Parks and Recreation Commission. In California, the California State Lands Commission has regulatory authority to the mean high tide line along the California coast.

In Oregon, the Oregon Parks and Recreation Department administers the State beach for the ocean shore recreation area, which is defined as the area between the line of extreme low water and the statutory vegetation line, which is a line surveyed to the approximate line of vegetation that existed in 1969 (Oregon Revised Statutes 390.770). The Oregon Division of State Lands also has jurisdiction over waters of the state along the Pacific coast to the line of highest tide or the line of established vegetation, whichever is higher. Therefore, the Oregon Parks and Recreation Department has direct jurisdiction, authority, and responsibility for management of western snowy plover habitats in the State of Oregon, which owns not only to the mean high tide line, which is western snowy plover foraging habitat, but also into the vegetation line, which is essentially the dry sand area used by western snowy plovers for nesting.

State coastal planning and regulatory agencies, such as the California Coastal Commission, require preparation of local coastal zone management plans by local coastal municipalities. These local coastal zone management plans must comply with the Coastal Zone Management Act of 1972 regarding protection of coastal resources, including natural resources. Under the California Coastal Management Program, coastal resources are managed and cumulative impacts addressed through: (1) coastal permits and appeals; (2) planning and implementation of local coastal programs; and

(3) Federal consistency review. However, effective management of cumulative impacts is difficult under the existing management framework because multiple jurisdictions have varying policies and standards in different geographic areas (California Coastal Commission 1995). Through the Coastal Commission's regional cumulative assessment program, cumulative impacts to coastal resources can be addressed through the periodic review of local coastal programs. In California, most local coastal programs and general plans were completed prior to 1993 (when we listed the western snowy plover as a threatened species); therefore, many do not reflect protective measures specifically for the western snowy plover.

The Oregon Department of Land Conservation and Development is the designated coastal zone management agency for the State of Oregon. The State of Oregon's land use planning system has several elements that are related to conservation of western snowy plovers and their habitats. In Oregon, local jurisdictions (cities and counties), service districts, and State agencies are required to develop Local Comprehensive Plans and Implementing Measures, such as zoning and land division ordinances, to effect these plans. Each plan must satisfy a set of 19 goals established through Oregon land use law and policy. Plans must be reviewed by the Land Conservation and Development Commission for consistency with these goals before they can be put into effect. Several of the planning goals have application to, or should be considered during, planning for western snowy plover conservation and recovery. These goals include: Goal 5 - Open Spaces, Scenic and Historic Areas, and Natural Resources; Goal 7 - Areas Subject to Natural Disasters and Hazards; Goal 8 - Recreational Needs; Goal 16 - Estuarine Resources; Goal 17 - Coastal Shorelands; and Goal 18 - Beaches and Dunes.

Taken in aggregate, the elements of these goals that can contribute to western snowy plover recovery include:

- several requirements for protection of wildlife habitat;
- requiring protection of estuarine ecosystems including habitats, diversity, and other natural values;
- establishing that uses of beaches and dunes shall be based on factors including the need to protect areas of critical environmental concern and significant wildlife habitat;

- requiring that coastal plans provide for uses of beaches and dunes that are consistent with their ecological values and natural limitations;
- requiring an evaluation of the beneficial effects to natural resources from allowing continuation of natural events that are hazardous to human developments (such as erosion and ocean flooding);
- establishing a preference for nonstructural solutions to erosion and flooding of coastal shorelands over structural approaches (such as seawalls and rip-rap);
- requiring that development of destination resorts be compatible with adjacent land uses and maintain important natural features such as threatened and endangered species habitats;
- encouraging coordination among State, Federal, and local governmental agencies while developing recreation plans, and discouraging development of recreation plans that exceed the carrying capacity of the landscape;
- encouraging planning for Open Space, Scenic and Historic Areas, and Natural Resources (Goal 5), Recreational Needs (Goal 8), and Coastal Shorelands (Goal 17) in close coordination; and
- allowing dune stabilization programs only when in conformance with the overall comprehensive plan and after assessment of the potential impacts.

Some aspects of these planning goals could be interpreted to be contrary to western snowy plover conservation and recovery when viewed in isolation. However, when viewed in the context of the entire goal or all the planning goals, these elements should be compatible with western snowy plover conservation and carefully-planned habitat restoration activities. Two such elements are the directive to increase recreational access to coastal shorelands and the restrictions placed on dune grading and removal of vegetation. Goal 17 - Coastal Shorelands directs local governments and the Oregon Parks and Recreation Department to develop a program to increase public access. In many areas, recreational use of western snowy plover habitat during the nesting season is detrimental to or incompatible with western snowy plover conservation. However, this goal also recognizes that many shorelands have unique or exceptional natural area values, includes the objective of reducing adverse impacts to fish and wildlife habitat associated with use of coastal shorelands, clearly establishes that significant wildlife habitat shall be protected, establishes that uses of such habitat areas shall be consistent with protection of natural values, and directs recreation plans to provide for "appropriate" public access and recreational use. Goal

18 - Beaches and Dunes directs local governments and State and Federal agencies to regulate actions in beach and dune areas to minimize any resulting erosion and only allows foredune breaching to replenish interdune areas or in the case of an emergency. Western snowy plover habitat restoration efforts in areas that have been overtaken by European beachgrass (*Ammophila arenaria*) may involve foredune breaching, vegetation removal, dune grading, and other actions that will remove the European beachgrass and restore the natural beach and dune processes of sand movement, including erosion and deposition. However, this goal also recognizes the need to protect areas of critical environmental concern, areas of biological importance, and areas with significant habitat value, specifically identifies removal of "desirable" vegetation as an action requiring minimization of erosion, and requires that any foredune breaching be consistent with sound principles of conservation.

The Washington State Parks and Recreation Commission administers the Seashore Conservation Act of 1988 in accordance with the Revised Code of Washington and the Washington Administrative Code. The Seashore Conservation Area (Revised Code of Washington 43.51) emphasizes the importance of beaches to the public for recreational activities. In designating beach areas to be reserved for pedestrian use, it considers natural resources, including protection of shorebird and marine mammal habitats, preservation of native beach vegetation, and protection of sand dune topography. Chapter 352-37 (Ocean Beaches) of the Washington Administrative Code requires local governments within the Seashore Conservation Area to prepare recreation management plans that designate at least 40 percent of the ocean beach for use by pedestrians and nonmotorized vehicles from April 15 to the day after Labor Day. These regulations also identify restrictions on certain uses within ocean beaches, including motor vehicles, equestrian traffic, speed limits, aircraft, wind/sand sailers, parasails, hovercraft, group recreation events, and beach parking and camping. In 1989, an interagency agreement was signed by the Washington Department of Natural Resources, Washington State Parks and Recreation Commission, Washington Department of Wildlife, and City of Ocean Shores regarding management of mixed uses at Damon Point. The intent of the agreement was to protect western snowy plovers while allowing recreation.

State regulations, policies, and goals for the States of California, Oregon, and Washington provide many protective measures for western snowy plovers. However,

because they frequently emphasize public uses of beach habitat, there is potential for conflicts between human uses of the coastal zone and needed management measures for recovery of the western snowy plover.

The California Department of Parks and Recreation has written management guidelines for the western snowy plover which are meant to be used in conjunction with the recovery plan. Management actions will be implemented from the guidelines and may result in changes in how coastal units are operated. Increased emphasis will be required for monitoring, nest area protection, prohibition of certain activities in important nesting areas, and public education.

6. Consultations, Habitat Conservation Plans, and Other Regulatory Actions

Through consultations with Federal agencies under section 7 of the Endangered Species Act and through the development of habitat conservation plans with non-Federal agencies developed under section 10 of the Endangered Species Act, we provide nondiscretionary terms and conditions that minimize (sections 7 and 10) and mitigate (section 10) the impacts of covered activities on listed species and their habitat. Several major consultations and habitat conservation planning efforts to benefit the western snowy plover have been completed or are currently under way.

In 1995 our Sacramento Fish and Wildlife Office completed formal consultation with the National Park Service, Golden Gate National Recreation Area, on the effects of their management of Ocean Beach, San Francisco on the western snowy plover. Ocean Beach experiences tremendous visitor use year-round because of its proximity to San Francisco, yet it supports high numbers of nonbreeding western snowy plovers, which may be present from May through July. The consultation covered actions and policies the National Park Service had taken that resulted in unnecessary harassment of nonbreeding western snowy plovers. Most significant of these measures was their policy not to enforce regulations requiring pets to be leashed and under control by their owners on all National Park Service lands. Data collected by the National Park Service clearly identified that unleashed dogs were the most significant disturbance factor of the many sources of disturbance to western snowy plovers on Ocean Beach. As a result of the consultation, the National Park Service began to enforce their “leash law” along 3.2 kilometers (2 miles) of beach utilized by western snowy plovers. The

National Park Service implemented this policy despite vocal and persistent opposition by the San Francisco Society for the Prevention of Cruelty to Animals and other local advocacy groups, including the "Rovers for Plovers", which organized themselves to challenge the National Park Service's leash law. These groups were successful in advocating their position in numerous television news stories and articles in local newspapers. At the height of this discourse, the local public radio station held a round-table discussion between the National Park Service, U.S. Fish and Wildlife Service, and Society for the Prevention of Cruelty to Animals, and solicited audience members to call in and identify their viewpoint. The overwhelming majority of callers supported leash law restrictions that would minimize harassment of western snowy plovers.

Our Arcata Fish and Wildlife Office has formally consulted with the U.S. Army Corps of Engineers regarding gravel extraction on the Eel River, California. Gravel mining operations are subject to permits from the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act. The western snowy plover breeds on the Eel River gravel bars. Impacts to the western snowy plover and its designated critical habitat associated with gravel mining operations have been assessed based on nesting surveys and changes to habitat resulting from gravel extraction. The Arcata Fish and Wildlife Office has also worked with Humboldt County, the California Department of Fish and Game, and the California Department of Parks and Recreation to implement additional protections for nesting western snowy plovers at MacKerricher, Manchester, Little River, Humboldt Lagoons, and Prairie Creek State Parks; Clam Beach County Park, and the Eel River Wildlife Area. These measures include installation of nest exclosures, signing, and development of educational material for kiosks. Technical assistance has also been provided to Prairie Creek State Park and MacKerricher State Park on exotic vegetation management programs (J. Watkins *in litt.* 1999, pers. comm. 2001). A section 7 consultation with the Bureau of Land Management on finalization of a management plan for Humboldt Bay South Spit is expected to be initiated soon (J. Watkins, pers. comm. 2006).

Our Ventura Fish and Wildlife Office is attempting to initiate a regional approach to habitat conservation planning for western snowy plovers and other listed species along Monterey Bay in Monterey County, California. Currently, there are several proposed development projects within the city of Sand City and a "city wide" habitat

conservation plan has been prepared for these projects. The City of Sand City has yet to present a complete draft of their habitat conservation plan to the Ventura Fish and Wildlife Office for review. Formerly, the City of Marina was also proposing several coastal developments that were expected to have adverse effects on western snowy plovers, but these projects are no longer planned due to changes in land ownership and other factors. The City of Marina has halted the drafting of a habitat conservation plan for lands within their jurisdiction. We have expressed concerns about projects being presented in a piecemeal fashion, which does not allow an adequate assessment of their cumulative effects, and have recommended a regional approach through preparation of a regional habitat conservation plan. This plan would provide greater conservation benefits to the western snowy plover. In addition to the adverse effects of development on western snowy plovers and their habitat, recreation on the extensive public lands along Monterey Bay is also adversely affecting western snowy plovers. Therefore, public land managers, including our Refuges Division, the California Department of Parks and Recreation, the California Department of Fish and Game, and the Monterey Peninsula Regional Park District, need to be involved in planning efforts along Monterey Bay.

Through the consultation process, our Ventura Fish and Wildlife Office determined that a draft biological opinion on Vandenberg Air Force Base's initial proposed beach management plan for the western snowy plover, concluding that the plan would "likely jeopardize the continued existence of the western snowy plover and adversely modify its critical habitat." Our draft biological opinion of January 2001 pointed out that the Air Force's beach plan would have allowed twice as much nesting habitat to be open to public recreation as was allowed during the 2000 breeding season, and it would have reduced the time the Air Force spends patrolling the beaches by about 80 percent. Based on this feedback, the Air Force subsequently reinitiated consultation on a modified version of the beach management plan, including commitments to signage, information kiosk, and enforcement patrols. The Ventura Fish and Wildlife Office issued a non-jeopardy biological opinion on the modified action in March 2001. Beach opening and full implementation of conservation measures was implemented on May 25, 2001, with hours and days of open beach limited due to limited availability of enforcement personnel. For the next three breeding seasons (2002, 2003, 2004), the Service issued biological opinions on annual beach management plans proposed by the Air Force. In 2004, we had a series of meetings

with the Air Force to discuss their beach management strategy and its effects on the western snowy plover. Through a cooperative effort, the Service and the Air Force came to agreement on a 5-year beach management plan that includes many of the same protective measures that had been in place the last several years, yet allows the Air Force to provide recreational access seven days a week. On March 1, 2005, the Ventura Fish and Wildlife Office issued a new non-jeopardy biological opinion on the Air Force's proposed 5-year beach management plan (2005-2009).

Our Ventura Fish and Wildlife Office is also involved with the development of a habitat conservation plan being funded by the Off-Road Vehicle Division of the California Department of Parks and Recreation for the Pismo/Oceano Dunes State Vehicular Recreation Area and other State parks within the San Luis Obispo District of the California Department of Parks and Recreation. The Ventura Fish and Wildlife Office is also involved in the development of a HCP for the Rancho Guadalupe County Park, Santa Barbara, California. These habitat conservation plans will evaluate and mitigate for effects that recreation and park management activities are having on the covered species, including the western snowy plover.

Recent consultations handled by our Newport Field Office include those in response to the New Carissa Oil Spill, a consultation on BLM management actions at the New River Area of Critical Environmental Concern (ACEC), and a consultation on the Integrated Predator Damage Management Program 2002 to 2007. The Oregon Parks and Recreation Department is currently developing a Habitat Conservation Plan that proposes restrictions on some Oregon beaches to help the plover population recover.

The New Carissa oil spill was a long and complicated incident involving a variety of Federal, State, local and private participants. On February 4, 1999, the *New Carissa,*carrying 359,000 gallons of bunker oil and 37,400 gallons of diesel, grounded on the north spit of Coos Bay and began leaking oil shortly thereafter. Subsequently, oil and oiled wildlife were observed on the beach. Attempts were made to burn off the oil. The vessel broke into two pieces during the second attempt. There were three formal consultations associated with the *New Carissa* between 1999 and 2000. The first consultation addressed the effects of issuing permits for salvage of the *New Carissa* stern section, the second the effects of restoring recreational access to the Coos Bay north spit, and the third the response efforts led by the Coast Guard. In all

three consultations, it was concluded that the proposed actions would not jeopardize the western snowy plover if protective measures required to limit take were implemented.

A consultation on the New River ACEC was completed in 2005. The purpose of the biological opinion was to address a variety of issues: recreation management at Floras Lake where measures were not adequately protecting nesting plovers; the periodic construction of a breach on the New River spit to improve fish and wildlife habitat and alleviate flooding; increased habitat restoration; and the development of a primitive beach camping area.

A consultation on Oregon's Integrated Predator Damage Management Program was completed in 2001. The objective of this program is to assist in recovery of the western snowy plover in Oregon by improving western snowy plover nesting and fledging success, through 1) expanding assessment efforts to all western snowy plover breeding and nesting locations to determine predator species responsible for nest, chick and adult predation; and 2) reducing the local predator populations where feasible and where the predator species or individual is known. The consultation calls for a variety of lethal and non-lethal methods to be used by APHIS-WS personnel to control the predator population.

The Oregon Parks and Recreation Department has been working with various cooperating agencies to develop a Habitat Conservation Plan for Oregon beaches. The Oregon Parks and Recreation Department is responsible for various management activities for most of Oregon's coast, including recreation management, general beach management, and the management of natural resources. In addition, the Oregon Parks and Recreation Department is responsible for issuing various permits along the Oregon coast. Some of these activities may result in "take" of or harm to the snowy plover. A draft version of the Habitat Conservation Plan was distributed to the public in January 2004. The Oregon Parks and Recreation Department conducted public meetings in seven coastal communities to solicit public comment. The area covered under the HCP includes the portions of the ocean shore along the Oregon coast that extend between the mouth of the Columbia River South Jetty on the north and the California/Oregon border on the south (approximately 230 miles of beach). In addition, specific portions of six key state parks, state natural areas, and state

recreation areas are included in the covered lands to be managed for snowy plover recovery. Implementation of the plan will begin after approval and completion of the Habitat Conservation Plan and its associated documents.

In southern California, we, through our Carlsbad Fish and Wildlife Office, have worked with local jurisdictions to develop regional habitat conservation plans under section 10 of the Endangered Species Act. The Multiple Species Conservation Program addresses southwestern San Diego County, including, for example, western snowy plover breeding habitat in south San Diego Bay through the City of San Diego. The Multiple Habitat Conservation Program addresses northwestern San Diego County. This plan provides for the conservation of western snowy plover breeding habitat and will potentially result in more management in association with a proposed preserve.

Also in San Diego County, we have been working with the Navy and the Marine Corps to avoid and minimize impacts to western snowy plovers. For example, with the assistance of our programmatic biological opinion in 1995, the Marine Corps has addressed training-related impacts on western snowy plovers and other species on approximately 17 miles of coastline on Camp Pendleton. We have likewise worked with the Navy at Naval Base Coronado to develop a program to conserve western snowy plover nesting and breeding habitat and allow necessary military training. As a result of successful management on these San Diego County military installations, they support a majority of the western snowy plover population in Recovery Unit 6 (*e.g.*, roughly 65 percent in 2006 from window survey data) while the military installations accomplish their respective training missions.

In the past, several instances were documented of western snowy plover nests being trampled by cattle belonging to the Vail and Vickers Company on Santa Rosa Island within the Channel Islands National Park, owned and managed by the National Park Service. In 1996, a lawsuit to remove cattle from Santa Rosa Island was initiated by the Environmental Defense Center, Santa Barbara, on behalf of the National Park Conservation Association. It was initiated under the authority of the Clean Water Act and the Endangered Species Act, based on concerns about management of livestock by the National Park Service and associated impacts to water quality and sensitive

plant and animal species. As a result of a lawsuit settlement, all cattle were removed from Santa Rosa Island in early 1998.

7. Regulatory Protection and Policies of Local Governments

Local governments regulate municipal land uses through development of local land use plans, general plans, comprehensive plans, and zoning policies. On April 21, 1998, we requested that county and coastal city planners within the states of Washington, Oregon, and California complete land-use management surveys regarding the western snowy plover. We sent surveys to 91 State, county, or coastal city planners and received responses from 37 percent of the recipients. Approximately 50 percent of the respondents were aware that western snowy plover habitats occur within their jurisdictions. However, only about one-third knew whether sandy beach and other habitats within their jurisdictions provided breeding and/or wintering habitat for western snowy plovers. Many general plans, coastal zone programs, and comprehensive plans prepared by local governments contain land use designations that are protective of western snowy plover habitats (*e.g.*, parkland, open space, and conservation designations for sandy beach). However, allowable uses in or adjacent to these zones, such as development (*e.g.*, seawalls, recreational facilities, single-family homes), recreation and public access, could cause direct or indirect threats to breeding or wintering western snowy plovers.

Whereas 43 percent of the respondents include regulatory policies that protect western snowy plover habitat (*e.g.*, sandy beach) in their general plans, local coastal programs or comprehensive plans, only 8 percent have developed regulatory policies specifically to protect the western snowy plover. These respondents included the City of Half Moon Bay, California, and Coos and Curry Counties, Oregon. Only 23 percent of the respondents specifically explain the threatened status of the western snowy plover, identify western snowy plover breeding/wintering locations, or specify shorebird nesting/roosting habitats as environmentally sensitive habitat areas in their jurisdictions. About 50 percent of the respondents indicated they either (1) have approved development within or adjacent to sandy beach or other habitats used by the western snowy plover, or (2) did not know whether such development had been approved by their agency. About half of these same respondents could provide some information on the number of permits authorized, area or linear distance affected,

percentage of development types (*e.g.*, housing, recreational) permitted, and permit conditions.

Based on these responses, it seems that specific locations of, and protective measures for, western snowy plover breeding and/or wintering locations are not included in most of the existing general plans, comprehensive plans, local coastal programs, or their implementing ordinances. Also, to better assess cumulative impacts, these responses indicate a need for a better tracking method regarding development projects approved within and adjacent to western snowy plover habitat.

8. Interagency Coordination

Each of the six recovery units for the western snowy plover is represented by a working group which meets at least once a year to coordinate western snowy plover recovery efforts. The working groups have provided a forum for the participation of affected Federal and State agencies and others in discussion, implementation, and adjustment of recovery efforts. Items addressed include research and monitoring needs, predator control, recreation management, habitat restoration, public outreach and law enforcement. In addition, a joint meeting of all six working groups is held annually. This group, consisting of beach managers, researchers, and outreach staff, meet to discuss range-wide issues (within the United States), to coordinate recovery actions, to learn from the experience of others, and to share information and research. Attendees have included local, State, and Federal agency staff, non-governmental organizations, consulting firms, private citizens, and volunteers.

The recovery unit working groups vary somewhat in organizational structure depending on major local issues, patterns of land ownership within the area, and specific agencies responsible for management. For example, the Oregon/Washington working group is composed of several subcommittees, including Outreach, Media, Predator Control, Research, Law Enforcement, and Recovery Plan Implementation. They facilitate funding partnerships for monitoring and management programs, thus promoting the best use and leveraging of limited funds. They also act as the main forum for discussing and tracking the status and trends of the snowy plover population. The subcommittees have worked on or supported a variety of cooperative projects, such as monitoring of yearly reproductive success, predator control, and

outreach materials. Products developed by the Outreach subcommittee include an outreach plan for Oregon/Washington and "Share the Beach" bookmarks, table tents, dog leashes, brochures, interpretive signs, and coloring books. The Media subcommittee is producing a media outreach CD for distribution to various media outlets and inter-agency press releases. The Predator Control subcommittee approved a predator management plan for Oregon, which first went into effect in 2002. The purpose of the Research subcommittee is to identify research and monitoring priorities, establish criteria for setting priorities, review proposed projects, and address funding mechanisms. The Law Enforcement subcommittee focuses on improving compliance with rules and regulations in plover nesting areas and the Recovery Plan Implementation subcommittee is working on guidance that would assist in "stepping down" the recovery plan for Oregon and eventually Washington.

In 1998, an interagency effort in Oregon produced a slide show and portable display to educate beach visitors about western snowy plover conservation. Outdoor education specialists and/or western snowy plover biologists from the U.S. Bureau of Land Management, U.S. Forest Service, Oregon Department of Fish and Wildlife, Oregon Parks and Recreation Department, and U.S. Fish and Wildlife Service participated in this effort. The show provides basic information about the western snowy plover, the reasons for its decline, and actions needed for its recovery, emphasizing the contribution that beach visitors can make.

II. RECOVERY

A. RECOVERY STRATEGY

The recovery strategy for the Pacific coast population of the western snowy plover (western snowy plover) includes three major components: 1) increase population numbers distributed across the range of the Pacific coast population of the western snowy plover; 2) ameliorate or eliminate threats by conducting intensive ongoing management for the species and its habitat, and developing mechanisms to ensure management in perpetuity; and 3) monitor western snowy plover populations and threats to determine success of recovery actions and to refine management actions. Developing and implementing intensive adaptive management actions, ensuring that management will continue in perpetuity, and monitoring to refine management actions, are all necessary to achieve the targeted population increases across the range. These three major components of the recovery strategy each include many actions and multiple partners that are described in further detail below.

1. Recovery Strategy Components

The following recovery strategy components will guide future recovery efforts for the U.S. Pacific coast population of the western snowy plover.

a. Population increases should be distributed across the western snowy plover's Pacific coast range.

A key component of recovering western snowy plovers is to ensure that population increases are distributed throughout the species' Pacific coast range. In order to achieve this, management goals (Appendix B) and needed management actions (Appendix C) have been determined for 155 sites distributed along the coasts of southern Washington, Oregon, and California. Additionally, the population's range has been divided into six recovery units (see discussion below) with population goals established for each recovery unit. The six recovery units correspond to regions of the U.S. Pacific coast and to the six subpopulations used in the Population Viability Analysis for the Pacific coast Snowy Plovers (Appendix D). In the population viability analysis, the Pacific coast population of the western snowy plover is treated

as a metapopulation, defined as a set of subpopulations among which there is limited dispersal.

The population viability analysis assumes dispersal among subpopulations is limited; however, even limited dispersal among subpopulations is important to species survival and recovery. Dispersal of the population across its breeding range helps to counterbalance catastrophes, such as extreme climatic events, oil spills, or disease that might depress regional survival and/or productivity. Maintaining robust, well-distributed subpopulations should reduce variance in survival and productivity of the Pacific coast population of the western snowy plover as a whole, facilitate interchange of genetic material between subpopulations, and promote recolonization of any sites that experience declines or local extirpations due to low productivity and/or temporary habitat loss.

This recovery plan and the population viability analysis (Appendix D) consider the U.S. Pacific coast population of the western snowy plover to be a single management entity, and population goals and objectives are based on that premise. No portion of the Pacific coast population of the western snowy plover appears to function as a distinct population segment. The Recovery Team therefore recommends that no State, geographic region, or subpopulation of the Pacific coast population of the western snowy plover be considered for delisting separately from the others.

b. Remove or reduce threats by conducting intensive ongoing management for the species and its habitat, and develop mechanisms to ensure management in perpetuity to prevent a reversal of population increases following delisting under the Endangered Species Act.

Management consists of multiple components, including identifying actions to ameliorate or eliminate threats, developing mechanisms to ensure management in perpetuity, continuing outreach and education to provide information to the public, partners, and stakeholders on recovery needs and opportunities, and developing of partnerships among Federal, State, and local agencies and groups to develop and implement effective management. Management actions for the western snowy plover are described in the recovery action outline and in Appendix C. These management actions are necessary to eliminate or ameliorate threats to the western snowy plover,

including loss, degradation, and alteration of habitat; disease, predation; and other manmade factors including disturbance of breeding and wintering birds, contaminants, and oil spills.

In addition to specific management recommendations to ameliorate or eliminate threats, the recovery action outline and recovery strategy for the western snowy plover include several recovery actions to develop mechanisms to ensure that management actions continue in perpetuity to ensure that threats remain neutralized. These include establishing working groups and developing participation plans for each recovery unit; ensuring sufficient U.S. Fish and Wildlife Service staff to coordinate recovery of the Pacific coast population of the western snowy plover; developing and implementing management plans for publicly owned lands; assisting local governments and private land owners in developing habitat conservation plans, developing land use protection measures, and developing landowner agreements; and acquiring habitat where necessary. A key component of these efforts includes education and outreach to inform partners and the public about recovery needs and opportunities for the western snowy plover. Actions for outreach are included in the recovery action outline, and the Information and Education Plan (Appendix K) provides greater detail on implementing these outreach and education actions.

Participation of many different groups will be essential to achieve both short-term and long-term management for the western snowy plover and its habitat. The roles of various groups, potential conservation tools and funding available, and the Recovery Team's vision for participation and coordination of partners are further described below.

c. Annual monitoring of western snowy plover subpopulations and reproductive success, and monitoring of threats and effects of management actions in reducing threats, is essential for adaptive management and to determine the success of recovery efforts.

The recovery action outline describes monitoring for breeding, wintering, and migration areas both to determine whether population numbers and survival of western snowy plovers is increasing and whether threats continue to limit population increases. Additional research actions are also recommended to study certain threats

and develop management techniques and monitoring methods. Results from research and monitoring efforts will be used to develop, refine, and improve management of western snowy plovers and their habitat. Monitoring of demographic characteristics will be necessary to demonstrate that population goals in the recovery criteria are being achieved. Monitoring of threats and effects of management actions in reducing those threats also is essential in demonstrating progress toward recovery and ultimately will assist in threats analyses necessary to make a delisting determination.

2. Roles of Federal, State, Local, and Private Sectors

a. Role of Federal Lands

Federal lands administered by the U.S. Fish and Wildlife Service, National Park Service, U.S. Forest Service, U.S. Bureau of Land Management, the National Marine Sanctuary Program, U.S. Marine Corps, and the U.S. Departments of the Army (including Corps of Engineers), Navy, and Air Force are extremely important to the conservation of the western snowy plover. In California, breeding occurs on National Wildlife Refuge lands, Department of Defense lands, Bureau of Land Management lands, and National Park Service lands. In Oregon, the major Federal landowners are the U.S. Forest Service and Bureau of Land Management, although the State also has jurisdiction over much of the Federally owned area (from mean high tide to the vegetation line) through a recreational easement (E.Y. Zielinski and R.W. Williams *in litt.* 1999). In Washington, the breeding area at Leadbetter Point is within a National Wildlife Refuge.

Under section 7(a)(1) of the Endangered Species Act, Federal agencies are required to actively promote the conservation of listed species. The western snowy plover cannot be recovered simply through general habitat protection or complying with required section 7(a)(2) consultations. The western snowy plover must be actively monitored and managed for the purpose of recovery or its population size will decline. Federal agencies alone cannot assure recovery of the western snowy plover, but should have a leading role in monitoring and management efforts to assure survival and recovery of this species. Some Federal lands contain large areas of contiguous habitat, including adjacent inland areas that are easier to manage for conservation of natural resources than fragmented, linear strips of land that may be owned by states, counties, cities,

and private landowners. Protection of western snowy plovers and their habitat on Federal lands is important not only because of the direct benefits to plovers that use these areas, but also because plover protection programs on Federal lands frequently utilize state-of-the art management measures and therefore serve as examples to non-Federal landowners. The Federal Government also should take the lead in addressing the sensitive issue of predator control.

b. Role of State Lands

State lands administered by the California Department of Parks and Recreation, California Department of Fish and Game, Oregon Department of Fish and Wildlife, Oregon Parks and Recreation Department, Washington Department of Fish and Wildlife, Washington State Parks and Recreation Commission, and Washington Department of Natural Resources play an important role in conservation of western snowy plovers and their habitats. Intensive management for western snowy plovers occurs at a number of State-owned plover habitat areas. The western snowy plover cannot be preserved simply through general habitat protection. Western snowy plovers must be actively monitored and managed to achieve recovery goals on State lands or their population size will decline.

c. Roles of State and Local Governments

State and local government agencies, including state planning agencies and city and county planning and community resources departments, have the primary responsibility for overseeing land uses within their jurisdictions. Therefore, their involvement in future recovery planning and implementing processes is critical. All Appendix B locations should be identified as environmentally sensitive habitat areas requiring protective measures for the western snowy plover in state and local planning documents and zoning designations. Local coastal programs should be amended to include these areas. To facilitate this effort, Federal and State agencies managing western snowy plover habitat should provide technical assistance and information to local governments (see Actions 3.1.6, 3.1.7 and 5.2). We can provide detailed maps of current western snowy plover breeding and/or wintering locations; these maps will be updated periodically as needed.

d. Role of Municipal Lands

Regional, county, and city lands, including regional and municipal park districts, also serve a role in conserving breeding and wintering habitats for western snowy plovers. Because these areas frequently receive heavy pedestrian and recreational use, local jurisdictions with active public outreach programs can reach a large segment of the coastal community regarding the plover's status and habitat needs.

e. Role of Private Lands

Conservation efforts on private lands are needed for the survival and recovery of many listed and other sensitive species. Private landowners can also make important contributions to western snowy plover conservation through facilitating or allowing the monitoring of western snowy plover populations on their land and implementing protective measures.

3. Conservation Tools and Strategies

There are numerous conservation tools and strategies available to Federal, State, municipal, and private landowners interested in western snowy plover protection and recovery. Appendix H includes a summary of conservation tools and strategies that may be adopted by landowners, nonprofit organizations, and regulatory agencies to protect western snowy plover habitat.

4. Funding Sources

Appendix I includes a summary of some potential sources of funds for implementation of recovery actions for the western snowy plover. This list is not intended to be exhaustive, however, and other funding opportunities may also be available.

An essential mechanism for recovery of the western snowy plover is the development and implementation of participation plans for each of the six recovery units (see Action 3.1.2). A key element of these participation plans is the long-term commitment by participating agencies to seek annual, ongoing funding for western

snowy plover management and monitoring activities so that funding within agency budgets can be secured.

In many areas a significant portion of western snowy plover conservation resources are expended in efforts to minimize the adverse impacts of recreation. Often, the primary objective of signs, ropes, on-site interpretation, and enforcement is to manage the behavior of beach-goers such that impacts to western snowy plovers are reduced as much as possible. In areas that have suffered extensive habitat loss or degradation, such recreation management activities are an extremely high priority in order to protect the western snowy plovers using the limited habitat that remains. For some beach managers, much of the funding and staff time expended on recreation management in and near western snowy plover habitat comes from resources targeted for threatened and endangered species recovery. In absence of the need to coordinate and pay for recreation management activities, more of these limited conservation dollars and staff resources could be directed toward western snowy plover management actions such as biological monitoring, habitat restoration, and predation control.

This situation is unique in the experience of many resource biologists. More typically, avoidance, minimization, and mitigation measures are integral components of projects or programs that entail adverse impacts to sensitive resources, and the costs of these activities are regarded as part of the overall cost of the project or program. Applying this traditional construct to recreation projects and programs could significantly promote western snowy plover recovery in several ways. First, it would require impacts to western snowy plovers to be considered up front when planning beach access or other recreation projects. Second, it would encourage impact avoidance and minimization since such measures are often less expensive than mitigation. Third, it would promote involvement of recreation professionals in designing and implementing recreation management measures. And fourth, it would eliminate or reduce the diversion of biological resource management funds toward recreation management activities, thus enabling more of those dollars to be spent on western snowy plover recovery actions.

5. Coordination, Participation, and Working Groups

We strongly believe that a collaborative stewardship approach to the proactive management of listed species involving government agencies (Federal, State, and local) and the private sector is critical to achieving the ultimate goal of recovery of listed species under the Endangered Species Act. An essential mechanism to achieve recovery of the western snowy plover is the formation and maintenance of working groups for each of the six recovery units (Appendix A), (see Action 3.1.1). Representation from the full range of Federal, State, local, and private landowners and other parties who have a stake in western snowy plover conservation within each of these six recovery units is needed to advance the recovery actions recommended in this recovery plan. Working group membership should include land managers, environmental groups, user groups, and groups involved in conservation projects (including local chapters such as the National Audubon Society, Sierra Club, Native Plant Society, Americorps, California Conservation Corps, Boy Scouts, Surfrider Foundation, and other recreational use groups). These groups can provide large networks of volunteers who can be mobilized to assist public resource agencies in the implementation of management measures for protection and recovery of the western snowy plover.

Working groups for each of the six recovery units currently exist and convene annually for regional and rangewide meetings. Through evaluation, communication, and coordination, members of each of the six working groups should manage the western snowy plover population and monitor progress towards recovery. They should produce annual reports on population monitoring and the effectiveness of management activities for the working group and our Arcata Fish and Wildlife Office. Each of the six working groups should prepare a participation plan, thereby formalizing recovery implementation efforts and the intentions of responsible agencies to seek ongoing, annual funding for recovery implementation. The Recovery Coordinator should coordinate and communicate with each recovery unit to support recovery efforts and assure implementation of the recovery plan (see Actions 3.1 through 3.4, 6, and 7). The Recovery Coordinator also should coordinate with other western snowy plover survey efforts and assessments throughout the west and throughout North America. Coordination with these other efforts may provide valuable information on the status and distribution of the western snowy plover, as

well as valuable information on management actions that may benefit the Pacific coast population of the western snowy plover. A coordinated international conservation program with Mexico also should be established to protect western snowy plover populations and their habitat in that country (see Action 8).

B. RECOVERY UNITS

The Pacific coast population of the western snowy plover has been divided into six recovery units (Appendix A, Figures A-1 through A-7). Establishing recovery units with specific recovery goals for each recovery unit will assist in meeting the objective of ensuring that population increases are distributed throughout the western snowy plover's Pacific coast range. A recovery unit is a special unit of a listed species that is geographically or otherwise identifiable and is necessary to the survival and recovery of the entire listed entity. Recovery units are individually necessary to conserve genetic robustness, demographic robustness, important life history stages, or other features for long-term sustainability of the entire listed species. However, recovery units are not listed as separate entities and cannot be delisted individually. Each recovery unit must be recovered before the species can be delisted.

The resilience to extinction of a widespread species can be negated if the species is subjected to a new stress over a large area (Raup 1991:122, 182). For the western snowy plover the primary stresses that led to the listing of the species were the loss of habitat due to encroachment of European beachgrass and urban development. As a consequence of such widespread habitat loss and the subsequent reduction in the range and vigor of the species, the western snowy plover is now more vulnerable to environmental fluctuations and catastrophes that the species would otherwise be able to tolerate. Chance events such as oil and contaminant spills, windstorms, and continued habitat loss from European beachgrass expansion, described earlier in this plan, could now cause or facilitate the extirpation of the entire listed species or one or more of the breeding populations.

The recovery unit approach in this recovery plan addresses this risk to the long-term survival and recovery of the western snowy plover by employing two widely recognized and scientifically accepted goals for promoting viable populations of listed species: (1) creation or maintenance of multiple populations so that a single or series

of catastrophic events cannot destroy the whole listed species; and (2) increasing the size of each population in the respective recovery unit to a level where the threats of genetic, demographic, and normal environmental uncertainties are diminished (Mangel and Tier 1994; National Research Council 1995:91; Tear *et al.* 1993; Meffe and Carroll 1994:192).

In general, the larger the number of populations and the larger the size of each population, the lower the probability of extinction (Raup 1991:182; Meffe and Carroll 1994:190). This basic principle of redundancy applies to the western snowy plover. By maintaining viable populations at the breeding locations within multiple recovery units, the threats represented by a fluctuating environment are alleviated and the species has a greater likelihood of achieving long-term survival and recovery. Conversely, loss of one or more important breeding locations within a recovery unit could result in an appreciable increase in the risk that the entire listed species may not survive and recover. Because western snowy plovers tend to exhibit site fidelity, migration to new nesting sites could increase stress to breeding birds and reduce nesting success.

Therefore, when evaluating the potential impact of land management actions that may affect the western snowy plover, we will consider whether a significant loss of western snowy plover breeding or wintering habitat in one recovery unit --without adequate compensation alleviating the impacts of that loss-- would adversely affect the viability of the population in that recovery unit as well as the long-term viability of populations in other recovery units.

Several aspects of the biology and life history of the western snowy plover indicate that designation of recovery units is necessary to ensure the long term health and sustainability of the western snowy plover. A portion of the Pacific coast population of western snowy plovers do not migrate up or down the coast and are year round residents. Additionally, the majority of western snowy plovers that do migrate are site-faithful, returning to the same breeding areas in subsequent breeding seasons (Warriner *et al.* 1986, Stenzel *et al.* 1994). Western snowy plovers occasionally nest in exactly the same location as the previous year (Warriner *et al.* 1986). These two features indicate that the Pacific coast population of western snowy plover likely exhibits subpopulation and metapopulation structure (see also Appendix D).

Designation of separate recovery units across the range will ensure that metapopulation dynamics can be maintained for the species.

The area covered by the six recovery units encompasses all the known breeding and wintering sites for the Pacific coast population of the western snowy plover. In addition to exhibiting site fidelity to breeding locations, western snowy plovers also exhibit fidelity to wintering locations. In contrast to many migratory birds, winter migration of the Pacific coast population of western snowy plovers is not uni-directional. Western snowy plovers may move both north and south along the coast from breeding locations. Nesting birds from Oregon have wintered as far south as Monterey Bay, California, while birds from Monterey Bay in central California have wintered north to Bandon, Oregon and south to Laguna Ojo de Liebre in Baja California, Mexico (Page *et al*. 1995*a*). Nesting birds from San Diego County in southern California have wintered north to Vandenberg Air Force Base in Santa Barbara County and south to Baja California (Powell *et al*. 1995, 1996, 1997). Designation of separate recovery units, each essential to the recovery of the western snowy plover, will ensure that wintering and migratory habitat is distributed across the western snowy plover's Pacific coast range and is protected and managed to maximize western snowy plover population survival.

The six recovery units for the Pacific coast population of the western snowy plover are: (1)Washington and Oregon; (2) Del Norte to Mendocino Counties, California; (3) San Francisco Bay, California; (4) Sonoma to Monterey Counties, California; (5) San Luis Obispo to Ventura Counties, California; and (6) Los Angeles to San Diego Counties, California. These recovery units were designated partly based on gaps in distribution of western snowy plover breeding and wintering locations, and on gaps in available habitat along the coast. For example, a significant portion of the coast of Sonoma County and southern Mendocino County is rocky and composed of steep bluffs lacking beach, dune, or estuary habitat suitable for the western snowy plover. This area constitutes a gap in the distribution of breeding and wintering locations between recovery units 2 and 4. This situation is repeated along the coast of Monterey County, where a gap in western snowy plover locations and suitable habitat occurs between recovery units 4 and 5. Smaller gaps also occur between recovery units 1 and 2, and between recovery units 5 and 6. Recovery unit 3 is unique and has

been designated as a separate recovery unit because much of the habitat in the San Francisco Bay area consists of salt ponds and salt pond levees.

The six recovery units designated for the western snowy plover also vary significantly in numbers of breeding western snowy plovers. Recovery unit 5 supports the greatest number of western snowy plovers, approximately half of the U.S. population, and has the greatest amount of available suitable habitat. Recovery units 4 and 6 support, or have the potential to support, a lesser number of western snowy plovers, collectively about a third of the population. The population in Recovery Unit 3 is relatively lower but has potential to increase with intensive management of salt pond habitat. Recovery units 1 and 2 also support relatively low numbers of western snowy plovers, probably due to suitable habitat being lesser in extent and more widely separated, but represent about half of the geographic range of the Pacific coast population of western snowy plovers within the United States and provide essential wintering, migratory, and breeding habitats.

Collectively, recovery of western snowy plovers within each of the six recovery units is necessary to maintain metapopulation dynamics, ensure protection and appropriate management of wintering and migratory habitat, and ensure the long term health and sustainability of the Pacific Coast population of western snowy plovers across its current range.

C. RECOVERY GOALS AND OBJECTIVES

The goal of this recovery plan is to ensure the long-term viability of the Pacific coast western snowy plover population so that this population can be removed from the Federal list of endangered and threatened species. The specific objectives to achieve this goal are the major components of the recovery strategy described above:

1) Increase population numbers distributed across the range of the Pacific coast population of the western snowy plover;

2) Conduct intensive ongoing management for the species and its habitat and develop mechanisms to ensure management in perpetuity; and

3) Monitor western snowy plover populations and threats to determine success of recovery actions and refine management actions.

D. RECOVERY CRITERIA

Recovery criteria for the Pacific coast population of the western snowy plover include numeric subpopulation targets, reproductive productivity targets, and establishment of management actions. Under each of these three major recovery criteria are additional subcriteria that must be achieved in order to progress toward the major criteria or that must be achieved in order to determine whether the major criteria are being met. Subcriteria include completing development and implementation of population, demographic and threat monitoring programs, incorporating specific management actions into participation and management plans, and completing research actions necessary to refine management actions.

Recovery criteria in this recovery plan are necessarily preliminary and will need periodic reassessment because additional data upon which to base decisions about western snowy plover recovery are needed (*i.e.*, effective predator management techniques, effective restoration techniques, improved monitoring techniques, additional demographic information for some subpopulations). Research actions, monitoring programs, and periodic recovery implementation review are included as recovery actions in order to obtain this information. The completion of many of these actions have been incorporated into recovery criteria in order to ensure that new information is incorporated into recovery implementation decisions.

The recovery criteria recommend that the Pacific Coast population of the western snowy plover be maintained at 3,000 breeding birds. This population increase to 3,000 breeding individuals could occur within 25 years with intensive management of breeding and wintering sites (see Appendix D. Population Viability Analysis for Pacific Coast Snowy Plovers). This population level must be maintained for at least ten years. In addition, average annual productivity of at least one (1.0) fledged chick per male in each recovery unit must be maintained in the last 5 years prior to delisting. Forty years may be required to achieve these demographic components of the recovery criteria, assuming that mechanisms to assure long-term protection and

management of breeding, wintering, and migration areas necessary to maintain the subpopulation sizes and average productivity have been developed and are in place.

The Pacific coast population of the western snowy plover will be considered for delisting when the following criteria have been met:

Criterion 1. Monitoring shows that an average of 3,000 breeding adults distributed among 6 recovery units as specified below have been maintained for a minimum of 10 years:

Recovery Unit	*Subpopulation Size*
1. Washington and Oregon	250 breeding adults
2. Del Norte to Mendocino Counties, California	150 breeding adults
3. San Francisco Bay, California	500 breeding adults
4. Sonoma to Monterey Counties, California	400 breeding adults
5. San Luis Obispo to Ventura Counties, California	1,200 breeding adults
6. Los Angeles to San Diego Counties, California	500 breeding adults

Subpopulation sizes represent the best professional judgment of the Western Snowy Plover Recovery Team's technical subteam. Numbers are based on a site-by-site evaluation of historical records, recent surveys, and future potential (assuming dedicated, proactive management at breeding and wintering locations). Collectively, these numbers represent an approximately 70 percent increase in the Pacific coast population size from the time of listing. On a cumulative range-wide basis the recovery criteria are approximately 83 percent of the total of the "Management Goal Breeding Numbers" identified in Appendices B and C, which represent site-specific target populations under an intensive management scheme. The recovery criteria for population size and distribution for the Pacific coast population of the western snowy plover represent only a portion of its historical abundance and distribution.

To reach these subpopulation sizes will require proactive management to attain a level of productivity that will allow the population to grow. The population viability analysis (Appendix D) suggests that reproductive success between 1.2 to 1.3 fledglings per male per year, with adult survival of 76 percent and juvenile survival of 50 percent, provides a 57 to 82 percent probability of reaching a population of 3,000 western snowy plovers within 25 years. Enhancing productivity is critical to population growth. Once the population size criterion is met, a lower rate of productivity can sustain the population.

1a. A program is developed and implemented to monitor the western snowy plover breeding population and wintering locations (see Actions 1.1 and 1.2) to determine whether recovery unit subpopulation criteria are being achieved.

The monitoring program must include monitoring of population size and distribution, survival, and productivity. Monitoring population size and distribution are necessary as a means of measuring whether the recovery criterion is being met. Monitoring demographic characteristics such as survival and productivity also will be necessary to determine population trends and progress toward achieving the recovery criterion. The monitoring program should also assess whether management goals for breeding and wintering sites listed in Appendix B are being achieved. Collectively, the breeding management goal numbers are about 20 percent higher than the recovery criteria subpopulation sizes. Monitoring of individual sites will assist in determining the effectiveness of management actions and whether any refinements are necessary. Monitoring of wintering sites will assist in indicating whether survival of western snowy plovers is sufficient to make progress toward meeting breeding population size criteria.

When the species has recovered sufficiently to be delisted, the ongoing program of monitoring actions should be integrated into a post-delisting monitoring plan to cover a minimum of 5 years after delisting and ensure ongoing recovery and effectiveness of management actions. This monitoring plan should be developed and ready for implementation before delisting.

1b. A program is developed and implemented to monitor the site-specific threats identified in Appendix C (Action 1.3) and monitoring results are used to refine site-specific management actions identified in Appendix C.

In conjunction with monitoring of breeding subpopulation sizes and distribution and demographic characteristics, threats at each breeding and wintering site must be monitored in order to determine whether management actions are effective in increasing western snowy plover survival and reproduction. If threats continue limiting population increases, or additional threats are identified, management actions recommended in Appendix C may require modification.

1c. Management activities identified in Appendix C that are necessary to ameliorate threats and achieve increases in reproductive success, survival, and overall population size are incorporated into participation and management plans developed and implemented under Criterion 3.

Appendix C provides location-specific summaries of current management activities at western snowy plover breeding and wintering sites based on: 1) responses by public land managers and private conservation organizations to a survey prepared by the Recovery Team on western snowy plover management and beach use; and 2) supplemental information from the Recovery Team and from our field office staff. Appendix C also identifies additional management activities needed at each site to ameliorate threats and achieve management goals. These management recommendations are intended to provide preliminary guidance but additional management needs likely will be identified through monitoring, research, and site-specific experience.

1d. Research actions (Action 4) are completed and incorporated into management and participation plans and into monitoring plans.

Several research needs identified under Action 4 are necessary to refine and improve management activities for the western snowy plover and also to improve monitoring of western snowy plover population sizes, demographics, and threats. Improving and refining management actions will increase the effectiveness of management actions in increasing population numbers, survivorship, and productivity. Improved monitoring

techniques are needed to ensure that monitoring efforts are adequate to detemine whether recovery actions are successful and recovery criteria are being met.

Criterion 2. A yearly average productivity of at least one fledged chick per male has been maintained in each recovery unit in the last 5 years prior to delisting.

From currently available data, it is estimated that males must average one fledged young annually for population equilibrium (see Appendix D). Higher rates of productivity will be necessary to reach the target population size of 3,000 breeding adults. After this population size is achieved and maintained for a minimum of 10 years, a lower rate of productivity of one fledged chick per male will be necessary to maintain the population size at an average of 3,000 breeding adults. Monitoring programs developed and implemented under criteria 1a and 1b should continue throughout this period. We also assume that management designed to ameliorate threats (criteria 1c and 3) will continue through this period and after delisting.

Criterion 3. Mechanisms have been developed and are in place to assure long-term protection and management of breeding, wintering, and migration areas listed in Appendix B to maintain the subpopulation sizes and average productivity specified in Criteria 1 and 2.

Development of mechanisms to ensure long-term management and protection of western snowy plovers and their habitat are listed under Action 3, which outlines the recovery actions recommended to meet these recovery criteria. The recovery action outline section describes each action in detail. The recovery action outline lists all subactions necessary to fulfill the main recovery action. It also represents a prioritization of measures to be implemented. Completion of these actions will ensure that threats to western snowy plovers and their habitat are ameliorated and that management will continue after delisting to prevent a reversal of population increases.

3a. Working groups for each of the six recovery units are established.

Action 3.1 recommends the establishment of working groups for each recovery unit. Working groups should be diverse and include representatives from Federal, State, local, and private sectors. At present working groups are in existence for all recovery

units, and should continue to be maintained and meet regularly. The roles of the working groups are to coordinate and facilitate recovery efforts within each recovery unit, assess population trends, and carry out outreach activities.

3b. A participation plan for each recovery unit working group has been developed and implemented.

Each working group is tasked with developing a participation plan that delineates and prioritizes recovery activities within each recovery unit and for each location identified in Appendix B. These plans should identify the roles and responsibilities of each member of the working group and their commitments to carry out identified recovery actions.

3c. Management plans for all Federal and State lands identified in Appendix C have been developed and implemented.

Appendix C identifies the landowners of western snowy plover wintering and breeding sites. Many of the sites are owned or managed by Federal or State agencies. Development and implementation of management plans that incorporate the management goals and recommendations in Appendix C for all these sites are necessary to ensure that population goals are reached, threats ameliorated, and long-term protection and management of western snowy plovers and their habitat are in place.

3d. Mechanisms to protect and manage western snowy plover breeding and wintering sites identified in Appendices B and C are in place for all areas owned or managed by local governments or private landowners.

Appendix C also identifies many western snowy plover breeding and wintering locations that are owned or managed by local governments, private conservation organizations, or private landowners. These lands also require protection and management to ensure that population goals are reached, threats ameliorated, and long-term protection and management of western snowy plovers and their habitat are in place. Because of the diverse ownership and management of these lands, many different mechanisms may be used to ensure protection and management of these

locations. These mechanisms are further described in the recovery action outline and Appendices H and I.

3e. Public information and education programs are developed and implemented.

Outreach is a major component of developing and putting in place mechanisms to assure long-term protection and management of breeding, wintering, and migration areas listed in Appendix B. Outreach efforts will be needed to solicit participation of the many Federal, State, local, and private groups in recovery efforts and notify groups and individuals of recovery opportunities and incentives for the western snowy plover. Outreach efforts also must be used as a component of management of western snowy plovers and their habitats. These efforts will include informing the public and gaining their support for measures intended to protect western snowy plovers.

E. RELATIONSHIP OF RECOVERY ACTIONS AND CRITERIA TO THREATS

The goal of this recovery plan is to ensure the long-term viability of the Pacific coast population of western snowy plovers so that they can be removed from the Federal list of endangered and threatened species. The delisting process requires demonstrating that threats to the western snowy plover have been reduced or eliminated such that the species survival in the wild is assured. Table 8 lists the threats to the western snowy plover that have been identified during and since the listing process and indicates the actions and recovery criteria in the recovery plan that address each threat.

The western snowy plover faces multiple threats throughout its Pacific coast range. Major threats to the western snowy plover include habitat destruction and modification and lack of habitat protection mechanisms (listing factors A and D), disease or predation (listing factor C), and manmade factors that primarily result in disturbance or mortality of breeding birds (listing factor E). Effects of research on western snowy plovers (listing factor B) is also a threat but is comparatively minor and easily addressed through permitting processes. Many of the threats to western snowy plovers are interrelated or have complex interactions with each other. For example, coastal development that destroys or modifies habitat (listing factor A) also

results in increased disturbance from recreational activities (listing factor E) and in increased predator populations (listing factor C). Recovery actions and criteria therefore may address multiple threats.

The majority of threats to the western snowy plover, other than habitat destruction or modification, affect the western snowy plover's productivity (breeding success) and survival within otherwise suitable habitat. Criteria 1 and 2 are directed at determining whether the effects of threats on productivity and survival have been removed and expected population and productivity increases are being achieved. Threats addressed by these recovery criteria primarily fall under listing factors B, C, and E. Reduction and elimination of these threats, and the expected increases in productivity and survival, rely primarily on developing intensive management and monitoring programs for the western snowy plover. Criterion 3 is directed at achieving the management and habitat protections necessary to reduce and eliminate threats that fall primarily under listing factors A and D, but also address threats under listing factors B, C, and E that can be eliminated or ameliorated by ensuring long-term management.

Table 8. Threats to the Pacific coast population of the western snowy plover and steps within the recovery plan to reduce or eliminate threats.

Factor*	Threat	Action	Criterion
A	**The present of threatened destruction, modification, or curtailment of its habitat or range.**		
A*	Encroachment of introduced beachgrass and nonnative vegetation.	1.1-1.3, 2.2.1, 3.1-3.10, 4.1.1, 5.1-5.7	1b-d, 2, 3a-e
A*	Shoreline stabilization	1.1-1.3, 2.1, 3.1-3.10, 5.1-5.7	1b, 1c, 3a-e
A*	Urban development and construction	1.1-1.3, 2.1, 3.1-3.10, 5.1-5.7	1b, 1c, 3a-e
A	Dredging disturbance and tailings deposit	1.1-1.3, 2.1, 3.1-3.10, 5.1-5.7	1b, 1c, 3a-e
A*	Sand mining	1.1-1.3, 2.1, 2.2.2, 3.1-3.10, 5.1-5.7	3a-e
A	Beach nourishment with inappropriate design and/or sand type	1.1-1.3, 2.2.3, 3.1-3.10, 5.1-5.7	3a-e
A	Driftwood removal	1.1-1.3, 2.3.4, 3.1-3.10, 5.1-5.7	1b, 1c, 2 3a-e
A	Beach fires and camping	1.1-1.3, 2.3.3, 3.1-3.10, 5.1-5.7	1b, 1c, 2 3a-e

Factor*	Threat	Action	Criterion
A	Water course diversion, impoundment, or stabilization	1.1-1.3, 3.1-3.10, 5.1-5.7	1b, 1c, 3a-e
A	Habitat conversion for other species	1.1-1.3, 3.1-3.10, 5.1-5.7	1d, 3a-e
A	Operation of salt ponds	1.1-1.3, 3.1-3.10, 5.1-5.7	1b, 1c, 3a-e
B	**Overutilization for commercial, recreational, scientific or educational purposes.**		
B*	Egg collecting	1.1-1.3, 2.3.8	none, 1c
B	Studying and monitoring plovers	1.4, 1.5, 3.1-3.2, 4.3	1a-d 2
B	Banding	4.6	1a-d
C	**Disease or predation.**		
C*	Introduced nonnative predators	1.1-1.3, 2.4, 4.2, 3.1-3.10, 5.1-5.7	1b, 1c, 2 3a-e
C	Increased populations of native predators due to human influences	1.1-1.3, 2.4, 4.2,3.1-3.10, 5.1-5.7	1b, 1c, 1d, 2, 3a-e
C*	Predator attractants	1.1-1.3, 2.4, 4.2, 3.1-3.10, 5.1-5.7	1b, 1c, 1d, 2, 3a-e
C	Predation by domestic and feral cats	1.1-1.3, 2.4, 4.2, 3.1-3.10, 5.1-5.7	1a-d, 2, 3a-e
D	**The inadequacy of existing regulatory mechanisms.**		

Factor*	Threat	Action	Criterion
D*	Limited habitat protection under the Migratory Bird Treaty Act and State laws	2.3.8, 3.1-3.10, 5.1-5.7	3a-e
D	Conflicting beach management methods and mandates	1.1-1.3, 2.3.8, 3.1-3.10, 5.1-5.7	1b, 1c, 3a-e
D*	Sections 404 of Clean Water Act and 10 of Rivers and Harbors Act apply to limited amount of habitat	2.3.8, 3.1-3.10, 5.1-5.7	1b-d 3a-e
D*	Lack of protection in Baja California, Mexico	8	
E	**Other natural or manmade factors affecting its continued existence.**		
E*	Loss of nests and habitat due to natural events	1.1-1.3, 1.6, 2.1, 2.2, 2.3.8, 3.1-3.10, 4.4, 4.5, 4.10	1b, 1c, 3a-e
E*	Disturbance by pedestrians	1.1-1.3, 2.3.1, 2.3.8, 3.1-3.10, 4.9, 5.1-5.7	1b, 1c, 2, 3a-e
E*	Disturbance by dogs	1.1-1.3, 2.3.1, 2.3.2, 2.3.8, 3.1-3.10, 4.9, 5.1-5.7	1b, 1c, 2, 3a-e
E*	Disturbance by motorized vehicles	1.1-1.3, 2.3.5, 2.3.8, 3.1-3.10, 4.9, 5.1-5.7	1b, 1c, 2, 3a-e

Factor*	Threat	Action	Criterion
E*	Disturbance by beach cleaning	1.1-1.3, 2.3.5, 2.4.1, 3.1-3.10, 4.9, 5.1-5.7	1b, 1c, 2, 3a-e
E*	Disturbance from equestrian traffic	1.1-1.3, 2.3.6, 2.3.8, 3.1-3.10, 4.9, 5.1-5.7	1b, 1c, 2, 3a-e
E	Disturbance from fishing activities	1.1-1.3, 2.3.3, 2.3.8, 3.1-3.10, 4.9, 5.1-5.7	1b, 1c, 2 3a-e
E	Disturbance by fireworks	1.1-1.3, 2.3.3, 2.3.8, 3.1-3.10, 4.9, 5.1-5.7	1b, 1c, 2, 3a-e
E	Disturbance by kites and model airplanes	1.1-1.3, 2.3.3, 2.3.8, 3.1-3.10, 4.9, 5.1-5.7	1b, 1c, 2, 3a-e
E*	Military exercises and aircraft overflights	1.1-1.3, 2.3.8, 2.3.9, 3.1-3.10, 5.1-5.7	1b, 1c, 2 3a-e
E	Large crowds associated with special events	1.1-1.3, 2.3.3, 2.3.8, 3.1-3.10, 4.9, 5.1-5.7	1b, 1c, 2 3a-e
E	Increased coastal access to beaches	1.1-1.3, 2.3.1.2, 2.3.8, 3.1-3.10, 4.9, 5.1-5.7	1b, 1c, 2 3a-e
E	Livestock grazing	1.1-1.3, 2.3.7, 2.3.8, 3.1-3.10, 5.1-5.7	1b, 1c, 3a-e

Factor*	Threat	Action	Criterion
E	Oil spills and disturbance from oil spill clean-ups	1.1-1.3, 2.5, 4.7, 5.6	1b-d 3a-e 1b, 1c, 2 3a-e
E	Environmental contaminants	1.1-1.3, 4.8, 5.6	1b-d, 3a-e
E	Litter, garbage, & debris	1.1-1.3, 2.3.8, 2.4.1, 3.1-3.10, 4.9, 5.1-5.7	1b, 1c, 2 3a-e
E	Urban runoff and impaired water quality	1.1-1.3, 2.1, 2.3.8, 3.1-3.10, 5.1-5.7	3a-e
E	Management for other special status species	1.1-1.3, 1.7, 2.6, 2.7, 2.3.3, 3.1-3.10, 4.2.2, 5.1-5.7	3a-e

* Indicates threats originally identified during the listing process.

III. NARRATIVE OUTLINE OF RECOVERY ACTIONS

1 **Monitor breeding and wintering population and habitats of the Pacific coast population of the western snowy plover to determine effects of recovery actions to maximize survival and productivity.** To assure the long-term viability of western snowy plover populations, their populations and breeding and wintering habitat should be monitored and managed in a systematic, ongoing fashion. Systematic, ongoing monitoring of breeding birds and wintering birds should be undertaken at the recovery-unit level to measure progress towards recovery and identify management and protection efforts that are needed. In addition to the known breeding sites, all known wintering locations (Appendix B) are considered currently important to western snowy plover conservation. These sites include both wintering locations that currently support breeding birds and locations that may potentially support nesting birds in the future. These locations also may support migrating western snowy plovers. There is a need for better information about wintering and migration sites, including spatial and temporal use patterns, feeding areas, habitat trends, and threats. Appendix C, Table C-1 identifies 147 locations where monitoring western snowy plover populations is occurring or recommended to achieve management goals.

1.1. Annually monitor western snowy plover abundance, population size, and distribution at breeding and wintering locations in each recovery unit using window surveys. Comprehensive range-wide window surveys of breeding locations and wintering locations (Appendix B) should be conducted annually to determine population trends and fluctuations, and to determine whether management goal breeding numbers (Appendix B) are being achieved. The window survey described in Appendix J (Monitoring Guidelines) should be employed as the primary index of population size to minimize the probability of double-counting birds nesting at multiple locations during the same season. Window surveys are conducted over a relatively short time period to minimize double-counting of birds that change location during the season, but may not fully account for all breeding or wintering birds. Window survey methodology should be improved and correction factors estimated (Action 4.3.1) to improve the

accuracy and utility of population indices. This correction may require some banding at sites where there are currently no marked birds on which to base correction factors.

1.2 Develop and implement a program to monitor western snowy plover productivity and annual survival in each recovery unit. Development and implementation of a program to monitor western snowy plover productivity and survival, in addition to comprehensive population size and distribution monitoring, is necessary to measure progress toward achieving recovery criteria and to assess the effectiveness of management in removing threats that affect nesting success and survival. Results from this monitoring program also may be used to update the population viability analysis and assess progress toward recovery goals (Actions 4.11 and 6). Monitoring productivity and survival likely will be much more intensive than monitoring population sizes and distribution (Action 1.1), and cannot be implemented at all breeding sites because of insufficient color band combinations to monitor the entire Pacific coast population. Plans for monitoring these demographic characteristics instead should utilize methods to sample demographic characteristics across the breeding range and in each recovery unit. Actions 4.3.2 and 4.3.3 recommend developing methodologies to estimate productivity and survival. The monitoring program should incorporate these methods and should specify the number of sites sampled in each recovery unit, how sites will be selected, and indicate control sites from intensively monitored breeding locations (*i.e.*, the coast of Oregon, extreme northern California, and the shoreline of Monterey Bay).

1.3 Develop and implement a program to monitor at all breeding and wintering sites the habitat conditions, disturbances, predation, and other threats limiting abundance of breeding and wintering birds, clutch hatching success, chick fledging success, and survival. Monitoring of threats to the western snowy plover is necessary to determine effectiveness of recovery actions in ameliorating or eliminating threats, assess progress toward recovery, and refine site-specific managements as necessary. A standardized threats monitoring program

should be developed and applied to all breeding and wintering sites in conjunction with monitoring developed and implemented under actions 1.1 and 1.2. At a minimum, monitoring should include determining substrate characteristics and vegetation composition (level of nonnative species), frequency and levels of disturbance (*e.g.*, recreational activities, pets, vehicles, horses), and presence and abundance of predators. Appendix J (Monitoring Guidelines) provides general guidance on monitoring but may require revision as research actions under action 4 are completed. Opportunities to incorporate monitoring into Federal activities subject to section 7 of the Endangered Species Act, such as dredging and discharges regulated by the U.S. Army Corps of Engineers, should be utilized when possible.

1.4 Develop and implement training and certification programs for western snowy plover survey coordinators and observers, consistent with recommendations in Appendix J (Monitoring Guidelines). Classroom and field training are required for observers who survey for western snowy plovers, and before we can issue a section 10(a)(1)(A) permit. Instruction programs and materials should be developed for comparable training to occur throughout the western snowy plover range to improve consistency of data collection. Classroom topics should include, but not be limited to: (1) biology, ecology, and behavior of breeding western snowy plovers; (2) identification of adult plovers, their young, and their eggs; (3) threats to plovers and their habitats; (4) survey objectives, protocols, and techniques; (5) regulations governing the salvage of carcasses or eggs; (6) special conditions of existing recovery permits; (7) field identification of potential western snowy plover predators; (8) biology and behavior of predator and scavenger species; and (9) other activities (*e.g.*, banding). Field training should include, as appropriate: (1) locating, identifying, and monitoring nests; (2) handling eggs and capturing and handling adults or chicks; (3) specifics on the target activity for which a recovery permit is to be issued, or under which an observer will work; (4) practical field exercises; and (5) field review of appropriate classroom topics.

1.5 Develop a submittal system for monitoring data to ensure consistent reporting among recovery units and sites, and annually review and revise the system as necessary. Initially, range-wide survey data will be limited to results from 2 annual window surveys. As population and demographic monitoring methods are developed and implemented (Actions 1.1, 1.2, 4.3.1, 4.3.2, and 4.3.3), a more sophisticated reporting and compiling system will be necessary. Our lead office should coordinate with researchers involved with monitoring to ensure that data collection, submittal, and entry systems remain current, include correction factors that account for lack of detections during surveys, and are consistent among recovery units and sites. An annual range-wide report should be developed and distributed to all interested parties. Additionally, consistent reporting of sightings of banded western snowy plovers is needed. Sightings of banded birds provide information on the wintering sites of breeding birds, use of multiple sites by breeding and wintering plovers, and survival and dispersal of adults and juveniles. In accordance with procedures of the U.S. Geological Survey, Bird Banding Laboratory, the Point Reyes Bird Observatory should continue to act as the color band coordinator for the Pacific coast population to avoid use of duplicate color banding schemes among researchers.

1.6 Assess and evaluate new breeding, wintering, and migration areas as they are discovered to determine threats and management needs and update lists of areas identified in Appendices B and C as data become available. As new western snowy plover breeding and wintering areas are discovered, data should be collected to assess site boundaries, habitat characteristics, population levels, and any significant threats. The current list of important breeding and wintering locations (Appendix B) should be expanded or refined as appropriate, and any new areas incorporated into management and monitoring plans. Areas determined to be important for migration through action 4.4.4 also should be evaluated and added to the list of areas requiring protection, management, and monitoring. Management goals and needed management to ameliorate or eliminate threats should be developed for all new breeding, wintering, and migration

areas and should be included in periodic revisions of Appendices B and C of this recovery plan.

1.7 Annually coordinate monitoring of western snowy plovers and California least terns to minimize effects of disturbance to both species. Coordination with least tern monitors and managers is needed in all areas where western snowy plovers share breeding sites with California least terns. Coordination should take place at biannual pre-and post-season California least tern monitoring meetings. Protocols for monitoring California least terns should be revised as necessary so that western snowy plovers are not detrimentally affected. Human activities within some least tern colonies in southern California include monitoring by one to four people several days per week; maintenance of tern fences; predator management; site preparation; and banding/observation efforts. Human activities associated with tern monitoring must be recognized as additional disturbance to western snowy plovers. Section 10(a)(1)(A) permits, issued under the authority of the Endangered Species Act for western snowy plovers and least terns, should include both species where applicable. Monitoring efforts for both species should be kept separate because of differences in monitoring techniques and species' behaviors. Monitors of least terns and western snowy plovers should be aware of species' differences in nest spacing, brood-rearing, foraging behavior, time of breeding, vulnerability to disturbance, and monitoring and banding techniques.

Western snowy plovers generally begin nesting at least 1 month before the arrival of breeding least terns; thus, tern management often begins well after western snowy plovers have initiated nests. Site preparation (vegetation removal and fence construction) should be coordinated to minimize disturbance to nesting western snowy plovers, and if possible to enhance breeding success for both species (as well as considering other sensitive species, including plants, that may be present). Predator management also should be coordinated to benefit both species.

1.8 Develop post-delisting monitoring plan. Prior to delisting a five-year monitoring plan should be developed. Methodology and scope of post-delisting monitoring should be appropriately integrated with existing monitoring efforts for continuity and comparability. Monitoring and research results should be used to guide the long-term conservation of the species.

2 Manage breeding and wintering habitat of the Pacific coast population of the western snowy plover to ameliorate or eliminate threats and maximize survival and productivity. The Pacific coast population of the western snowy plover is sensitive to changes in productivity and in adult and juvenile survival rates (see Appendix D). Furthermore, recovery of this species is contingent on intensive management of breeding habitat and availability of wintering habitat for more than the current number of western snowy plovers (see recovery criteria). Appendix C provides a summary of site-specific management needs at 155 breeding and wintering locations (actions 2 and 3). Management efforts may be time-consuming, costly, and sometimes require intensive management. Western snowy plover breeding habitat is extremely dynamic and factors affecting breeding success, such as types and numbers of predators, can change quickly; therefore, managers should be prepared to modify protection as needed. Action 6 recommends annual review of progress toward recovery and revision of site-specific management actions based on monitoring and research results and site-specific experience. Management and protection of western snowy plovers on Federal and State lands are especially important. In addition, protection on Federal and State lands furnishes leadership by example to local land managers. Land managers should recognize that components of breeding habitat include: areas where plovers prospect for nesting sites, make scrapes, lay eggs, feed, rest, and rear broods. Breeding habitat also includes travel corridors between nesting, resting, brood-rearing, and foraging areas. Wintering and migration habitats should also be monitored and managed to maximize survival and recruitment of western snowy plovers into the breeding population.

2.1 Maintain natural coastal processes that perpetuate high quality breeding and wintering habitat by incorporating the following recommendations into development of participation plans, management planning, and habitat protection (action 3) for the sites identified in Appendix C and any additional sites identified through surveys and monitoring. The dynamic nature of beach strand habitats as storm-maintained ecosystems should be recognized and allowed to function. Natural process that contribute to maintaining wide, flat, sparsely-vegetated beach strands preferred by western snowy plovers include: inlet formation, migration, and closure; erosion and deposition of sand dunes; and overwash and blowouts of beach and dune habitat. Coastal development, beach stabilization, construction of rock jetties and seawalls, sand removal and dredging, water diversion and impoundment, and planting of nonnative vegetation interfere with these processes and result in loss and degradation of habitat.

Maintenance of natural coastal processes can be accomplished through establishment of management plans, conservation easements, fee title acquisition, zoning, and other means. Coastal development, beach stabilization, resource extraction, and water diversion and/or impoundment projects should be carefully assessed for impacts to wintering western snowy plovers. Recommendations from U.S. Fish and Wildlife Service offices (under the Endangered Species Act and Clean Water Act) and/or State agencies should focus on avoiding or minimizing adverse impacts to wintering habitat. Where adverse effects cannot be avoided, agencies should document impacts so that cumulative effects on this species' habitat can be assessed and compensated. When beach development cannot be avoided, the following protections should be implemented: (1) construction should take place outside the nesting season, (2) developers and others should be advised during planning stages that stabilization of shorelines will result in additional habitat degradation and that these impacts may affect evaluation and issuance of permits under the jurisdiction of the U.S. Army Corps of Engineers or State coastal management agencies, and of measures to minimize the impacts, (3) property owners (*e.g.*, hotel or resort owners) should tailor recreational

activity on the beach and dunes to prevent disturbance or destruction of nesting western snowy plovers, their eggs, and chicks, (4) lights for parking areas and other facilities should not shine on western snowy plover habitat, (5) sources of noise that would disturb western snowy plovers should be avoided, and (6) the establishment of predator perches and nesting sites should be avoided when designing facilities. Appendix C, Table C-1 identifies 86 locations which currently have development restrictions in place and 16 locations where development should be restricted or avoided to achieve management goals.

2.1.1 Develop a prioritized list of western snowy plover wintering and breeding sites where natural coastal processes need protection, or where impaired natural coastal processes should be enhanced or restored. Recovery Unit working groups should evaluate the sites within their recovery unit and determine where natural processes are likely to be disrupted or are in need of being enhanced or restored, or are of particular importance to maintaining high quality western snowy plover habitat. Sites should be prioritized based on their importance to western snowy plover breeding and the degree of threat to the western snowy plover and its habitat should natural processes be disrupted.

2.1.2 Identify mechanisms necessary to protect, enhance, or restore natural coastal processes for the sites identified in action 2.1.1 and implement through incorporating into actions 3.1 -3.10. Mechanisms to protect, enhance, or restore natural processes may include development of management plans that prohibit or restrict activities that disrupt natural process (*i.e.* dredging or sand removal, recreational activities that contribute to excessive erosion or compaction), acquisition of habitat, landowner agreements, local land use protection measures, or enhancement activities. Identification of these sites and mechanisms should be used to guide implementation of long-term management and protection under action 3.

2.2 Create and enhance existing and potential breeding and wintering habitat. Past and ongoing impacts to western snowy plover breeding habitat from development, artificial beach stabilization, and other projects have resulted in loss and degradation of western snowy plover habitat. Habitat enhancement and creation are needed at multiple sites to offset these losses. Where impacts cannot be avoided, projects should remediate and compensate habitat loss and degradation by maintaining natural long-shore sand budgets and minimizing interference with natural patterns of sand accretion and depletion. When these types of projects are planned, complex natural sand movement patterns should be taken into account. Beach management policies should recognize that many current erosion and sedimentation problems are the result of past property and/or inlet "protection" efforts. Habitat restoration projects in historic or potential breeding sites, where feasible, is encouraged. Creation of habitat should be emphasized in areas not subject to recreational impacts.

2.2.1 Remove nonnative and other invasive vegetation from existing and potential habitat and replace with native dune vegetation. Land managers should implement remedial efforts to remove or reduce vegetation that is encroaching on western snowy plover breeding habitat or obstructing movement of chicks from nesting to feeding areas. Particular attention should be given to the eradication of introduced beachgrass (*Ammophila* spp.) within coastal dunes.

2.2.1.1 Develop and implement prioritized removal and control strategies for introduced beachgrass and other nonnative vegetation for each recovery unit. These strategies should include early intervention to prevent expansion into breeding areas where introduced beachgrass and other nonnative vegetation have not yet spread or are in early stages of spreading. Attention also should be given to the removal of giant reed, Scotch broom, gorse, iceplant, and shore pine. Remove/manage vegetation on salt ponds, including levees.

Schedule/coordinate removal efforts to avoid disturbing nesting western snowy plovers. Appendix C, Table C-1 identifies 86 locations where removal of nonnative and other vegetation is either currently occurring or needs to be initiated to achieve management goals.

2.2.1.2 Replace exotic dune plants with native dune vegetation where it is likely to improve habitat for western snowy plovers. Land managers should make special efforts to reestablish native dune plants in western snowy plover nesting habitat, while concentrating on removal of nonnative vegetation. Native dune vegetation includes American dunegrass (*Leymus mollis*), beach morning glory (*Calystegia soldanella*), pink sand-verbena (*Abronia umbellata*), yellow sand verbena (*Abronia latifolia*), beach bursage (*Ambrosia chamissonis*), grey beach pea (*Lathyrus littoralis*), whiteleaf saltbush (*Atriplex leucophylla*), and California saltbush (*Atriplex californica*). These efforts should be targeted for coastal dune sites that currently support nonnative vegetation species such as introduced beachgrass (*Ammophila* spp), and should be combined with removal of this invasive plant. Seeds of local native dune plants collected within approximately 32 kilometers (20 miles) of the site to be planted should be used as replacement plant stock. Revegetation efforts should be monitored to ensure that the amount of vegetative cover is compatible with suitable breeding habitat for plovers.

2.2.2 Deposit dredged material to enhance or create nesting habitat. Near-shore (littoral drift) and on-shore disposal of dredged material seems to be beneficial for perpetuating high quality western snowy plover nesting habitat in some instances and should be encouraged where appropriate. However, monitoring of habitat characteristics before, during, and after projects is needed, particularly in cases of

large operations occurring on sites where western snowy plovers nest or are deemed likely to nest following the disposal operation. On-shore disposal of dredged material should be scheduled outside the nesting season and, where possible, during seasons when birds are not present. In addition, dredged material must be clean sand or gravel of appropriate grain size and must be graded to a natural slope.

2.2.2.1 Evaluate western snowy plover breeding and wintering sites listed in Appendix C and potential breeding sites to determine whether dredged materials may be used to enhance or create nesting habitat. Recovery Unit working groups should identify sites where dredged material may be used to enhance or create nesting habitat. Evaluation of sites should include impacts (short- and long-term) to existing western snowy plover habitat, likelihood of use by western snowy plovers, whether appropriate sources of clean dredged material exist, and opportunities to utilize material from dredging projects.

2.2.2.2 Develop and implement plans, including pre- and post-project monitoring, to use dredged material to enhance or create nesting habitat at the sites identified in action 2.2.2.1. Plans to implement use of dredged material to enhance or create nesting habitat should be developed for sites identified in action 2.2.2.1. Plans should include measures to minimize impacts to western snowy plovers and existing habitat and should include pre- and post-project monitoring to determine effectiveness of the project in enhancing or creating nesting habitat.

2.2.3. Implement beach nourishment activities if action 4.1.2 indicates beach nourishment activities are effective in enhancing western snowy plover habitat. Beach nourishment activities have the potential to enhance western snowy plover habitat, but should be carefully evaluated to weigh the probable adverse and beneficial effects on plovers and on other sensitive coastal dune species.

2.2.3.1 Evaluate and identify sites where beach nourishment activities may be effective in creating and enhancing western snowy plover habitat. Potential sites include those sites where natural coastal processes have been disrupted (*i.e*. by coastal development, beach stabilization, construction of rock jetties and seawalls, etc.). Evaluation of sites should consider potential for adverse effects to existing western snowy plover habitat, whether appropriate sand sources are available, and whether long-term benefits are likely to occur.

2.2.3.2 Develop and implement beach nourishment plans, including pre- and post-project monitoring for the sites identified in action 2.2.3.1. Plans to implement beach nourishment activities to enhance or create nesting habitat should be developed for sites identified in action 2.2.3.1. Plans should include measures to minimize impacts to western snowy plovers and existing habitat and should include pre- and post-project monitoring to determine effectiveness of the project in enhancing or creating nesting habitat.

2.2.4 Create, manage, and enhance coastal ponds and playas for breeding habitat. Coastal ponds and playas, including salt ponds, should be enhanced and created to improve breeding habitat. Significant opportunities for management of nesting plovers currently exist within San Francisco Bay salt ponds, Moss Landing

Wildlife Area, Bolsa Chica wetlands, and south San Diego Bay salt ponds. However, salt ponds should only be created or enhanced at existing salt pond habitat; they should not be used for mitigation or compensation of coastal beach-dune or other western snowy plover habitats. Creation of habitat should be emphasized in areas that would preclude or reduce recreational impacts. Appendix C, Table C-1 identifies 15 locations where habitat enhancement is either currently in place or needs to be initiated to achieve management goals. Additional sites also may provide opportunities to enhance western snowy plover breeding habitat.

2.3 Prevent disturbance of breeding and wintering western snowy plovers by people and domestic animals. Disturbance by humans and domestic animals causes significant adverse impacts to breeding and wintering western snowy plovers. Because human disturbance is a primary factor affecting western snowy plover reproductive success, land managers should give the highest priority to implementation of management techniques to prevent disturbance of breeding birds. Western snowy plover breeding and wintering sites are highly variable in their amount of recreational activity. Land managers should conduct site-specific evaluations to determine whether recreational activities, domestic animals, and off-road vehicles pose a threat to plovers and implement appropriate measures. As information is gathered, it should be incorporated into conservation efforts. Management plans (Actions 3.3.1, 3.3.2, and 3.4) should include appropriate human/domestic animal access restrictions to prevent disturbance of western snowy plovers. Management techniques described below can reduce impacts of beach recreation on western snowy plovers, but they must be implemented annually as long as the demand for beach recreation continues.

2.3.1 Prevent pedestrian disturbance. Management measures to protect western snowy plovers should be determined on a site-by-site basis; factors to consider include the configuration of habitat as well as types and amounts of on-going pedestrian activity. On national wildlife refuges and State natural preserves within the

California State Parks system, where protection of wildlife is the paramount purpose of Federal and State ownership, western snowy plover habitat should be closed during the breeding season. Other areas also should be closed when necessary to adequately protect breeding western snowy plovers.

2.3.1.1 Restrict access to areas used by breeding western snowy plovers, as appropriate. Unless a beach is closed to public entry, or use is minimal, posting and/or fencing of nesting areas is recommended to discourage pedestrian use of the area and allow for plover courtship and prenest site selection, to prevent obliteration of scrapes, crushing of eggs or chicks, and repeated flushing of incubating adults. Any access restrictions should be accompanied by outreach programs to inform the public of any restrictions and provide educational material on the western snowy plover (see action 5).

2.3.1.1.1 Seasonally close areas used by breeding western snowy plovers. Dates of seasonal closures/restrictions should be based on the best data available, and be coordinated by geographic region for consistency in communicating with the public. Closures may be determined on a year-to-year basis and other options such as fencing may be considered first. To provide broods with access to foraging areas, closures should cover the area down to and including the water line, where practical. Areas where territorial plovers are observed also should be closed to prevent disruption of territorial displays and courtship. Because nests can be difficult to locate, especially during egg-laying, closure of these areas will also prevent accidental

crushing of undetected nests. Appendix C, Table C-1 identifies 81 locations where public access is either currently restricted or it is recommended it be restricted to achieve management goals.

2.3.1.1.2 Fence areas used by breeding western snowy plovers. Fencing to keep people and beach activities out of nesting/brood rearing areas should not hinder chick movements, unless fencing is specifically meant to keep chicks from being harmed. Areas with a pattern of nesting activity in previous year(s) or where territorial plovers are observed should be fenced before plovers begin nest-site selection. Because nests can be difficult to locate, especially during egg-laying, closure of these areas will also prevent accidental crushing of undetected nests. Symbolic fences (one or two strands of 1/4 inch plastic-coated steel cable strung between posts) with signs identifying restricted areas substantially improve compliance of beach-goers and decrease people's confusion about where entry is prohibited. On portions of beaches that receive heavy human use during the breeding season, fencing of prime brood-rearing areas to exclude or reduce numbers of pedestrians also should be implemented to contribute to the survival and well-being of unfledged chicks. Appendix C, Table C-1 identifies 64 locations where nesting areas are fenced or where fencing is recommended to achieve management goals.

2.3.1.1.3 Post signs in areas used by breeding western snowy plovers. Areas with a pattern of nesting activity in previous year(s) should be posted before plovers begin nest-site selection. On portions of beaches that receive heavy human use during the breeding season, posting of prime brood-rearing areas to exclude or reduce numbers of pedestrians also should be implemented to contribute to the survival and well-being of unfledged chicks. Appendix C, Table C-1 identifies 65 locations where exclusionary signs are in place or recommended to achieve management goals.

2.3.1.2 Locate new access points and trails well away from western snowy plover nesting and wintering habitat, and modify existing access and trials as necessary. Recreational users such as campers, clammers, anglers, equestrians, collectors, *etc.*, should be encouraged to consistently use designated access points and avoid restricted areas. Roads, trails, designated routes, and facilities should be located as far away from western snowy plover habitat as possible. Recreationists using boats should be restricted or prohibited from areas being used by the western snowy plover. Appendix C, Table C-1 identifies 67 locations where boat use is currently and/or is recommended to be prohibited or restricted, and 81 locations where access is currently and/or is recommended to be prohibited or restricted to achieve management goals.

2.3.1.2.1 Evaluate existing and planned access at all breeding and wintering locations and determine whether access may adversely affect western snowy plovers and their habitat. Review of access points should include evaluating level of and timing of use by recreational users and level of effects on the western snowy plover.

2.3.1.2.2 For sites where access is determined in action 2.3.1.2.1 to adversely affect western snowy plovers, develop and implement plans to minimize effects. Actions that could minimize effects of access include seasonal restrictions, signs, fencing, or relocation or modification of access points or trails.

2.3.2 Implement and enforce pet restrictions. It is preferable that land managers prohibit pets on beaches and other habitats where western snowy plovers are present or traditionally nest or winter because any noncompliance with leash laws can cause serious adverse impacts to western snowy plovers. If pets are not prohibited, they should be leashed and under manual control of their owners at all times. Pets should be prohibited on beaches and other western snowy plover habitats if, based on observations and experience, pet owners fail to keep pets leashed and under full control.

Land managers should document the type and frequency of infractions of rules and regulations requiring pets on leash. This information, including the number of verbal warnings, written warnings, and notices to appear (citations), should be documented so that comparisons can be made between locations. This documentation could help ensure that adequate effort is being

made to enforce pet regulations. Appendix C, Table C-1 identifies 120 locations where pets are currently prohibited or restricted and where they are recommended to be prohibited or restricted to achieve management goals.

2.3.3 Annually review existing recreational activities at breeding and wintering sites listed in Appendix C and develop and implement plans to prevent disturbance from disruptive recreational activities where western snowy plovers are present. Some recreational activities may disrupt western snowy plover breeding and foraging, attract predators, destroy nests, or degrade habitat. Management of a variety of recreational activities is needed to minimize these effects. Special events, including sporting events, media events, fireworks displays, and beach clean-ups, attract large crowds and require special attention. Special events planned in western snowy plover nesting areas should not be held during the plover nesting season. Early planning and coordination with local resource agencies should be emphasized. Fireworks should be prohibited on beaches where plovers nest. When fireworks displays are situated to avoid disturbance to western snowy plovers, careful planning also should be conducted to assure that spectators will not walk through and throw objects into plover nesting and brood-rearing areas. Sufficient personnel also must be on-site during these events to enforce plover protection measures and prevent use of illegal fireworks in the vicinity of the birds.

Flying of kites and model airplanes should be managed to avoid adverse impacts in areas where nesting plovers are present. Sports such as ball- and frisbee-throwing should be managed within hitting and throwing distance of western snowy plover nesting areas because of tendencies for stray balls and frisbees to land in closed areas where they can smash nests and where efforts to remove them can disturb territorial or incubating birds. Camping and beach fires should be prohibited in western snowy plover

nesting areas during the nesting season. Appendix C, Table C-1 identifies 11 locations where kites are and/or should be prohibited and/or restricted to achieve management goals, but additional recreational activities also should be reviewed for potential adverse effects to western snowy plovers.

2.3.4 Inform beach users of restrictions on driftwood removal through posting of signs. Driftwood removal should not be allowed unless needed to create sufficient open habitat to induce nesting activities. In such cases, driftwood removal should occur outside of the breeding season. Appendix C, Table C-1 identifies 26 locations where driftwood collection restrictions currently occur and/or are recommended for restriction to achieve management goals. Driftwood removal should also be minimized through enforcement as identified in Action 2.3.8.

2.3.5 Prevent disturbance, mortality, and habitat degradation by prohibiting or restricting off-road vehicles, including beach-raking machines. Recreational off-road vehicles should be prohibited or restricted at western snowy plover breeding areas, as appropriate. Violations associated with unauthorized entry of recreational off-road vehicles into closed or fenced nesting areas should be strictly enforced. During the nonbreeding season, enforcement of violations regarding recreational off-road vehicle use should continue where western snowy plover use of beaches occurs year-round. Because of potential habitat degradation caused by mechanized beach cleaning, alternatives to this type of beach cleaning are recommended, including manual beach cleaning by agency staff and volunteers knowledgeable about the need to maintain coastal dune habitat characteristics and to protect western snowy plovers. Appendix C, Table C-1 identifies 101 locations where off-highway vehicles are currently and/or recommended for prohibition or restriction to achieve management goals.

Essential vehicles within western snowy plover nesting areas should: (1) travel on sections of beaches where unfledged chicks are present only if absolutely necessary; (2) when possible, travel through chick habitats only during daylight hours; (3) travel at less than 8 kilometers (5 miles) per hour; (4) use a guide familiar with western snowy plovers; (5) use open four-wheel motorized off-highway vehicles or nonmotorized all-terrain bicycles to improve visibility; (6) avoid driving on the wrack (marine vegetation) line and during high-tide periods; (7) travel below the high tide mark and as close to the water line as is feasible and safe; and (8) avoid previous tracks on the return trip.

2.3.6 Implement restrictions on horseback riding in nesting areas through annual coordination with commercial and private equestrian operations and groups. Strategies to reduce adverse impacts to nests from commercial and private equestrian use of western snowy plover habitat should include: (1) use of designated trail systems or, when absent, use of the wet sand area in areas not closed to the water line; (2) advance coordination with local resource agencies regarding locations of nests and broods; (3) compliance with closed or restricted areas; and (4) informing riders of the need for restrictions to protect habitats used by western snowy plovers and other sensitive coastal dune species. Avoid high-tide periods. Violations regarding unauthorized entry into closed or restricted breeding areas by equestrians should be strictly enforced. Appendix C, Table C-1 identifies 72 locations where restriction or prohibition of horses currently exists or is recommended to achieve management goals.

2.3.7 Implement and enforce restrictions on livestock in nesting areas through annual coordination with land managers, landowners, and grazing lessees. Strategies to reduce adverse impacts to nests from livestock grazing in western snowy plover habitat should include: (1) advance coordination with local resource agencies regarding locations of nests and broods; (2)

compliance with closed or restricted areas; and (3) informing landowners of the need for restrictions to protect habitats used by western snowy plovers and other sensitive coastal dune species. Violations regarding unauthorized entry into closed or restricted breeding areas by livestock should be strictly enforced. Appendix C, Table C-1 identifies 18 locations where restriction or prohibition of livestock currently exists or is recommended to achieve management goals.

2.3.8 Enforce regulations in areas used by breeding western snowy plovers. Land managers should monitor violations and enforce regulations within all closed and restricted areas, with particular attention to areas where nests or broods are present.

2.3.8.1 Determine enforcement needs for western snowy plover breeding and wintering sites and provide sufficient wardens, agents, or officers to enforce protective measures in breeding and wintering habitat. Wardens are especially needed on heavily-used beaches during the peak recreational season, which coincides with the western snowy plover breeding season in many locations. Federal, State, and local authorities should provide a coordinated law enforcement effort to eliminate activities that may adversely impact western snowy plovers, such as illegally-parked vehicles, trespassing off-road vehicles, pedestrians, pets in restricted areas, illegal or unauthorized activities (*e.g.*, fireworks, beach fires, driftwood removal), pets off leash, and littering. Patrols and enforcement are needed to ensure compliance and to make sure restrictive measures are successful. Specific actions to be implemented include patrols in protected areas (see action 2.3.8.2) and car patrols to prevent illegal driving and parking. Appendix C, Table C-1 identifies 105 locations where

enforcement of regulations currently occurs or is recommended to occur to achieve management goals.

2.3.8.2 Develop and implement annual training programs for enforcement personnel and others who work in western snowy plover breeding habitat to improve enforcement of regulations and minimize effects of enforcement actions on western snowy plovers and their habitat. Federal, State, and local enforcement personnel and others who work in western snowy plover habitat should be trained to be familiar with the Endangered Species Act and other wildlife conservation statutes, and with the measures recommended in this recovery plan. Training, especially specific training for professional law enforcement agents regarding investigation of potential wildlife and Endangered Species Act violations, should be coordinated with local U.S. Fish and Wildlife Service Law Enforcement offices. It is essential that wardens, whether professional or volunteers, (1) be thoroughly trained in procedures for conducting patrols in a manner that minimizes risk to plovers; (2) have at least basic knowledge of western snowy plovers for public education purposes; and (3) be trained to handle potentially confrontational situations. *In cases involving take of listed species, it is essential that investigations be conducted only by trained, certified, and professional law enforcement agents.* Our local Law Enforcement office should be informed *immediately* whenever evidence of suspected take of western snowy plovers is encountered.

Enforcement personnel should be instructed in measures that can minimize effects of enforcement actions on western snowy plovers. Where the extent of habitat to be protected is large, making foot patrols infeasible, horses,

four-wheel all-terrain vehicles/off-road vehicles, or nonmotorized all-terrain bicycles, are preferred over trucks, automobiles, *etc*., because they afford improved visibility for operators. Except during emergencies, vehicle speed should not exceed 8 kilometers (5 miles) per hour and horses should be ridden at a walk only. In addition to providing maximum visibility for operators, horse and foot patrols by uniformed personnel have the added advantage of providing informational/educational interactions with beach visitors to promote compliance with plover protection measures.

Enforcement and emergency response personnel (such as search and rescue, and fire) should be well aware of potential western snowy plover locations. These locations should be named as avoidance areas as a part of their plans and training exercises. Enforcement patrols should use the same access trails as beach visitors; if additional access points are needed, they should be the minimum necessary and as far away from nesting plovers as possible.

2.3.9 Develop and implement a program to annually coordinate with local airports, aircraft operations, and agency aircraft facilities to facilitate compliance with aviation regulations regarding minimum altitude requirements. Each recovery unit working group should develop a list of local airports, aircraft operations, and agency aircraft facilities within each recovery unit. Working groups, land managers, and the U.S. Fish and Wildlife Service should annually inform them of western snowy plover breeding areas that should be avoided by aircraft operations or where minimum altitude requirements should be enforced to minimize disturbance of western snowy plovers. Aircraft operations within western snowy plover habitat should require a minimum altitude of 152 meters (500 feet) for aircraft and a possibly higher altitude for

helicopters. Aircraft operations that have already established guidelines allowing aircraft to fly under the 152-meter (500-foot) threshold should raise the limits to this minimum threshold or higher as needed. Exceptions such as use for low-altitude military training should be addressed in coordination with the appropriate Fish and Wildlife Office through section 7 consultation.

Ultralight aircraft are a new potential source for negative effects to the snowy plover. Ultralight aircraft landed on nesting plover beaches at Point Reyes National Seashore in 2003. These aircraft are sometimes associated with an airport but often are kept on ranches or other private lands (S. Allen *in litt.* 2004).

In addition, land managers should report suspected violations of aviation regulations in western snowy plover nesting areas during the breeding season. Suspected violations and the aircraft's registration number should be reported to law enforcement officers and, if appropriate, the Federal Aviation Administration. If not in violation of aviation regulations (*e.g.*, helicopters), a description of the helicopter should be reported to law enforcement officers so they can notify the operator of the presence of, and potential for take of, western snowy plovers in nesting areas.

2.4 Prevent excessive predation for western snowy plovers. Land managers should employ an integrated approach to predator management that considers a full range of management techniques. Managers may need to reevaluate and clarify their policies on the management of predator populations and/or habitat where predation might be limiting local western snowy plover populations. In particular, policies that prohibit management of native predator populations, even when human-abetted factors have caused substantial increases in their abundance, may be counter-productive to the overall goal of protecting "natural" ecosystems.

In addition to predator management activities by on-site biologists, assistance from the U.S. Department of Agriculture (Wildlife Services

Branch) biologists, State wildlife agency furbearer biologists, biologists specializing in avian predators, and professional trappers should be sought and used as needed and appropriate. Federal, State, and local agencies and the general public should be aware of the adverse consequences to listed species if needed predator control measures are prohibited or restricted. Appendix C, Table C-1 identifies 61 locations where predator control currently occurs or is recommended to achieve management goals. Below are specific means of predator control.

2.4.1 Manage litter and garbage and its removal to minimize attracting predators on western snowy plover habitat. Litter and garbage in western snowy plover habitat may increase predation of western snowy plovers by providing food that attracts predators and encourages increased predator populations. Appropriate management of litter and garbage, particularly in areas that receive heavy recreational use, is needed to prevent or minimize excessive predation.

2.4.1.1 Implement and enforce anti-littering regulations. Litter should not be allowed in western snowy plover breeding areas to avoid attracting predators. Littering ordinances should be enforced year-round.

2.4.1.2 Evaluate the effects of current litter and garbage management on predation of western snowy plover at breeding and wintering sites. All sites in Appendix C should be evaluated to determine whether garbage and litter affect predation on western snowy plovers by attracting predators.

2.4.1.3 Develop and implement garbage and litter management plans for all sites identified in action 2.4.1.2 where litter and garbage contribute to predation on western snowy plovers. Plans for managing litter and garbage should be incorporated into

long-term protection and management efforts developed and implemented under action 3. Beachgoers should be discouraged from leaving or burying trash or food scraps on the beach. Trash cans should not be located on the beach unless there is no other recourse to prevent littering. Emptying cans in the evening instead of leaving them overnight is preferable. Fish-cleaning stations should be located well away from plover breeding areas. Land managers should supply covered or scavenger-proof trash receptacles at access points and away from western snowy plover habitat, and receptacles should be routinely emptied. Until predator-proof trash containers can be installed, existing trash cans should be emptied frequently to reduce attractiveness and availability of their contents to scavenging predators. Land managers should also provide toilets at access points and away from western snowy plover habitat to discourage people from using the dunes.

Although removal of trash from the beach reduces predation threats, beach-raking should be avoided year-round to protect breeding and wintering western snowy plovers (see action 2.3.5). Beach-raking of western snowy plover habitat also should be avoided because it removes plover food sources. Trash should be selectively removed from the beach manually, but natural materials, including shells, kelp, and driftwood, should be left intact (see action 2.3.4).

2.4.2 Annually identify predator perches and unnatural habitats attractive to predators and remove where feasible. Planners should not allow unnatural habitats or other predator attractants to be placed near western snowy plover nesting locations. Where feasible, land managers should remove from western snowy plover breeding locations any exotic vegetation, perches, and other

features that attract avian and mammalian predators. Where signs and fences are necessary as part of management to protect plover breeding areas, attempts should be made to design them in a way that will deter their use by predators (*e.g.*, install spikes on fence posts).

2.4.3 Erect predator exclosures to reduce western snowy plover egg predation and improve productivity (number of fledglings per male) where appropriate. Guidelines for the use of predator exclosures to protect nesting western snowy plovers are contained in Appendix F. Exclosures are a valuable tool for countering human-abetted predation threats to western snowy plover eggs, but they are not appropriate for use in all situations, nor do they provide any protection for mobile plover chicks, which generally leave the exclosure within one day of hatching and move extensively along the beach to feed. Exclosures should be used in conjunction with an integrated predator management program. Also, exclosures must be carefully constructed, monitored, and evaluated by qualified persons. In some areas, avian predators have learned over time to associate exclosures with a source of prey (J. Buffa *in litt.* 2004). String (twine) or a more substantial plastic stealth material may be needed on top of exclosures to deter avian predators. Appendix C, Table C-1 identifies 53 locations where exclosures are currently used or recommended for use to achieve management goals.

The use of exclosures (small circular, square, or triangular metal fences that can be quickly assembled) to deter predator and human intrusion is recommended as one of the most effective management tools to protect nests (see Appendix F for exclosure protocols). However, it should be recognized that while exclosures provide nest protection, they do not ensure survival of chicks to fledging age and may contribute to predation on adults, so their use should be evaluated carefully and may not substitute for other measures

that reduce human disturbance (2.3) or control predation (2.4.1, 2.4.2, 2.4.3, 2.4.5).

2.4.4 Evaluate the need for and feasibility of predator removal and implement removal where warranted. Where predators have been identified through monitoring to adversely affect western snowy plover breeding success and/or survival and cannot be adequately controlled through use of exclosures, land managers should evaluate the need for and feasibility of predator removal. Removal of predators should be pursued where it is feasible, warranted, humanely conducted, and useful. Situations that may especially warrant predator removal include those where nonnative predators such as red fox (*Vulpes vulpes regalis*), feral cats, and Norway rats (*Rattus norvegicus*) are present, where predators have been introduced to islands, where predator range extensions have been human-abetted, or where high rates of western snowy plover adult, chick, or egg predation (which cannot be countered with predator exclosures or other aversion methods) are occurring. Nonnative predators should be lethally controlled in plover nesting habitat. Native predators should be removed or controlled by nonlethal means whenever possible. Gulls also should be discouraged from establishing and expanding nesting colonies at western snowy plover nesting areas, and land managers should determine whether existing gull colonies warrant removal. If removal is not warranted, exclosures around plover nests should be used to prevent large flocks of roosting gulls from trampling plover nests.

Federal and State permits must be obtained to legally capture, kill, or hold and release birds protected under the Migratory Bird Treaty Act and State laws. Also, individuals responsible for capturing such birds and the holding facility must have the proper Federal and State permits, and Federal land managers must document that such activities are in compliance with the National Environmental Policy Act. Biological considerations for determining whether

removal of avian predators is appropriate include the time of year (to assess whether the predator is caring for young or is a fledgling itself), whether the predatory bird is a resident or migrating through western snowy plover nesting habitat, and whether the predatory bird is a sensitive species or listed under the Endangered Species Act. Because of the potential for swift and significant losses of plovers by avian predators, land managers should plan in advance to complete the necessary procedures and secure needed permits to effectively deal with cases of high negative impact on western snowy plovers. If feasible, removal of native predators should focus on problem individuals rather than populations. Possible control methods include egg addling, nest removal, translocation of problem individuals, and holding in captivity with later release after plover breeding season. State permits must also be obtained as appropriate for the capture and removal of problem mammals (*e.g.*, raccoons, skunks, and opossums). In 2001, the California Coastal Commission determined that predator management in western snowy plover habitat on Vandenberg Air Force Base was also subject to Coastal Consistency review under the Coastal Zone Management Act.

2.4.5 Remove bird and mammal carcasses in western snowy plover nesting areas. Where practical and not disturbing to western snowy plovers, dead birds and mammals that wash up on the beach in close proximity to plover nests should be removed to reduce the attraction of predators to plover nests. Removal of carcasses of marine mammals and species listed under the Endangered Species Act should be coordinated with the National Marine Fisheries Service and the U.S. Fish and Wildlife Service.

2.5 Protect western snowy plovers and their breeding and wintering habitat from oil or chemical spills. Land managers should develop oil/chemical spill emergency response plans that provide for protection of known western snowy plover breeding areas. The U.S. Coast Guard should update their emergency response measures to include protective

measures for the western snowy plover. In the event of a spill in the vicinity of a western snowy plover nesting or feeding area, efforts should be made to prevent oil/chemicals from reaching these beaches. Clean-up operations should be prompt, but agencies should exercise special care during remediation efforts and coordinate closely with us to prevent accidental destruction of nests and/or excessive disturbance of breeding adults, nests, or chicks. Response plans should include applicable recommendations contained in this recovery plan (*e.g.*, Action 2.3.5 regarding essential vehicles).

Efforts must be made to minimize the likelihood of oil or chemical spills in plover wintering areas. Land managers should develop oil/chemical spill emergency response plans that provide for protection of known plover wintering areas. The U.S. Coast Guard should update their emergency response measures to include protective measures for the western snowy plover. Shorebird or coastal ecosystem protection plans developed by State or local agencies to address oil/chemical spills should also include protection measures for western snowy plovers. In the event of a spill in a known western snowy plover wintering area, efforts should be made to prevent oil/chemicals from impacting plovers and unavoidable impacts should be documented. Restoration efforts should begin expeditiously, but agencies should exercise special care and coordinate closely with us to prevent excessive disturbance to wintering western snowy plovers. Further, habitat restoration efforts must be conducted in compliance with the National Environmental Policy Act and the Coastal Zone Management Act.

If western snowy plovers or their habitat sustain injury due to oil/chemical spills, the responsible parties should restore the areas to their original condition or the Federal Government (U.S. Coast Guard) should lead the clean-up effort; appropriate claims should also be filed under the Natural Resource Damage Assessment regulations to recover damages and undertake relevant restoration work. Assessment of natural resource damages is facilitated by availability of baseline data on pre-spill conditions. Therefore, whenever possible, agencies that own or manage

western snowy plover habitat should collect baseline data on behavior, reproduction, distribution, abundance, and habitat use. The baseline information on plover distribution and habitat use should also be supplied to the Area Committees that develop and update regional spill contingency plans so that this information can be incorporated into pre-spill planning efforts for protection of sensitive environments and species. Oil spill emergency response personnel should be well aware of potential plover locations. These locations should be named as avoidance areas as a part of their training exercises. Appendix C, Table C-1 identifies 4 locations where contaminant removal is occurring or is recommended to achieve management goals.

2.5.1 U.S. Fish and Wildlife Service biologists should participate in Area Committees responsible for maintaining the Area Contingency Plans for the Pacific Coast to facilitate the updating of spill response plans to include protection of western snowy plovers. Active participation in the Area Committees would require funding for staff participation from the six U.S. Fish and Wildlife Service offices responsible for the coastlines of California, Oregon and Washington.

2.5.2 Assign monitors to beaches that are inhabited by western snowy plovers to protect western snowy plovers from injury during spill responses. Monitors would be responsible for identifying areas of beach that are in use by plovers and directing response personnel and vehicles around these sensitive areas. Potential monitors should be identified in advance, and, where necessary, retained under contract so they can begin work immediately in the event of a spill. Spill response may require approximately two weeks of cleanup work that should be monitored, with potentially five incidents of this magnitude per year.

2.6 Reduce adverse impacts of recovery efforts for other sensitive species, including those within the San Francisco Bay Recovery Unit, by compensating for the loss of western snowy plover breeding and wintering habitat. Management and recovery actions for other sensitive species carried out in western snowy plover habitat should be evaluated for adverse effects to western snowy plover habitat. All efforts should be made to conserve western snowy plover habitat and minimize adverse effects. Where this is not possible, any loss of western snowy plover habitat values should be compensated. Within coastal beach-dune habitats in Washington, Oregon, and California, compensation efforts should emphasize the removal of beachgrass (*Ammophila* spp.) for lost western snowy plover breeding habitat resulting from management for other sensitive species.

To compensate for the loss of existing western snowy plover breeding habitat values in San Francisco Bay from planned conversion to tidal marsh, appropriate salt ponds should be designated for protection and enhancement as western snowy plover breeding habitat. Currently, most western snowy plover breeding habitat occurs on levee roads, margins of active salt ponds, and pond bottoms of inactive salt ponds. Roads and levees provide lower quality habitat because of disturbance and ease of predator access. Any losses of western snowy plover breeding habitat should be replaced with habitat that provides similar or higher values (*i.e.*, salt ponds or salt pans) in concert with recovery actions implemented from the Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California (U.S. Fish and Wildlife Service in prep.). Habitat enhancement for western snowy plovers should be phased in with scheduled tidal marsh restoration for other listed species. During this interim period, land managers should make all efforts to achieve the recovery criteria of 500 breeding adults within the San Francisco Bay Recovery Unit by intensively managing existing western snowy plover breeding habitat.

Any replacement of western snowy plover breeding habitat in San Francisco Bay should concentrate on areas where the necessary components of western snowy plover breeding habitat can be created.

These areas include locations where unvegetated salt pans, salt ponds, islets and levees, and tidal mudflats/sandflats can be created or enhanced. Also, attempts should be made to avoid areas that are adjacent to landfills or other high concentrations of potential predators. Unless it is shown to be infeasible, creation and enhancement of western snowy plover breeding habitat should be emphasized in areas that currently support high numbers of breeding plovers and/or are not conducive to salt marsh restoration. The area to be managed for western snowy plovers should be sufficient to support a population of 500 breeding birds, estimated at 809 hectares (2,000 acres) of managed salt ponds. Most of these managed salt ponds should be located in South San Francisco Bay, which supports most of the existing western snowy plover population; however, some should also be located in the North Bay. Created or enhanced salt ponds should be intensively managed, similar to the Moss Landing Wildlife Area salt ponds. Management measures practiced at these salt ponds include maintenance of water control structures to maintain desired water levels, removal of excessive vegetation, and predator control.

2.7 Discourage pinnipeds from usurping western snowy plover nesting areas. Land managers should monitor pinniped colonies adjacent to western snowy plover breeding habitat and seek to keep breeding pinnipeds from occupying western snowy plover nesting areas during the breeding season where possible. Where conflicts occur, breeding pinnipeds should be discouraged from hauling out at western snowy plover breeding areas or be relocated, if feasible. Implementation of this action should be coordinated with the National Marine Fisheries Service to ensure compliance with the Endangered Species Act of 1973 and the Marine Mammal Protection Act of 1972 (16 U.S.C. 1361 *et seq.*).

2.7.1 In coordination with National Marine Fisheries Service, investigate feasibility and methods for discouraging pinniped use of western snowy plover nesting areas. Marine mammal populations have increased in many western snowy plover nesting areas. However, methods, effectiveness, and impacts of discouraging pinniped use of beaches are unknown and should be

investigated. Methods considered should be evaluated for their effects on western snowy plovers and their habitat as well as effectiveness in discouraging pinniped use. Workshops, such as those conducted by NMFS, for developing methods to reduce conflicts between pinnipeds and other species and human users should be held.

2.7.2 Identify areas where pinniped use is negatively affecting western snowy plover nesting and implement any appropriate methods identified in action 2.7.1. If effective methods are determined through action 2.7.1, sites where pinniped use negatively affects western snowy plover nesting should be identified and methods to discourage pinniped use implemented. Implementation of any methods to discourage pinniped use should be closely coordinated with the National Marine Fisheries Service to ensure compliance with the Endangered Species Act of 1973 and the Marine Mammal Protection Act of 1972 (16 U.S.C. 1361 *et seq.*).

3 Develop mechanisms for long-term management and protection of western snowy plovers and their breeding and wintering habitat. Long-term management and protection will be needed on Federal and non-Federal lands to meet recovery criteria for each recovery unit and to meet management goals for individual breeding and wintering locations. Development of long-term protection mechanisms should include opportunities for participation of various stakeholders in development of management options.

3.1 Establish and maintain western snowy plover working groups for each of the six recovery units to facilitate regional cooperative networks and programs. Development of regional cooperative networks and programs, coordinating local public and private land use planning with State and Federal land use planning, recovery planning, and biodiversity conservation is needed (Figure 12). To facilitate and develop regional cooperative programs, working groups have been established for each of the six recovery units and should be maintained. U.S. Fish and Wildlife

Service field offices should facilitate exchange of information among working groups. The working groups should be composed of representatives from the Federal, State, local, and private sectors; and meet regularly to assess western snowy plover population trends and coordinate plover recovery efforts. Each of the six working groups should use this recovery plan as a guide, but members will prioritize in cooperation with our Arcata Fish and Wildlife Office what management measures need to be implemented in their recovery unit because they have on-the-ground, day-to-day, experience about what is currently being done in these areas. Working groups should assist with updating information contained in Appendices B and C, tracking whether management goals are being met, and recommending changes in management goals and site-specific management actions, if necessary. Public outreach also should be a major focus of the working groups. An interchange of ideas between all six working groups should also occur on an on-going basis.

3.2 Develop and implement regional participation plans for each of the six recovery units that outline strategies to implement recovery actions. The 1994 Interagency Cooperative Policy on Recovery Plan Participation and Implementation Under the Endangered Species Act (U.S. Fish and Wildlife Service and National Oceanic and Atmospheric Administration 1994) provides for a participation plan process, which involves all appropriate agencies and affected interests in a mutually-developed strategy to implement recovery actions. Participation plans for implementing recovery actions for the western snowy plover that include all partners should be developed by each of the six recovery unit working groups. In addition to outlining a strategy to implement recovery actions, the participation plan should include strategies for evaluation of progress and needs for plan revision. Participation plans may also achieve the policy's goal of providing for timely recovery of species while minimizing social and economic impacts. Plans should identify and prioritize specific recovery activities for each location identified in Appendices B and C,while considering the needs of the entire Pacific coast population. They

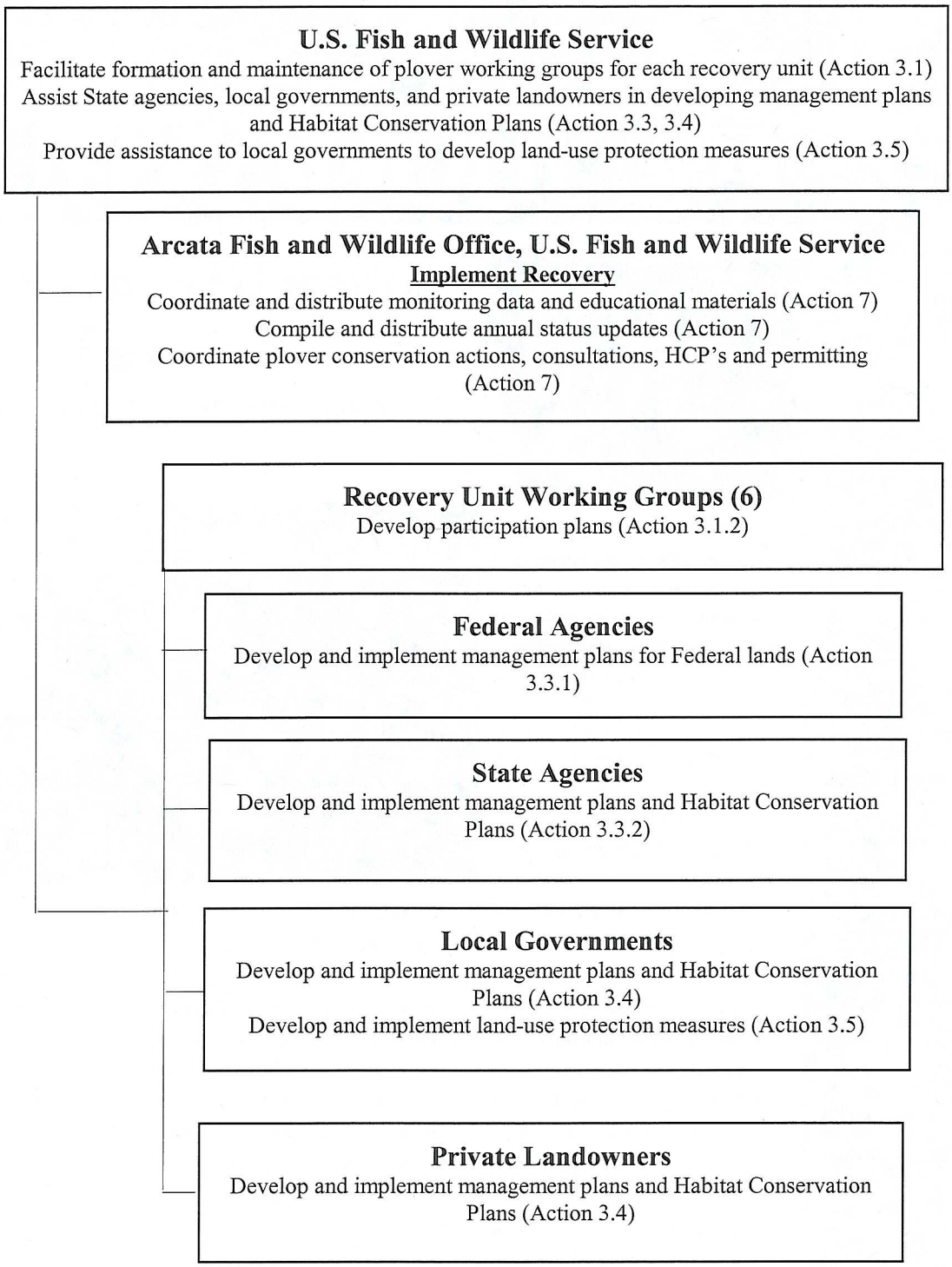

Figure 12. Chart of recovery planning and implementation efforts.

should include, but not be limited to: (1) endorsements by responsible agencies of their intent to seek economic resources for ongoing recovery actions; (2) outreach efforts to enhance the public's understanding of the western snowy plover's habitat needs (including an information and education strategy specific to area demographics and recreational activities); (3) economic incentives for conservation of western snowy plovers on private lands; and (4) all actions necessary to maintain western snowy plover productivity after delisting. Participation plans may also identify ways in which recovery actions for western snowy plovers will be covered as part of coastal ecosystem plans or other conservation measures.

3.3 Develop and implement management plans for all Federal and State lands to provide intensive management and protection of western snowy plovers and their habitat. Federal and State land managers should develop and implement management plans for all breeding and wintering locations (listed in Appendix B) that occur on Federal or State lands. Intensive management programs for western snowy plovers at national wildlife refuges should be implemented and annually evaluated to ensure they provide sufficient plover protection. Intensive management programs also should be implemented and periodically evaluated on lands administered by the National Park Service, U.S. Forest Service, U.S. Bureau of Land Management, U.S. Army Corps of Engineers, and Federal military bases, State wildlife areas, State ecological reserves, and State park lands (including State natural preserves and State seashores).

3.3.1 Develop and implement management plans for Federal lands. Federal agencies should develop or update, as appropriate, site-specific management plans that address threats to western snowy plovers, and adopt management measures for habitat protection and enhancement on Federal lands. Management plans should be implemented on an ongoing basis. Federal agencies also should review their proposed actions under the requirements of sections 7 and 10 of the Endangered Species Act prior to implementing the management plans because they may require authorization under section 7(a)(2) or 10(a)(1)(A).

3.3.2 Develop and implement management plans and habitat conservation plans on State wildlife areas, State ecological reserves, and State beaches. State agencies that manage State beaches, wildlife areas, or ecological reserves should develop and implement site-specific management plans and habitat conservation plans to minimize and mitigate impacts to western snowy plovers, and management measures for habitat protection and enhancement on State lands. State agencies should coordinate the development of habitat conservation plans with us and apply for section 10(a)(1)(B) permits under the Endangered Species Act if their management actions and allowed uses are resulting in incidental take of western snowy plovers.

3.4 Develop and implement habitat conservation plans or other management plans for western snowy plover breeding and wintering sites owned or managed by local governments and private landowners. We should provide assistance in the development of habitat conservation plans or other management plans to: (1) county and city governments that manage western snowy plover habitats; (2) private resource managers; and (3) owners of large amounts of private natural land. Habitat conservation plans are only required if an incidental take permit under section 10(a)(1)(B) of the Endangered Species Act is desired or required.

3.5 Provide technical assistance to local governments in developing and implementing local land use protection measures through periodic workshops. Federal and State agencies should assist local governments with jurisdiction over western snowy plover habitats in developing western snowy plover protection policies as part of new or revised local general plans, zoning policies, implementing measures, land use plans, comprehensive plans, and local coastal programs. For areas where beach closures are necessary, appropriate ordinances, administrative rules, and regulations should be developed by State and local governments to enable law enforcement officers to conduct necessary enforcement actions.

Technical assistance such as maps of western snowy plover habitats, identification of local threats, and recommended site-specific protective measures should be provided to coastal planners. At least two workshops within each recovery unit that provide local governments with basic information on the western snowy plover, its habitats, threats, and recommended protective measures should be conducted during the first 10 years of recovery plan implementation. Additional technical assistance likely will be required but should be provided on an as needed basis as new or revised general plans, policies, ordinances, and other land use protection measures are developed.

3.6 Develop and implement cooperative programs and partnerships with the California State Coastal Commission, the Oregon Department of Land Conservation and Development, the Washington State Parks and Recreation Commission, the Oregon Parks and Recreation Department, the California Department of Parks and Recreation, and the Oregon Department of Fish and Wildlife to ensure that they use their authorities to the fullest extent possible to promote the recovery of the western snowy plover. Federal and State agencies should assist the California State Coastal Commission, Oregon Department of Land Conservation and Development, Washington State Parks and Recreation Commission, Oregon Parks and Recreation Department, California Department of Parks and Recreation, and Oregon Department of Fish and Wildlife in reviewing, updating, and amending local coastal programs and policies for consistency with the western snowy plover recovery plan. This review should include protection of western snowy plover habitats, cumulative impacts to western snowy plovers, and policies or restrictive measures recommended in this recovery plan.

3.7 Obtain long-term agreements with private landowners. Agreements between Federal and State agencies and private landowners interested in western snowy plover conservation should be developed and implemented. Landowners should be informed of the significance of plover populations on their lands and be provided with information about available conservation mechanisms, such as agreements and incentive

programs. For private lands with potential occurrences of western snowy plovers, permission should be sought from landowners to conduct on-site surveys. If surveys identify plover populations, landowners should be informed of their significance and offered incentives to continue current land uses that support species habitat. Appendix C, Table C-1 identifies 69 locations where landowner cooperation/cooperative agreements are occurring or are recommended to achieve management goals.

3.8 Identify and protect western snowy plover habitat available for acquisition. Federal, State, and private conservation organizations should protect western snowy plover habitat as it becomes available, through fee title or conservation easement, *etc*. We and other organizations should identify sites that may become available for acquisition, and we should continue to evaluate excess Federal lands for western snowy plover habitat and apply to acquire them as they become available. Each recovery unit working group should develop a list of priority properties for acquisition, and Federal, State, and nongovernmental organizations should work with land conservancy groups to implement land trades and acquisitions. Management plans for the western snowy plover should be developed during the land acquisition process.

3.9 Ensure that section 10(a)(1)(B) permits contribute to Pacific coast western snowy plover conservation. Recommendations contained in this recovery plan should guide the preparation of habitat conservation plans under section 10(a)(1)(B) of the Endangered Species Act for western snowy plovers on the Pacific coast by providing information to: (1) guide potential applicants in developing plans that minimize and mitigate the impacts of take and (2) assist us in evaluating the impacts of any proposed conservation plans on the recovery of the Pacific coast western snowy plover population. The section 10(a)(1)(B) permit process may be a valuable mechanism for developing the long-term protection agreements called for in Actions 3.3.2 and 3.4, especially where significant population growth has already occurred and productivity exceeds l.0 fledged chick per male.

3.10 Ensure that consultations conducted pursuant to section 7 of the Endangered Species Act contribute to Pacific coast western snowy plover conservation. The recovery plan should also guide the evaluation of impacts to western snowy plovers pursuant to section 7(a)(2) of the Endangered Species Act. In evaluating these impacts, we and other Federal agencies should consider each of the breeding and wintering locations listed in Appendix B as important for recovery, and should also refer to the management goal breeding numbers for applicable locations and determine how the proposed project will affect those goals. Coordination with military bases which have western snowy plover populations is important to ensure that military activities do not affect the western snowy plovers or their habitat. Appendix C, Table C-1 identifies 54 locations where military uses are either restricted or recommended for restriction to achieve management goals.

4 Undertake scientific investigations that facilitate recovery efforts. Major gaps remain in our understanding of useful protection measures and conservation efforts for the western snowy plover. These include effective methods for habitat restoration, predator control, and monitoring population numbers and demographic characteristics.

4.1 Investigate effective methods for habitat restoration.

4.1.1 Evaluate the effectiveness of past and ongoing methods for habitat restoration by removal of introduced beachgrass and identify and carry out additional investigations necessary. Land managers, in coordination with recovery unit working groups, should summarize methods used to date for removal of introduced beachgrass and review their effectiveness. They also should pursue any additional field studies necessary to determine the most effective and cost-efficient methods for habitat restoration through removal of introduced beachgrass. Controlled studies with improved monitoring would provide needed direction for management decisions.

4.1.2 Evaluate the impacts and potential benefits of past and ongoing beach nourishment activities and identify and carry out any additional studies necessary to determine effects of beach nourishment activities on western snowy plover habitat. Beach nourishment activities should be carefully evaluated to weigh the probable adverse and beneficial effects on plovers and on other sensitive coastal dune species. Pre- and post-deposition beach profiles and faunal studies (including invertebrates) should be conducted to determine effects on habitat suitability for western snowy plovers. Consideration should be given to whether the projected long-term benefits are likely to occur.

4.2 Develop and test new predator management techniques to protect western snowy plover nests and chicks. Because many of the techniques currently used to reduce predation have disadvantages or limitations in effectiveness, new predator management techniques should be investigated. Assistance from the U.S. Department of Agriculture, Wildlife Services Branch, from State wildlife agency furbearer biologists, and other predatory bird and mammal specialists should be sought on these matters.

4.2.1 Develop higher-efficiency nest exclosures. Because exclosures must be deployed quickly, and currently-designed exclosures are heavy and labor- and time-intensive to erect, new exclosure designs should be tested. Prototypes should include lightweight materials that are easier to transport and a design that is easy to assemble and install.

4.2.2 Develop California least tern exclosures that prevent harm to western snowy plovers. Resource managers should continue to investigate modified designs for California least tern enclosures to further minimize western snowy plover mortality.

4.2.3 Identify, prioritize, and carry out needed investigations on control of native and nonnative predators. Aspects of the

ecology of problematic avian predators (*e.g.*, ravens and shrikes) and native mammals (*e.g.*, coyotes and gray foxes) that could be used to gain an understanding of how to control their impact on western snowy plover nesting areas during the plover breeding season should be investigated. Information also is needed on the applicability and usefulness of other control methods, including aversive techniques for conditioning predators to avoid foraging in western snowy plover nesting areas or preying on western snowy plover eggs, chicks, or adults. Investigation is also needed to develop methods to discourage gull colonies. Aversive techniques may include taste aversions, displaying predator carcasses, or installing electric fences. Effective modifications of signs and fencing to prevent their use as predator perches also requires investigation. While in many cases there appear to be practical obstacles to development of effective aversion techniques that can be efficiently applied in the field, the goal of reducing predation with minimum disruption to native predator populations that are important to overall ecosystem balance is desirable and any methods that appear potentially practical and useful should be evaluated for success and cost-effectiveness. Initial study trials might be done at sites or seasons where western snowy plovers are not present in order to minimize unplanned adverse impacts. Recovery unit working groups should identify and prioritize studies needed and inform us of their recommendations.

4.2.4 Identify, prioritize, and carry out needed investigations on predator management at the landscape level. Resource managers should investigate landscape-level management of predators that inhabit western snowy plover nesting areas. This management could include removal of predator nest sites and other predator attractants or habitat on lands surrounding western snowy plover breeding areas. Recovery unit working groups should identify and prioritize studies needed and inform us of their recommendations.

4.2.5 Investigate techniques for identifying predators responsible for individual nest predation events. Techniques should be developed to identify predators responsible for nest predation events so that appropriate management measures can be applied. Such techniques could include installation of a remote video camera to monitor western snowy plover nests and exclosures and identify problematical predators.

4.3 Improve methods of monitoring population size and reproductive success of western snowy plovers. Methods used to monitor western snowy plover populations have differed over time and from site to site. To measure progress toward recovery reliably, standard monitoring guidelines have been developed (Appendix J). Logistical and financial constraints likely will preclude complete coverage of all areas, so sampling methods should be developed.

4.3.1 Improve methods of monitoring western snowy plover population size. Not all western snowy plovers at a given location are detected during a single survey, such as the annual breeding-season window survey. Consequently, correction factors are necessary to extrapolate population size from window surveys. Correction factors are determined on a site-specific basis. Intensive monitoring and/or color banding make it possible to know the number of western snowy plovers present at a site. When a window survey is completed, the ratio of the total number of western snowy plovers to the number of western snowy plovers counted provides a correction factor that may be used for future window surveys of the site and for other sites with window surveys but without intensive monitoring. Site-specific correction factors should be obtained for all major nesting locations. When correction factors have been determined for many sites, patterns may emerge that allow correction factors to be applied more broadly.

4.3.2 Develop sampling methods for annually estimating reproductive success within each recovery unit. While it is extremely valuable to monitor clutch hatching success and chick fledging success at each site as a measure of habitat quality, it is critical to determine the number of young fledged per male for each recovery unit to measure the potential for population stability and growth. Measuring the number of young fledged per male requires intensive monitoring, and at sites with large numbers of birds, some method of identifying individual males. Extensive color banding of adults and their young, enabling determination of young fledged per male, has been undertaken in large portions of coastal Oregon, the shoreline of Monterey Bay, and coastal San Diego County for the past several years. These efforts should continue. Since there are insufficient color band combinations to monitor all individuals in every recovery unit, sampling procedures should be developed to color band adequate samples of males, and if necessary their chicks, in the other recovery units to obtain estimates of the number of young fledged per male. Color banding for measuring reproductive success should be integrated with banding for estimating population size.

4.3.3 Develop methods to monitor western snowy plover survival rates within each recovery unit. Extensive color banding of adult plovers and their young in coastal Oregon, the shoreline of Monterey Bay, and coastal San Diego County has enabled survival rates of adults and young to be calculated for several years (see Population Status and Trends and Survival sections). These efforts should continue. Information on survival rates of birds from other recovery units can be derived from birds banded for monitoring reproductive success or estimating population size.

4.4 Conduct studies on western snowy plover habitat use and availability.

4.4.1 Identify western snowy plover brood habitat and map brood home ranges. Brood movements should be mapped and distances

quantified to identify how large an area must be protected for broods. Determine home ranges of western snowy plovers through radio telemetry studies. Traditionally used brood habitat should be identified and protected through actions 2 and 3.

4.4.2 Identify components of high-quality western snowy plover brood rearing habitat. The elements of high-quality brood habitat should be determined to facilitate creation and enhancement of suitable characteristics at other breeding locations.

4.4.3 Quantify wintering habitat needs of western snowy plovers along the Pacific coast. The amount of habitat needed to support wintering western snowy plovers along the Pacific coast should be determined. This effort should include estimating the numbers of western snowy plovers that can be supported at wintering locations listed in Appendix B and identifying important site characteristics. This action will require consideration of wintering habitat quality along the Pacific coast of the United States and Mexico, and quantifying the combined interior and coastal populations.

4.4.4 Identify any important migration stop-over areas used by migrating but not by breeding or wintering western snowy plovers. Additional information on western snowy plover migration patterns is needed because migration involves expenditure of energy that may affect survival or productivity. Although monitoring and protection of breeding and wintering locations are currently higher priorities than protection of migration sites, further investigations of, and protective measures for, migration sites should be undertaken when feasible. Threats and management needs of identified migration stop-over habitat should be evaluated and included in management monitoring, and protection tasks (see action 1.6).

4.5 Develop and implement a research program to determine causes of adult western snowy plover mortality, including investigation of possible causes, magnitude, and frequency of catastrophic mortality. Determine causes of mortality and the stage in the annual cycle (*e.g.*, post-breeding, migration, winter, pre-breeding, breeding) at which mortality occurs for each sex and age class. This assessment can be done through intensive, bi-weekly monitoring to determine relative health and potential for disease. Monitoring could include fat content and weight related to the season.

4.6 Improve techniques for banding western snowy plovers. Improve the technique for banding birds to reduce injuries. Because western snowy plover injuries are usually associated with Federal metal bands but not with plastic bands, removal of U.S. Fish and Wildlife Service lettering from the inside of the metal band should be investigated. Eliminating use of the U.S. Fish and Wildlife Service metal band also should be considered. Experimentation with new techniques must be conducted cautiously and may need to include pre-testing on nonlisted surrogate species.

4.6.1 Compile information regarding number and types of banding injuries to western snowy plovers to determine extent and causes of banding injuries. Several banding injuries to western snowy plovers have been reported. However, there is currently no consistent reporting of injuries to determine the extent or types of injuries. Working groups should compile information on banding injuries to use in determining the type and extent of the problem and in developing a course of action. Information collected should include number of injuries, type of injury (abrasion, foot loss, broken leg, *etc.*), probable cause of injuries (foreign object lodged between band and leg, wearing of band, *etc.*), effect of injuries on behavior (breeding, foraging, predator avoidance), type of bands (plastic or metal) associated with injuries, whether metal bands had writing on the inside or other rough areas likely to cause abrasion or lodging of foreign object.

4.6.2 Review compiled information and determine and implement a appropriate course of action to minimize banding injuries. The information complied in step 4.6.1 should be reviewed to determine the appropriate course of action to minimize banding injuries. Review may reveal that banding injuries are rare or have little impact on breeding success or survival, in which case no changes to banding procedures may be necessary. However, extensive numbers of injuries or impacts on breeding success and survival may require actions such as changing the location of metal bands from the tarsus to tibiotarsus, discontinuing use of metal bands, or using different band types. All decisions regarding changes to banding procedures should consider effects of such changes to the type, quantity, and quality of data that may be gathered from banding efforts, and whether such changes will affect the ability to determine population trends, monitor success of management actions, or otherwise affect recovery efforts. For example, discontinuing use of metal bands may affect the ability to gather information on survival, longevity, and dispersal useful in analyzing population viability.

4.7 Identify effects of oil spills on western snowy plovers. Research should be conducted on the direct and indirect effects of oil spills on western snowy plovers, including, but not limited to: (1) how oil spills affect the plover's prey base; (2) chronic effects of oiling; (3) transmission of oil on partially-oiled birds from the breast to the egg; (4) at what stage oiled plovers need to be captured or re-captured; (5) preferable methods to remove oil from soiled birds; and (6) impacts to plovers during oil clean-up and remediation activities.

4.8 Monitor levels of environmental contaminants in western snowy plovers. When abandoned eggs and/or dead chicks that are not needed for law enforcement investigations become available, they should be collected for potential contaminants assessment. Egg removal and salvage of dead chicks should only be done by individuals possessing proper Federal and State authorizations. Chemical analysis of salvaged specimens should be

coordinated through our Division of Environmental Contaminants. All salvaged eggs should be analyzed for organochlorine pesticides, total polychlorinated biphenyls (PCB's), selenium, mercury, and boron.

All sampling should be opportunistic, based on availability of eggs that are known to be abandoned. Eggs should never be removed from the beach as long as there is any realistic chance that they might hatch. In the case of unhatched eggs from a partially hatched clutch, eggs should not be collected until at least 36 hours after the known hatch date of the other eggs. Full clutches should not be collected unless it is known that 35 or more days have elapsed since the last egg was laid. When this opportunistic sampling of failed eggs indicates potential problems with contaminants, follow up studies should be carried out (see action 4.9).

4.9 Design and conduct contaminants studies if monitoring of contaminants in action 4.8 indicates potential contaminants effects. When opportunistic sampling of failed eggs (action 4.8) indicates potential problems with contaminants, additional studies should be carried out to evaluate the extent of contamination in western snowy plover diets, its effects on nest success and egg hatchability, and its effects on various life stages of snowy plovers (eggs vs. adults). Thresholds when management action is required should be identified. When the target threshold is exceeded research should be conducted to identify the source.

4.10 Identify, prioritize, and carry out needed investigations of the effects of human recreation on western snowy plovers. Many studies on the effects of recreational activities on western snowy plovers have already been conducted. To avoid duplicating previous or ongoing efforts, recovery unit working groups should evaluate and prioritize additional study needs to determine the effects of human recreation on western snowy plover. Western snowy plover should be monitored for effects from recreational activities such as off-road vehicle riding, horseback riding, walking, jogging, fishing, aircraft, ultralight aircraft, and kite-flying.

4.11 Revise the population viability analysis (Appendix D), if needed, when sufficient additional information on demographic characteristics (survival rates, reproductive success) is available from each recovery unit and information is obtained on the probability and magnitude of catastrophic mortality events. As new information on population numbers, survival rates, and reproductive success are acquired from monitoring (actions 1.1 and 1.2), monitoring techniques are improved (action 4.3), and mortality sources and rates of mortality are determined (action 4.5), the population viability analysis should be reviewed and revised if additional information differs significantly from that used to construct the original analysis.

5 Undertake public information and education programs. Expanded efforts are needed to increase public awareness of the needs of western snowy plovers, other rare beach species, and the beach and dune ecosystem. Public outreach efforts should be a major focus of each of the working groups for the six recovery units. Appendix C, Table C-1 identifies 84 locations where public information and education is either currently occurring or is recommended to achieve management goals.

5.1 Develop and implement public information and education programs. Millions of beach recreationists come in contact with western snowy plover nesting and wintering areas each year. Disregard to signs, symbolic fencing, and leash laws by beach users can directly affect the productivity and health of western snowy plovers on those beaches. Public information and education efforts play a key role in obtaining compliance of beach recreationists with plover protection measures that, in turn, affect the birds' recovery. Central messages to the beach-going public include: (1) respect areas fenced or posted for protection of plovers and other rare beach species; (2) do not approach or linger near western snowy plovers or their nests; (3) if pets are permitted on beaches used by plovers, keep the pets leashed; (4) don't leave or bury trash or food scraps on beaches, as garbage attracts predators that may prey upon plover eggs or chicks; and (5) do not build wood structures that can be used as predator perches.

Because of the importance of information and education for the western snowy plover recovery effort, as part of this recovery plan, we developed an Information and Education Plan for the Western Snowy Plover, Pacific coast population (Appendix K).

5.2 Inform Federal, State, and local resource/regulatory agencies and local planning departments of threats to breeding and wintering western snowy plovers and their habitats. Periodic meetings and/or workshops should be held to inform Federal, State, and local resource management and regulatory agencies, and city and county planning departments about threats, research, and management needs for plovers. A network of public agency staff from each of the six recovery unit working groups should develop a coordinated approach to present this information to these agencies periodically, or as needed.

5.3 Develop and maintain updated information and education materials on western snowy plovers. Members of the six recovery unit working groups should develop new western snowy plover information and education materials for target audiences to stimulate public interest and awareness. In addition, all materials should be kept reasonably current regarding the status of the species and protection efforts. These materials should also explain the need for conservation of the beach and dune ecosystem and the plight of other rare beach-dwelling species. Videos detailing needed western snowy plover recovery actions by location and recovery unit should be developed, and might be efficiently produced in conjunction with updated public service advertisements.

5.4 Alert landowners and beach-goers about access restrictions within western snowy plover habitats. Land managers should begin providing informational and educational outreach at least 2 weeks prior to the onset of the nesting season to provide beach-goers and interested landowners with advance notice of impending restrictions on publicly-owned western snowy plover breeding habitats. This outreach is particularly important for the first year of restrictions. If necessary,

follow-up publicity that includes information on citations issued to violators should be implemented to help reinforce the message.

5.5 Provide trained personnel to facilitate protective measures, provide public education, and respond to emergency situations. Biologists, docents, volunteers, and other personnel should be trained to patrol western snowy plover nesting areas to monitor birds, distribute educational materials, respond to emergency situations, and ensure that beach-goers stay out of fenced areas and adhere to other plover protection measures. Biologists engaged in monitoring, management, or research activities should also advance the public's understanding of plover management needs.

5.6 Develop protocols for handling sick, displaced, injured, oiled, and dead birds or salvaged eggs. Land managers within each recovery unit should develop protocols for all trained personnel identifying who should be contacted when injured, dead, oiled, or displaced birds are found, and who is permitted to handle these birds. Federal and State salvage permits are necessary for the disposal of dead birds and the transportation of injured birds. Federal and State endangered species permits are necessary for wildlife rehabilitators to accept and care for injured and sick birds. Coordination with biologists that are monitoring and banding western snowy plovers is essential for capture and release of injured/rehabilitated birds. Live chicks that are found should not be moved or taken for rehabilitation as these chicks are often not abandoned, even though plover adults may not be obvious at the time the chicks are seen. Protocols should also be developed on how to collect and preserve salvaged eggs used for contaminants analysis.

5.7 Establish a distribution system and repository for information and education materials. Land managers must distribute information and education materials to target audiences. To reach the large population of potential beach-goers within a few hours' drive of many major metropolitan areas, broad-scale information and education mechanisms should be implemented, including distribution by mass media such as

newspapers, radio and television announcements, and internet web sites. Land managers should also focus their information and education efforts on user groups at beach parking lot entry stations and kiosks, visitor centers, marinas, beach-front housing developments, equestrian and angler access points, and locations providing off-road vehicle permits. Public outreach efforts should be directed to groups within the geographical location of the managed beaches (*e.g.*, to private and commercial equestrian users) and to groups outside of the area who use the beaches on a regular or seasonal basis (*e.g.*, to off-road vehicle associations from out-of-state or inland locations). Land managers, with the help of docents and volunteers, should coordinate with local school teachers to develop and present environmental education lesson plans and participatory activities for elementary and middle school groups.

We will act as a central repository for current and new information and education materials received; upon request, we will make these materials available to recovery unit working groups and the general public. We will also maintain information on western snowy plovers at our website (http://www.fws.gov/arcata). Major distributional efforts should also continue by Federal, State, and local agencies, and private conservation organizations.

5.8 Establish a reporting and distribution system for annual monitoring data and management techniques. Our Arcata Fish and Wildlife Office should coordinate and produce an annual report of submitted breeding and wintering monitoring data and distribute it to recovery unit working groups. This report should describe results of monitoring throughout the western snowy plover population's range. A distribution system should also be established for sharing information on predator management techniques, nest protection, etc. among working groups.

6 Review progress towards recovery and revise recovery efforts as appropriate. Communication, evaluation, and coordination play a major role in western snowy plover recovery efforts. Land managers within each of the six recovery unit working groups should review the effectiveness of their

management activities in coordination with other members of their working group, and revise management measures as appropriate. They should also provide results of annual population monitoring and the effectiveness of management activities to their working group and to our Arcata Fish and Wildlife Office.

6.1 Develop and implement a tracking process for the completion of recovery actions and the achievement of delisting criteria. A tracking process should be developed to track the completion of recovery actions and progress toward delisting. Utilizing information from specific actions, the recovery criteria such as the implementation of management activities can be tracked. Information from the tracking process can be used in outreach and in helping identify when the western snowy plover can be delisted.

6.2 Review progress toward recovery annually within each recovery unit working group and revise site-specific recovery efforts as appropriate to meet recovery goals. Communication, evaluation, and coordination play a major role in western snowy plover recovery efforts. Land managers within each of the six recovery unit working groups should review the effectiveness of their management activities in coordination with other members of their working group, and revise management measures as appropriate. They should also provide results of annual population monitoring and the effectiveness of management activities to their working group and to our Arcata Fish and Wildlife Office.

Additionally, the working groups in conjunction with land managers should review success in meeting management goal breeding numbers recommended in Appendix B, and develop recommendations for any necessary revisions to those numbers based on site-specific conditions. Ongoing and needed management activities recommended in Appendix C also should be evaluated and revised according to site specific conditions. Revisions to management goals and management activities should be provided to our Arcata Fish and Wildlife Office.

6.3 Assess the applicability, value, and success of this recovery plan to the recovery of the western snowy plover every 5 years until the recovery criteria are achieved. Rather than revising the entire recovery plan, it is proposed that minor revisions, clarifications, and prioritization changes be made through an addendum, to be produced and distributed every 5 years. This addendum would address data gaps identified in this version of the recovery plan including recommended management prescriptions, specific habitat management recommendations, management goal breeding numbers, directed surveys; and necessary changes discussed in previous recovery actions. It would provide a summary of the recovery actions implemented to date, and it would be a forum to solicit comments from the Recovery Team, stakeholders, and others interested parties on any proposed major changes. Major changes, elimination, or addition of recovery actions may initiate a revision.

6.4 Prepare a delisting package for the Pacific coast population of the western snowy plover. If actions 6.1 through 6.3 indicate recovery criteria have been met, actions to ameliorate or eliminate threats have been implemented and determined to be effective, and analyses of threats demonstrate that threats identified during and since the listing process have been ameliorated or eliminated, prepare a delisting package.

6.5 Prepare and implement a post-delisting monitoring plan. If delisting is warranted, prepare a post-delisting monitoring plan. Section 4 of the Endangered Species Act requires, in cooperation with the States, monitoring for a minimum of five years all species that have been recovered (*i.e.*, delisted).

7 Dedicate sufficient U.S. Fish and Wildlife Service staff for coordination of western snowy plover recovery implementation. Our Arcata Fish and Wildlife Office holds lead responsibility for coordinating implementation of western snowy plover recovery. We should assure that the Arcata Fish and Wildlife Office has sufficient staff to handle the primary responsibility of implementing the western snowy plover recovery plan. Duties should include

coordination and distribution of monitoring information and educational materials; transmission of copies of annual population monitoring results to our field offices that are responsible for western snowy plover issues; compilation and distribution of annual population status updates to all working groups; coordination with our other field offices in CNO and Region 1 regarding western snowy plover conservation actions, consultations, habitat conservation plans, and permits; facilitating coordination among the working groups created for the six recovery units; and fund raising to support recovery implementation actions.

8 Establish an international conservation program with the government of Mexico to protect western snowy plovers and their breeding and wintering locations in Mexico. Meeting the recovery goals outlined in this recovery plan is dependent only on actions recommended for implementation along the Pacific coast of the United States. However, other actions are identified for Mexico to complement conservation efforts in the United States. Efforts should be made to establish an international conservation program between the U.S. Fish and Wildlife Service and Mexico's National Institute of Ecology, Ministry of Environment, Natural Resources and Fisheries. Programs to facilitate implementation of this conservation program should include Partners in Flight, North American Waterfowl Management Plan, and the Borderlands Initiative.

8.1 Develop a joint effort between the United States and Mexico to protect western snowy plover populations and their habitat. Joint efforts should be implemented to determine important habitat in Mexico and protect these breeding and wintering locations from human disturbance.

8.2 Encourage research and monitoring of breeding and wintering western snowy plovers in Baja California, Mexico, by universities and authorities of Mexico. Joint efforts should be made to develop and implement a long-term monitoring program for western snowy plover populations of Mexico. They should include developing methods for consistent monitoring, coordination of banding and color-marking with

banders from the United States, assessment of the population status of breeding and wintering birds, and assessment of environmental impacts that may adversely affect plover populations.

8.3 Encourage development and implementation of public information and conservation education in Mexico for western snowy plovers. Public information and educational efforts should be coordinated and implemented by the United States and Mexico. They should include development of bilingual pamphlets for distribution to anglers, tourists, and local communities, and construction and placement of bilingual signs alerting them of the presence of nesting western snowy plovers.

9 Coordinate with other survey, assessment, and recovery efforts for the western snowy plover throughout North America. Western snowy plovers range through much of North America, and many individuals of the Pacific Coast population of western snowy plovers may overwinter in areas that overlap with other populations. Participation and coordination with other groups working on survey, assessment, and recovery efforts may yield valuable information on the distribution, status, and management needs for the Pacific Coast population of the western snowy plover. This coordination effort should be included in establishment of an international conservation program with Mexico.

IV. IMPLEMENTATION SCHEDULE

The following Implementation Schedule outlines actions needed, responsible parties, and estimated costs to recover the United States portion of the Pacific coast population of the western snowy plover. Considering the recovery criteria, results of the population viability analysis (Appendix D), and fulfillment of the recommendations contained in the recovery plan, recovery of the western snowy plover could occur in approximately 40 years. This time estimate assumes dedicated, proactive efforts toward improvements in western snowy plover management in the near-term, and subsequent management at a maintenance level commensurate with fulfillment of the recovery criteria.

The total cost of implementing actions outlined in this recovery plan over 40 years is $149,946,000. However, this figure represents only a portion of the overall costs because the cost of many actions cannot be estimated at this time. For example, costs associated with intensive protection and management on Federal and State lands (Action 3.3) should be determined by members of each of the six recovery unit working groups because they are most familiar with their site-specific needs and constraints. Costs of many actions were estimated based on current management recommendations provided in Appendix C. However, coastal ecosystems are dynamic and necessary management actions may vary with time, as site conditions change. Improvements over time in methods for predator control, control of nonnative vegetation, and monitoring are also expected and may affect actual costs.

It should be recognized that expenditure of funds for recovery of the western snowy plover will provide far-reaching benefits beyond those gained for a single species. Allocation of these funds will also benefit many other sensitive fish and wildlife species, the coastal beach-dune ecosystem, public appreciation for natural habitats, and aesthetics. These estimated costs do not reflect a cost/benefit analysis that incorporates other values or economic effects with implementation of the recommendations contained in this recovery plan.

We believe that protection and management costs could be substantially reduced by selecting protection strategies that are more restrictive of other beach uses.

While we believe that it is neither feasible nor desirable to completely eliminate beach recreation in most western snowy plover habitat, we also recognize that management strategies that protect western snowy plovers on beaches where public use is also maintained require a continuing commitment of person-power, and are inherently expensive.

The Implementation Schedule lists and ranks actions that should be undertaken within the next 5 years. This schedule will be reviewed routinely until the recovery objective is met, and priorities and actions will be subject to revision.

Key to Acronyms used in the Implementation Schedule

Definition of action priorities:

Priority 1 - An action that must be taken to prevent extinction or prevent the species from declining irreversibly in the foreseeable future.

Priority 2 - An action that must be taken to prevent a significant decline in species population or habitat quality, or some other significant negative impact short of extinction.

Priority 3 - All other actions necessary to provide for full recovery of the species.

Definition of action durations and costs:

Annual - An action that will be implemented each year.

Continual - An action that will be implemented on a routine basis once begun.

Ongoing - An action that is currently being implemented and will continue until action is no longer necessary.

As needed - An action that will be implemented on an "as needed" basis.

Unknown - Either action duration or associated costs are not known at this time.

To Be Determined (TBD) - Costs to be determined at a later date.

Responsible parties*:

ARMY	U.S. Army
BLM	U.S. Bureau of Land Management
CCC	California State Coastal Commission
CDFG	California Department of Fish and Game
CDPR	California Department of Parks and Recreation
CE	U.S. Army Corps of Engineers
CI	Cities
CO	Counties
CON	California Coastal Conservancy
EBRPD	East Bay Regional Park District
ES	U.S. Fish and Wildlife Service, Division of Ecological Services (includes Endangered Species and Contaminants)
FAA	U.S. Department of Transportation, Federal Aviation Administration
HARD	Hayward Area Recreation and Park District
IA	U.S. Fish and Wildlife Service, Office of International Affairs
LE	U.S. Fish and Wildlife Service, Division of Law Enforcement
LMAO	Land Management Agencies and Organizations and other Cooperators. (This category includes Federal and local land management agencies listed above, private organizations and individuals that own and manage snowy plover breeding and wintering habitat, and private conservation groups that provide on-site protection of lands owned by others.)
MPOSD	Mid-Peninsula Open Space District
MPRPD	Monterey Peninsula Regional Park District
NASA	National Aeronautics and Space Administration-Ames Research Center
NAVY	U.S. Navy
NMFS	National Marine Fisheries Service
NPS	National Park Service
ODFW	Oregon Department of Fish and Wildlife
ODLCD	Oregon Department of Land Conservation and Development
OPRD	Oregon Parks and Recreation Department

P	Private landowners (except HARD, MPOSD, and TNC)
PA	U.S. Fish and Wildlife Service, Public Affairs
PGH	Port of Grays Harbor
PO	Port of Oakland
PRBO	Point Reyes Bird Observatory Conservation Science
PSL	Port of San Luis Harbor District
RSCH	Research institutions and agencies
RW	U.S. Fish and Wildlife Service, Division of Refuges and Wildlife (includes Realty)
SDRPJPA	San Dieguito River Park Joint Powers Authority
TNC	The Nature Conservancy
TPL	Trust for Public Land
USAF	U.S. Air Force
USCG	U.S. Coast Guard
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
BBL	U.S. Geological Survey, Bird Banding Laboratory
BRD	U.S. Geological Survey, Biological Resources Division
USMC	U.S. Marine Corps
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WS	U.S. Department of Agriculture, Wildlife Services Branch
WSPRC	Washington State Parks and Recreation Commission

* All responsible parties listed for actions in Implementation Schedule are considered lead agencies for those actions.

IMPLEMENTATION SCHEDULE

Western Snowy Plover Pacific Coast Population Recovery Plan

Priority No.	Action Description	Action Number	Action Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
1	Annually monitor abundance, population size and distribution at breeding and wintering locations.	1.1	annual	LMAO, CO, CI, RSCH	2,194	54.9	54.9	54.9	54.9	54.9	Assumes 157 window survey days, with 2 biologists per location at. Action needed to determine fulfillment of recovery criteria.
1	Develop and implement a program to monitor productivity and annual survival.	1.2	annual	LMAO, CO, CI. RSCH	TBD						Action needed to determine fulfillment of recovery criteria. Depends partly on completion of 4.3.2 and 4.3.3.
1	Develop and implement a program to monitor habitat condition and threats at all breeding and wintering sites.	1.3	annual	LMAO, RSCH	1,125	60	27	27	27	27	Assumes initial cost for development of standardized monitoring program and subsequent monitoring for 155 sites.
3	Develop and implement training and certification programs for western snowy plover survey coordinators and observers.	1.4	continual	ES, LMAO, RSCH	363.5	32	8.5	8.5	8.5	8.5	Assumes initial cost to develop program and subsequent implementation.

Priority No.	Action Description	Action Number	Action Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
3	Improve submittal system for monitoring data to ensure consistent reporting.	1.5	continual	ES, LMAO, BBL, PRBO	346	32	8	8	8	8	Assumes initial cost to develop submittal and reporting system and subsequent annual review.
3	Assess and evaluate new breeding wintering and migration areas for threats and management needs and update lists as data become available.	1.6	continual	ES, LMAO, PRBO	TBD						Depends on results of annual surveys and monitoring.
3	Coordinate monitoring of snowy plovers and California least terns to minimize disturbances.	1.7	annual	ES, RW, NAVY, USMC, USAF, CDFG, CDPR, WS, BRD	1,020	25.5	25.5	25.5	25.5	25.5	Coordinate at biannual pre- and post-season California least tern monitoring meeting. Assumes 2 meetings at 2 days per meeting with 9 agency staff attending.
3	Develop a post-delisting monitoring plan.	1.8	TBD	ES, LMAO, CO, CI, RSCH	TBD						

Priority No.	Action Description	Action Number	Action Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
1	Develop a prioritized list of wintering and breeding sites where natural coastal processes need protection and/or enhancement.	2.1.1	2 yrs	ES, LMAO, CO, CI, RSCH	59.65	59.65					Assumes time to evaluate sites and development of the prioritized list.
1	Identify and implement mechanisms to protect, enhance or restore natural coastal processes.	2.1.2	continual	ES, LMAO, CO, CI, RSCH	TBD						Incorporate into ongoing management in action 3. Costs will depend on mechanisms identified and carried out.
1	Develop and implement prioritized removal and control for introduced beachgrass and other non-native vegetation.	2.2.1.1	continual	CE, LMAO, CO, CI	TBD						App C identifies 86 sites. Costs range for mechanical, manual and/or chemical control: $1,000 to $87,000/hectare ($400 to $35,000 per acre).
2	Replace exotic dune plants with native dune vegetation where it is likely to improve habitat.	2.2.1.2	continual	CE, LMAO, CO, CI	TBD						Estimated cost of planting native vegetation: $30,000 per hectare ($12,000 per acre). Number of sites to be determined.

Priority No.	Action Description	Action Number	Action Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
3	Evaluate breeding and wintering sites to determine whether dredged materials may be used to enhance or create nesting habitat.	2.2.2.1	2 yrs	CE, ES, LMAO, CO, CI	110	55	55				Assumes cost to evaluate each site.
3	Develop and implement plans to use dredged materials may be used to enhance or create nesting habitat.	2.2.2.2	ongoing	CE, ES, LMAO, CO, CI	TBD						Costs will depend on completion of acts on 2.2.2.1.
3	Identify sites where beach nourishment may be effective in creating and enhancing habitat.	2.2.3.1	2yrs	CE, ES, LMAO, CO, CI	110	55	55				Assumes cost to evaluate each site.
3	Develop and implement beach nourishment plans for site identified in action 2.2.3.1.	2.2.3.2	ongoing	CE, ES, LMAO, CO, CI	TBD						Cost dependent on number of sites identified in 2.2.3.1 and outcome of 4.1.1.

Priority No.	Action Description	Action Number	Action Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
1	Create, manage, and enhance coastal ponds and playas for breeding habitat.	2.2.4	ongoing	ES, RW, CE, CDFG, NASA, HARD, LMAO	TBD						App C identifies 15 sites. Costs dependent on type and area of restoration.
1	Seasonally close areas used by breeding snowy plovers.	2.3.1.1.1	annual	LMAO, CO, CON, CI	559.2	13.98	13.98	13.98	13.98	13.98	App C identifies 81 sites. Assumes cost to close these sites.
1	Fence areas used by breeding snowy plovers	2.3.1.1.2	annual	LMAO, CO, CON, CI	14,840	371	371	371	371	371	App C identifies 64 sites. Cost assumes 1 kilometer fencing required per site at a cost of $5,900 per kilometer.
1	Post signs in areas used by breeding snowy plovers	2.3.1.1.3	annual	LMAO, CO, CON, CI	202	5	5	5	5	5	App C identifies 65 sites. Cost dependent on number of signs needed at each site, but assumes cost for installation and a minimum of 4 signs at $20 per sign.
1	Evaluate effects of existing and planned access at all breeding and wintering locations and any new locations identified.	2.3.1.2.1	1 year	LMAO, CO, CI	455	455					Appendix C identifies 81 sites. Assumes cost to conduct use survey for the identified sites.
1	Develop and implement plans to minimize adverse access effects.	2.3.1.2.2	continual	LMAO, CO, CI	TBD						Costs depend on outcome of 2.3.1.2.1.

Priority No.	Action Description	Action Number	Action Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
3	Implement and enforce pet restrictions.	2.3.2	continual	LMAO, CO, CI	39,406	985	985	985	985	985	Appendix C identifies 120 sites Assumes staff time to implement and enforce restrictions at the identified sites.
1	Annually review recreational activities and develop and implement plans to prevent disturbance from disruptive recreational activities at breeding and wintering sites	2.3.3	annual	LMAO, CO, CI	21,948	549	549	549	549	549	Assumes staff cost to develop and implement plans at each site annually.
3	Prevent driftwood removal through posting of signs	2.3.4	continual	LMAO, CO, CI	1,805	50	45	45	45	45	Appendix C identifies 26 sites. Cost dependent on number of signs needed at each site, but assumes cost for installation and a minimum of 4 signs at $20 per sign.
1	Prevent disturbance, mortality, and habitat degradation by prohibiting or restricting off-road vehicles and beach-raking machines.	2.3.5	continual	LMAO, CO, CI	18,760	469	469	469	469	469	Appendix C identifies 101 sites. Assumes staff time for monitoring on weekends.
3	Implement restrictions on horseback riding through annual coordination.	2.3.6	annual	LMAO, CO, CI	1,033.7	25.8	25.8	25.8	25.8	25.8	Appendix C identifies 72 sites. Assumes staff time to implement restrictions.

Priority No.	Action Description	Action Number	Action Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
3	Implement and enforce restrictions on livestock through annual coordination.	2.3.7	annual	LMAO, CO, CI	255	6.3	6.3	6.3	6.3	6.3	Appendix C identifies 18 sites. Assumes staff time to implement restrictions.
1	Determine enforcement needs and provide sufficient wardens, agents or officers to enforce protective measures in breeding and wintering habitat.	2.3.8.1	continual	LE, LMAO, CO, CI	TBD						Cost will depend on identified enforcement needs.
3	Develop and implement training programs for enforcement personnel to improve enforcement of regulations and minimize effects of enforcement.	2.3.8.2	continual	LE, LMAO, CO, CI	320	8	8	8	8	8	Annual training cost estimate $8,000 per year.
2	Develop and implement a program to annually coordinate with local airports, aircraft operations regarding minimum altitude requirementss.	2.3.9	annual	LMAO, CO, CI, FAA, LE	339.8	8.5	8.5	8.5	8.5	8.5	Assumes staff costs per recovery unit to compile list and notify aircraft operations and facilities.
3	Implement and enforce anti-littering regulations.	2.4.1.1	annual	LMAO, CO, CI	TBD						Incorporate into ongoing management and Action 3.

Priority No.	Action Description	Action Number	Action Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
3	Evaluate the effects of current litter and garbage management on predation at breeding and wintering sites.	2.4.1.2	2 yrs	LMAO, CO, CI	110	55	55				Assumes evaluation time per site.
3	Develop and implement garbage and litter management plans where litter and garbage contribute to predation.	2.4.1.3	continual	LMAO, CO, CI	TBD						Costs will depend on 2.4.1.2 and plans developed.
3	Annually identify and remove predator perches and unnatural habitats attractive to predators.	2.4.2	continual	LMAO, CO, CI	375.2	9.4	9.4	9.4	9.4	9.4	Assumes staff time to complete action each year.
1	Erect predator exclosures to reduce egg predation and improve productivity.	2.4.3	annual	LMAO, CO, CI	18,266	456	456	456	456	456	App C identifies 53 sites. Assumes cost per unit installation.
1	Evaluate the need for predator removal and implement where warranted and feasible.	2.4.4	as needed	LMAO, CO, CI, WS, CDFG	TBD						App C identifies 61 sites for additional predator control. Costs dependent on assessment of needs and feasability.
3	Remove bird and mammal carcasses in nesting areas.	2.4.5	as needed	LMAO, CO, CI	TBD						

Priority No.	Action Description	Action Number	Action Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
1	U.S. Fish and Wildlife Service biologists should participate in Area Committees responsible for maintaining the Area Contingency Plans for the Pacific Coast to facilitate the updating of spill response plans to include protection of western snowy plovers.	2.5.1	annual	ES	5,154	128.9	128.9	128.9	128.9	128.9	Assumes staff time from the six ES office responsible for coastlines of CA, OR, and WA.
1	Assign monitors to beaches that are inhabited by western snowy plovers to protect western snowy plovers from injury during spill responses.	2.5.2	as needed	ES, USCG, LMAO, CO, CI	1,984	49.6	49.6	49.6	49.6	49.6	Assumes cost of two weeks of monitoring for five incidents per year.
2	Compensate the loss of plover breeding and wintering habitat associated with recovery efforts for other sensitive species.	2.6	ongoing	ES, RW, CE, LMAO	TBD						Costs dependent on effectiveness of minimizing habitat loss.
3	Investigate feasibility and methods for discouraging pinniped use of nesting areas.	2.7.1	5 yrs	ES, NMFS, NAVY, LMAO	320	64	64	64	64	64	Assumes staff time to investigate.

Priority No.	Action Description	Action Number	Action Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
3	Identify areas where pinniped use is negatively affecting nesting and implement any appropriate methods.	2.7.2	TBD	ES, NMFS, NAVY, LMAO	TBD						Costs dependent on number of sites identified and methods determined in 2.7.1.
1	Establish and maintain snowy plover working groups for each of the six recovery units.	3.1	continual	ES, LMAO, CO, C I, P	3,650	96	96	91	91	91	Essential mechanism to advance plover recovery. Includes biannual meeting costs and staff costs to establish new working groups.
2	Develop and implement regional participation plans for each of the six recovery units.	3.2	1 yr for develop-ment, continual thereafter	ES, LMAO	193		193				Assumes staff cost to develop and implement participation plans.
3	Develop and implement management plans for Federal lands.	3.3.1	ongoing	RW, ARMY, BLM, CE, NASA, NAVY, NPS, USAF, USMC, USFS	TBD						Implementation cost dependent on content of plans developed.

Priority No.	Action Description	Action Number	Action Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
3	Develop and implement management plans and Habitat Conservation Plans on State wildlife areas, State ecological reserves, and State beaches.	3.3.2	5 years	CDFG, CDPR, ODFW, OPRD, WDFW, WDNR, WSPRC	966	193	193	193	193	193	Assumes cost for each recovery unit to assist in development. Implementation cost to be determined.
3	Develop and implement Habitat Conservation Plans or other management plans for sites owned by local governments or private landowners.	3.4	5 years	ES, LMAO, CO, CI, P, EBRPD, HARD, MPOSD, MPRPD, PGH, PO, SL, TNC, SDRPJPA	966	193	193	193	193	193	Assumes cost for each recovery unit to assist in development. Implementation cost to be determined.
2	Provide technical assistance to local governments in developing and implementing local land use protection measures through periodic workshops.	3.5	10 years	ES, CCC, CDFG, CDPR, CON, ODFW, ODLCD, OPRD, WDNR, WDFW, WSPRC, CO, CI	TBD						Estimated at 2 workshops per recovery unit at a cost of $ (Patty Carol in RO)

Priority No.	Action Description	Action Number	Action Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
3	Develop and implement cooperative programs and partnerships with the California State Coastal Commission, the Oregon Department of Land Conservation and Development, the Washington State Parks and Recreation Commission, the Oregon Parks and Recreation Department, the California Department of Parks and Recreation, and the Oregon Department of Fish and Wildlife.	3.6	continual	ES, CCC, ODLCD, ODFW, OPRD, CDPR, WSPRC	TBD						Costs may vary from year to year based on identified program needs.
3	Obtain long-term agreements with private landowners.	3.7	12 years	ES, CDFG, P CDPR, ODFW, WDFW, WSPRC, LMAO	2,319	193	193	193	193	193	Assumes staff time to facilitate 6 agreements per year per recovery unit. Appendix C identifies 72 sites.
3	Identify and protect habitat available for acquisition.	3.8	ongoing	CON, ES, RW, LMAO	TBD						

Priority No.	Action Description	Action Number	Action Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
3	Ensure that any section 10(a)(1)(B) and section 7(a)(2) permits contribute to Pacific coast western snowy plover conservation.	3.9	ongoing	ES, Federal agencies	1,288	32`32	32	32	32	32	Assumes staff time for annual evaluation.
3	Ensure that section 7 consultations contribute to Pacific coast western snowy plover conservation.	3.10	ongoing	ES, Federal agencies	1,288	32`32	32	32	32	32	Assumes staff time for annual evaluation.
2	Evaluate effectiveness of habitat restoration by removal of introduced beachgrass and identify additional studies necessary.	4.1.1	continual	CON, ES, LMAO, RSCH	TBD						Depends on the number and location of sites as well as the temporal duration of the restoration project.
3	Evaluate the impacts and potential benefits of past and ongoing beach nourishment activities and identify and carry out any additional studies necessary.	4.1.2	ongoing	ES, LMAO, RSCH, CE, CI, CO	TBD						
2	Develop higher-efficiency nest enclosures.	4.2.1	ongoing	ES, LMAO, RSCH	20	10	5	3	2	0	Compare new exclosures with current ones to determine effects on snowy plovers.

Priority No.	Action Description	Action Number	Action Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
2	Develop California least tern enclosures that prevent harm to snowy plovers.	4.2.2	as needed	ES, USMC, CDFG, CDPR, LMAO, RSCH	TBD						Costs specific to sites with California least tern enclosures. Estimated cost for materials (fencing/posts): $7 per linear foot ($23 per meter).
3	Identify, prioritize and carry out investigations on control of predators.	4.2.3	as needed	ES, RW, LMAO, WS, CDFG, RSCH, CO, CI, P	TBD						Cost dependent on number and types of studies identified.
3	Investigate predator management at the landscape level.	4.2.4	as needed	ES, RW, LMAO, WS, RSCH, CO, CI, P	TBD						Costs dependent on number and types of studies identified.
3	Investigate techniques for identifying nest predators.	4.2.5	continual	LMAO, RSCH	TBD						
2	Improve methods of monitoring population size.	4.3.1	ongoing	ES, LMAO, RSCH	TBD						Dependent on costs of intensive monitoring of some sites.
2	Develop sampling methods for annually estimating reproductive success.	4.3.2	2 years	ES, RSCH	64	64					Assumes time to compile and review data and develop methodology.
3	Develop methods to monitor plover survival rates.	4.3.3	ongoing	ES, LMAO, RSCH	TBD						

Priority No.	Action Description	Action Number	Action Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
3	Identify brood habitat and map brood home ranges.	4.4.1	ongoing continual	ES, LMAO, RSCH, CO, CI, P	TBD						Costs dependent on study design. May include radio telemetry.
3	Identify components of high-quality brood rearing habitat	4.4.2	1 year	ES, LMAO, RSCH, CO, CI, P	131	131					Assumes study at 6 geographically representative sites for duration of breeding season.
3	Quantify wintering habitat needs along the Pacific coast.	4.4.3	5 years	ES, RSCH, BRD, PRBO	75	75					Assumes study at 6 geographically representative sites during winter months.
3	Identify important migration stop-over habitat.	4.4.4	ongoing	ES, LMAO	TBD						
3	Develop and implement a research program to determine causes of adult mortality.	4.5	ongoing	LMAO, RSCH	TBD						Costs dependent on study design.
3	Compile information regarding number and types of banding injuries to plovers.	4.6.1	1 year	ES, RSCH, PRBO, BRD, BBL	32	32					Assumes staff time to develop, distribute and compile information requests.
3	Review compiled information (see 4.6.1) and determine and implement an appropriate course of action.	4.6.2	1 year	ES, RSCH, PRBO, BRD, BBL	32						Assumes staff time to review compiled information, distribution and coordination with other responsible parties.

Priority No.	Action Description	Action Number	Action Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
3	Identify effects of oil spills on snowy plovers.	4.7	as needed	ES, RSCH, BRD, LMAO	TBD						Typical range of cost for study is estimated between $25,000 - $100,000.
3	Monitor levels of environmental contaminants in snowy plovers.	4.8	as needed	ES, RSCH, BRD, LMAO	TBD						Depends on number and type of samples. Cost estimate $700 per sample, but may vary depending on type of contaminant.
3	Design and conduct contaminants studies if monitoring of contaminants in action 4.8 indicates potential contaminants effects.	4.9	as needed	LMAO, ES, RSCH, BRD	TBD						Depends on number of sites and samples analyzed. Cost estimates for studies range from $25,000 to $50,000 per site.
3	Identify, prioritize and carry out studies on the effects of human recreation on western snowy plovers.	4.10	ongoing	LMAO, ES, RSCH, PRBO, BRD	TBD						Costs dependent on research needs identified.
3	Revise the population viability analysis when sufficient additional information is available	4.11	1 year	ES, RSCH, PRBO, BRD	25						Assumes cost to conduct modeling.
2	Develop and implement public information and education programs.	5.1	ongoing	ES, PA, LMAO	TBD	TBD	TBD	TBD	TBD	TBD	Depends on individual recovery unit strategies. See Appendix K (Information & Education Plan) for estimates of component expenses.

Priority No.	Action Description	Action Number	Action Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
3	Inform Federal, State and local planning agencies and local planning departments of threats to breeding and wintering snowy plovers and their habitats.	5.2	continual	ES, LMAO, CCC, CDFG, CDPR, ODFW, ODLCD, OPRD, WDFW, WDNR, WSPRC, CO/CI	TBD						
3	Develop and maintain updated information and education materials on snowy plovers.	5.3	ongoing	ES, PA, LMAO, CO, CI	TBD						Incorporate into ongoing management and Action 3.1 through 3.10. See Appendix K
3	Alert landowners and beach-goers about access restrictions within snowy plover habitats.	5.4	ongoing	ES, PA, LMAO, CO, CI	TBD						Incorporate into ongoing management and Action 3.1 through 3.10. See Appendix K
3	Provide trained personnel to facilitate protective measures, provide public education, and respond to emergency situations.	5.5	continual	LMAO, CO, CI	TBD						Need to secure funds for volunteer coordinator and staff to train volunteers. Incorporate into Action 3.1 through 3.10. See Appendix K.
3	Develop protocols for handling sick, displaced, injured, oiled, and dead birds or salvaged eggs.	5.6	1 with periodic review	LMAO, CO, CI	32.2	32.2					Assumes staff time to develop protocol.

Priority No.	Action Description	Action Number	Action Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
3	Establish a distribution system and repository for information and education materials.	5.7	continual	ES, LMAO, CO, CI	TBD						Incorporate into ongoing management and Action 3.1 through 3.10 and 7. See Appendix K.
3	Establish a reporting and distribution system for annual monitoring data.	5.8	annual	ES	644	16	16	16	16	16	Assumes time spent collecting and compiling data.
2	Develop and implement a tracking process for the completion of recovery actions and the achievement of delisting criteria.	6.1	continual	ES, RW, ARMY, BLM, CE, NASA, NAVY, NPS, USAF, USFS, USMC, CDFG, CDPR, ODFW, OPRD, WDFW, WDNR, WSPRC, LMAO	688	64	16	16	16	16	Assumes staff time to develop and implement tracking process.
3	Review progress toward recovery annually.	6.2	annual	ES, LMAO	566	14	14	14	14	14	Assumes staff time to compile and review data.
3	Assess the applicability, value and success of this plan to the recovery of the western snowy plover every 5 years.	6.3	every 5 years		258					32.2	Assumes staff time to review every 5 years.
3	Prepare a delisting package for the Pacific coast population of the western snowy plover.	6.4	6 months	ES	64	64					Assumes staff time to prepare delisting package.

Priority No.	Action Description	Action Number	Action Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
3	Prepare and implement a post-delisting monitoring plan.	6.5	6 months	ES	64	64					Assumes staff time to prepare and implement post-delisting monitoring plan.
1	Dedicate sufficient U.S. Fish and Wildlife Service staff for coordination of western snowy plover recovery implementation.	7	continual	ES	5,152	128.8	128.8	128.8	128.8	128.8	Assumes staff time to coordinate recovery implementation
3	Develop a joint United States and Mexico effort to protect snowy plover populations and their habitat.	8.1	continual	ES, IA	TBD						
3	Encourage research and monitoring of breeding and wintering snowy plovers in Baja California, Mexico by universities and authorities of Mexico.	8.2	continual	ES, IA, RSCH, BRD	TBD						
3	Encourage development and implementation of public information and conservation education in Mexico.	8.3	continual	ES, IA, PA	TBD						

Priority No.	Action Description	Action Number	Action Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
3	Coordinate with other survey, assessment, and recovery efforts for the western snowy plover throughout North America.	9	continual	ES, IA, RSCH, BRD	TBD						

Total Cost of Recovery through 2046: $149,946,000 plus additional costs that cannot be estimated at this time.

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