Western Snowy Plover

(*Charadrius alexandrinus nivosus*)

Pacific Coast Population

Draft Recovery Plan

(May 2001)

U.S. Fish and Wildlife Service
Region 1

Approved: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
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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 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 Fish and Wildlife Service. Objectives of the 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 cooperating or other parties to undertake specific tasks, and may not represent the views nor the official positions or approval of any individuals or agencies involved in the 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 tasks.

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EXECUTIVE SUMMARY

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

HABITAT REQUIREMENTS AND LIMITING FACTORS: The Pacific coast population of western snowy plovers 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, 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 western snowy plover population from the *List of Endangered and Threatened Wildlife and Plants* by: (1) achieving well-distributed increases in numbers and productivity of breeding adult birds, and (2) providing for long-term protection of breeding and wintering plovers and their habitat.

RECOVERY PRIORITY: 3C, per criteria published by Federal Register Notice (48 FR 43098; September 12, 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. Maintain for 10 years an average of 3,000 breeding adults 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, 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.

2. Maintain a 5-year average productivity of at least 1.0 fledged chick per male in each recovery unit in the last 5 years prior to delisting.

3. Have in place participation plans among cooperating agencies, landowners, and conservation organizations to assure 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 above.

ACTIONS NEEDED:

1. Monitor and manage breeding habitat of the Pacific coast population of the western snowy plover to maximize survival and productivity.

2. Monitor and manage wintering and migration areas to maximize snowy plover population survival.

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

4. Undertake scientific investigations that facilitate recovery efforts.

5. Undertake public information and education programs.

6. Review progress towards recovery annually and revise recovery efforts as appropriate.

7. Dedicate U.S. Fish and Wildlife Service staff and funding for the Sacramento Fish and Wildlife Office to coordinate recovery implementation.

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

Appendix J addresses Actions 1 and 2, providing guidelines for monitoring snowy plovers during the breeding and wintering seasons. Appendix K addresses Action 5, providing a public information and education plan.

ESTIMATED COST OF RECOVERY: $28,588,000 plus additional costs that cannot be estimated at this time.

DATE OF RECOVERY: Delisting could occur by 2025 if recovery criteria 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*) was listed as threatened under provisions of the Endangered Species Act of 1973 (16 U.S.C., 1531-1544), as amended (U.S. Fish and Wildlife Service 1993*a*). This population breeds primarily on coastal beaches from southern Washington to southern Baja California, Mexico (Figure 1). General locations of the snowy plover's breeding and wintering locations are shown in Appendix A. Recent surveys, status reviews, and literature searches have identified 157 current or historical snowy plover breeding or wintering locations on the U.S. Pacific coast. These localities include 5 in Washington, 19 in Oregon, and 133 in California (Appendix B). In Baja California, breeding 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.

In Washington, the western snowy plover was listed as endangered under Washington Department of Game Policy #402 in 1981. The State endangered status was reaffirmed in 1990 by the Washington Wildlife Commission (Washington Administrative Code 232-12-014). In Oregon, the western snowy plover was listed as a threatened species by the Oregon Fish and Wildlife Commission in 1975. Its threatened status was reaffirmed in 1989 under the Oregon Endangered Species Act during the review required by Oregon Revised Statutes 496.176(7)(b). The Oregon Fish and Wildlife Commission confirmed the species' threatened status as part of its periodic review in December 1993, and again in December 1998. The Oregon Endangered Species Act was amended through House Bill 2120 in 1995 and was implemented by administrative rule in January 1998. The western snowy plover conservation program adopted in 1994 provides "survival guidelines" for this species under this amended rule. In California, the western snowy plover has been classified by the California Department of Fish and Game as a "species of special concern" throughout all of

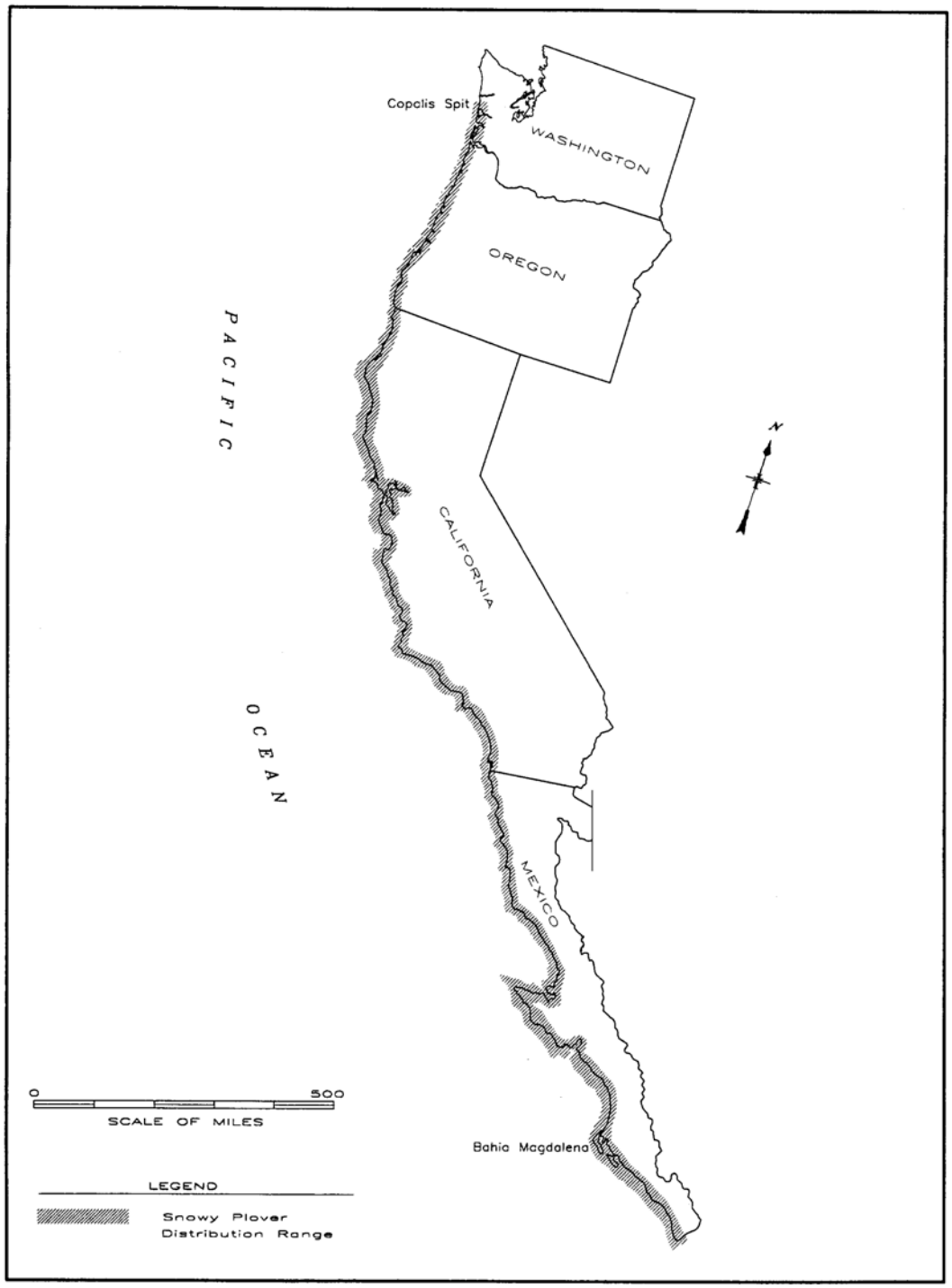


Figure 1. Map of known breeding and wintering distribution of the Pacific coast population of the western snowy plover.

California since 1978 (Remsen 1978, California Natural Diversity Database 2001).

Under section 4 of the Endangered Species Act of 1973, as amended, the U.S. Fish and Wildlife Service is required to develop a recovery plan after a species 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 that reverses the decline of a listed species, neutralizes threats, and ensures 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 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 the counties of Napa, Alameda, Santa Clara, and San Mateo); (4) Monterey Bay (including coastal areas along counties of Monterey, Santa Cruz, San Mateo, San Francisco, Marin, and Sonoma); (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 snowy plover's breeding and wintering range.

This recovery plan emphasizes opportunities for improved management on Federal and State lands. Improved management on these lands will incur long-term costs to these public land managers and restrict public use on some habitat areas. Public support and involvement will be crucial to the recovery of the western snowy plover. The nesting season of the snowy plover includes the period of greatest public recreational use of beaches (Memorial Day through Labor Day). This recovery plan is a call to action to the public for snowy plover

conservation. Opportunities for public participation in recovery efforts are emphasized in Appendix K (Information and Education Plan). This recovery plan provides a strategy for recovery of the entire Pacific coast population of the western snowy plover, although site-specific recommendations are limited to the populations within its United States range.

A. DESCRIPTION AND TAXONOMY

The 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 (see Figure 2). The bill and legs are blackish. In breeding plumage,

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

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 is evident on breeding males, but not on females. In nonbreeding plumage, sexes cannot be distinguished because the breeding markings disappear. Fledged juveniles have white edges on their wing coverts and scapulars and can thus be

distinguished from adults until approximately July through October, depending on when the eggs hatch. During this period, molt and feather wear makes fledged juveniles indistinguishable from adults. The mean annual life span of snowy plovers is about 3 years, but at least one individual was at least 15 years old when last seen (Page *et al.* 1995*a*).

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 western snowy plover breeds on the Pacific coast from southern Washington to southern Baja California, Mexico, and 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). The Cuban snowy plover (*C. a. tenuirostris*) 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).

The Pacific coast population of the snowy plover is defined as those individuals that nest on the mainland coast, peninsulas, offshore islands, bays, estuaries, or rivers of the United States Pacific coast and Baja California, Mexico (U.S. Fish and Wildlife Service 1993*a*).

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*). Snowy plovers tend to be site faithful, with the majority of birds returning to the same nesting location in subsequent years (Warriner *et al.* 1986). Intensive banding and monitoring studies have documented only two clear instances of interbreeding between coastal and interior populations, but there have been observations of four other birds that may have been interbreeding. First, a banded female hatched at

Monterey Bay was observed nesting the following year at Mono Lake, California (G. Page *in litt.* 1989). This one observation was among 1,730 plovers observed at interior sites. Secondly, a snowy plover that nested at Monterey was observed the following year nesting at a Central Valley site (G. Page pers. comm. 1992). It is expected that more than these two individuals would have been seen if the two populations mixed more fully. In addition, an adult male, banded as a chick in San Diego County, was seen at Owens Lake in May of 1997 and may have been breeding (G. Page and A. Powell pers. comm. 1998). Three snowy plovers banded as chicks on the California coast were observed at interior Oregon breeding sites during the breeding season in 1990 (Stern *et al.* 1991*a*). However, there was no documentation whether or not these birds nested at these interior sites. Conversely, no breeding plovers or their young banded at Abert Lake, in interior Oregon, Mono Lake in interior California, or at Great Salt Lake, Utah have been observed nesting at any coastal sites (Stern *et al.* 1990*a*, G. Page pers. comm. 1998). Since 1977, several thousand snowy plovers have been banded on the Pacific coast; the numbers of plovers banded in the interior were: 130 adults and 237 chicks at Mono Lake; 356 adults and 139 chicks at Great Salt Lake; and 166 adults and 204 chicks at Abert Lake (G. Page pers. comm. 1999).

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., coastal beach, Figure 3). This habitat is unstable because of unconsolidated soils, high winds, storms, wave action, and colonization by plants. 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 (Wilson 1980, Stenzel *et al*. 1981). 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).

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

a. Population Size and Distribution

Snowy plovers concentrate in suitable habitat, with the number of adults at coastal breeding locations ranging from 1 to 246, depending, in part, on the size of the area (Appendix B). It is estimated that, at most, about 2,000 snowy plovers may breed along the U.S. Pacific coast (Page *et al.* 1995*a,* Appendix D) and at least a similar number breed on the west coast of Baja California (Palacios *et al.* 1994). The largest number of breeding birds occurs from south San Francisco Bay to southern Baja California (Page and Stenzel 1981, Palacios *et al.* 1994). Population estimates referenced below were based on window surveys, breeding surveys, and data used in the population viability analysis prepared for this recovery plan. The locations of the following parenthetical references to snowy plover breeding and wintering locations in the States of Washington, Oregon, and California are shown in Figures A-1 through A-7 of Appendix A. Information on the numbers of breeding and wintering snowy plovers at these locations is described in Appendix B.

Three breeding areas currently exist in southern Washington: Leadbetter Point, in Willapa Bay (WA-5); Damon Point, in Grays Harbor (WA-2); and Midway Beach (WA-4). During most recent breeding seasons, fewer than 25 plovers and 12 nests

have been found during regular, standardized surveys. In Oregon, nesting birds have been recorded in nine locations (Appendix B). In 1997, snowy plovers nested at seven sites in Oregon: Sutton (OR-8), Siltcoos (OR-10), Tenmile (OR-12), Coos Bay North Spit (OR-13), Bandon (OR-15), New River Spit (OR-15), and Floras Lake (OR-15). An estimated 141 adult plovers were observed at these sites during the breeding season. Ninety-three nests were located, with 52 percent of the nests at two sites (Coos Bay North Spit and New River Spit). In 1995 and 1996, individual nests were also found at two other Oregon sites, Bayocean Spit (OR-3) and Threemile-Umpqua River (OR-11), respectively. Eight geographic areas support over three-quarters of the California coastal breeding population: San Francisco Bay (CA-27 to 47), Monterey Bay (CA-63 to 65), Morro Bay (CA-79 to 81), the Callendar-Mussel Rock Dunes area (CA-83), the Point Sal to Point Conception area (CA-84 to 88), the Oxnard lowland (CA-96 to 99), Santa Rosa Island (CA-93), and San Nicolas Island (CA-100) (Page *et al.* 1991). A survey of breeding snowy plovers along the Pacific coast of Baja California, Mexico in 1991 to 1992 found 1,344 adults, mostly at 4 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 birds at coastal locations consist of both year-round residents and migrants (Warriner *et al.* 1986). Migrants begin arriving at breeding sites 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).

Although pair bonds are first observed on the breeding grounds, they are likely to begin while birds are together in wintering flocks. Mated birds from the previous breeding season frequently reunite. Old and new pair bonds may be established prior to territory defense and nest scraping (Warriner *et al.* 1986). 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. 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.

c. Duration of Breeding Season

Along the west coast of the United States, the nesting season of the snowy plover extends from early March through late September. Generally, the breeding season begins earlier in more southerly latitudes, and 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.

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 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*b*). 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). In southern California, plovers nest in areas with 6 to 18 percent vegetative cover and 1 to 14 percent inorganic cover; vegetation is usually less than 6 centimeters (2.3 inches) tall (Powell *et al.* 1995, 1996). Nests consist of a shallow scrape or depression 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 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 hundreds of 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 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 snowy plovers are site-faithful, returning to the same breeding site in subsequent breeding seasons, some also disperse within and between years (Warriner *et al.* 1986, Stenzel *et al.* 1994). Birds occasionally nest in exactly the same location as the previous year (Warriner *et al.* 1986).

e. Egg Laying, Clutch Size, and Incubation

Along the U.S. Pacific coast, snowy plovers make scrapes in February but never lay eggs that early. Initiation of clutches (i.e., groups of eggs) and egg laying occurs from 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 is three eggs (see Figure 4) although, rarely, up to six eggs have been found and two eggs are not unusual (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 plovers will frequently attempt to lure people and predators from hatching eggs with alarm calls and distraction displays. Occasionally, parents behave similarly when they have incomplete clutches or, less often, clutches that

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

are only partly incubated. 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 with three eggs having some degree (in days) of incubation.

Snowy plovers renest readily after loss of their eggs (Wilson 1980, Warriner *et al.* 1986). Renesting occurs 2 to 14 days after failure of a clutch and up to five renesting attempts have been observed for a pair (Warriner *et al.* 1986). Double brooding with polyandry (meaning the female successfully hatches more than one brood 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*). After losing a clutch or brood (i.e., group of chicks) or successfully hatching a nest, plovers may renest 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 snowy plovers (Widrig 1980, Wilson 1980, Saul 1982, Wilson-Jacobs and Dorsey 1985, Wickham unpubl. data *in* Jacobs 1986, Warriner *et al.* 1986). Low clutch hatching success has been attributed to a variety of factors, including predation, human disturbance, high tides, and inclement weather. In San Diego County, at least one egg hatched in 56 to 76 percent of clutches from 1994 to 1997 (Powell and Collier 1994, Powell *et al.* 1995, 1996, 1997). Observed clutch hatching success ranged from 12.5 to 86.8 percent and averaged 50.6 percent in eight studies of coastal breeding snowy plovers (Page *et al*. 1995*a*).

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 plover, while incubating the eggs, also broods the first chick. The nonincubating adult may also 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.

Snowy plover chicks are precocial, leaving the nest within hours after hatching to search for food. They are not able to fly for approximately 4 weeks after hatching; fledging requires 28 to 33 days (mean equals 31 days) (Warriner *et al.* 1986). Broods rarely remain in the nesting area until fledging (Warriner *et al.* 1986, Stern *et al.* 1990*b*). Plover broods may travel along the beach as far as 6.4 kilometers (4 miles) from their natal area (Casler *et al.* 1993).

Adult 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. Adult plovers signal the chicks to crouch, with calls, as another way to protect them (Page *et al.* 1995a). They may also lead chicks, especially larger ones, away from predators. Most chick mortality occurs within 6 days after hatching (Warriner *et al.* 1986).

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*).

h. Fledging Success

The fledging success of snowy plovers (percentage of hatched young that reach flying age) varies greatly by location and year. Even 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 and averaged 24 percent overall (Page *et al.* 1997). During the prior 13 years, the percentage of young fledged 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 in Appendix B), the fledging rate of chicks ranged from 13.2 percent to 57.1 percent (mean equals 41.4 percent) from 1988 to 1997. In San Diego County, the fledging rate of chicks ranged from 32.6 to 51.4 percent (mean equals 41 percent) from 1994 through 1998 (Powell *et al.* 1997). In Oregon, annual fledging success for 1992 to 1997 for all coastal sites combined, ranged from 30 to 48 percent (mean equals 38 percent) (M. Stern unpubl. data). Like California, there is considerable variation among sites within years. For example, in 1997, the fledging rate ranged from a low of 14 percent at Sutton (OR-8) to a high of 66 percent at South Tenmile (OR-12). There is also variation at individual sites among years. For example, at the Coos Bay North Spit (OR-13), one of the larger nesting areas in coastal Oregon, annual fledging rates for 1993 to 1997 ranged from 32 to 63 percent (mean equals 46 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 days after hatching. Estimates of the number of young fledged per adult male are available for the coast of Oregon, the shoreline of Monterey Bay, California, and the coast of San Diego County, California. Along the Oregon coast, coincident with extensive efforts to protect nests from predators, the average number of young fledged per male and per female annually from 1993 to 1997 has been estimated as 1.04 and 1.30, respectively. Male fledging rates ranged from 0.80 to 1.51 annually and female rates from 0.73 to 2.10 (M. Stern unpubl. data). At Monterey Bay, California, from 1984 to 1991, when little effort was made to protect nests from predators and people, males averaged 0.85 and females 0.86 fledglings annually. After intensive efforts were undertaken to protect nests from predators and people from 1992 to 1997, the number of young fledged per adult averaged 1.11 for males and 1.23 for females (Point Reyes Bird Observatory, unpubl. data). Over the 14 years of study at Monterey Bay, the annual number of young fledged ranged from 0.61 to 1.26 per male and 0.70 to 1.36 per female (Point Reyes Bird Observatory unpubl. data). From 1995 to 1997 in San Diego County, males averaged 0.92 fledged young. From 1994 to 1997 in San Diego County, females averaged 0.87 fledged young. Rates for males ranged from 0.80 to 1.08 fledged young annually, and for females 0.82 to 1.06 fledged young annually (A. Powell and J. Terp unpubl. data). From 1995 to 1997, nesting snowy plovers in San Diego County likely benefitted from predator management efforts targeted at California least terns (A. Powell pers. comm. 1998). Male reproductive rates were used in the snowy plover population viability analysis as explained in Appendix D.

j. Survival

Annual survival rates for adult and juvenile 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 averaged 51 percent

from the Oregon coast, 45 percent from Monterey Bay, and 45 percent from the San Diego coast. Annual survival rates for adult females averaged 75 percent from the Oregon coast, 69 percent from Monterey Bay, and 72 percent from the San Diego coast. Male survival rates were 75 percent for the Oregon coast, 75 percent for Monterey Bay, and 71 percent for San Diego County. Differences between males and females were only significant for the Monterey Bay area. Adult survival rates for San Diego County were not significantly different from the other areas. Appendix D explains how these survival rates were incorporated into the population viability analysis. At the Great Salt Lake, Utah, Paton (1994) estimated annual survival rates of snowy plovers from 58 to 88 percent, depending on year, with no significant difference between the sexes.

2. Feeding Habitat and Habits

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, sandy 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, 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). Snowy plover food consists of immature and adult forms of marine and terrestrial invertebrates. Little quantitative information is available on food habits. In San Diego, invertebrates found in 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 snowy plovers feeding on sand hoppers (Orchestoidea) and small fish on the Oregon coast. Other food items reported for coastal snowy plovers include mole crabs (*Emerita analoga*), crabs (*Pachygrapsus crassipes*), polychaetes (Neridae, *Lumbrineris zonata, Polydora socialis, Scoloplos acmaceps)*, amphipods (*Corophium* ssp., *Ampithoe* spp., *Allorchestes angustus*), tanadacians (*Leptochelia dubia*), flies (Ephydridae), beetles (Carabidae, Buprestidae, Tenebrionidae), clams (*Transenella* sp.), and

ostracods (Page *et al.* 1995*a*). In San Francisco Bay salt evaporation ponds, the following prey have been recorded: flies (*Ephydra cinerea*), beetles (*Tanarthrus occidentalis*, *Bembidion* sp.), moths (*Perizoma custodiata*), and lepidopteran caterpillars (Feeney and Maffei 1991).

3. Migration

While some 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). On Monterey Bay in California, 41 percent of nesting males and 24 percent of the females were consistent year-round residents (Warriner *et al.* 1986). At 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 snowy plovers into Washington; it is suspected that these wandering birds are migrants (S. Richardson pers. comm. 1998).

Most plovers that nest inland migrate to the coast for the winter (Page *et al.* 1986, 1995*b*). Those from the Central Valley of California and the western Great Basin migrate to the California or Baja California coasts, and those from the eastern Great Basin (Great Salt Lake) migrate to Mexico (Page *et al.* 1995*b*). The departure from inland nesting areas begins by early July and is completed, except for stragglers, by mid-October (Page *et al.* 1995*a*).

Thus, the flocks of nonbreeding 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 snowy plover winters (here defined as November 1 to February 28/29) 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 plovers occur at two locations on the Washington coast, the northernmost being Midway Beach (WA-4) in Pacific County (S. Richardson pers. comm. 1998). Fewer than 100 plovers winter at 9 locations on the Oregon coast (Appendix B), probably as many as 2,500 along the mainland California coast, and hundreds more at each of San Francisco Bay and the Channel Islands (Appendix B, Page *et al.* 1986). The majority of wintering plovers on the California coast are found from Bodega Bay, Sonoma County, southward (Page *et al.* 1986). Inland, a few hundred birds also winter at agricultural waste water ponds in the San Joaquin Valley and at desert saline lakes, particularly the Salton Sea in California (Shuford *et al.* 1995).

Nesting birds 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, snowy plovers are found on many of the beaches used for nesting and 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 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 plovers south, but not north, of San Mateo County, California. In Washington, the main wintering location is

Leadbetter Point, Willapa Bay (Washington Department of Fish and Wildlife 1995).

b. Site Fidelity

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

Snowy plovers are typically gregarious in winter. Although some individuals defend territories on beaches, most usually roost in loose flocks; frequently plovers are also observed foraging in loose flocks (Page *et al.* 1995*a*). Roosting 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 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 than they are currently. In Washington, snowy plovers formerly nested at five coastal locations (Washington Department of Fish and Wildlife 1995). Three

sites are currently active, representing a minimum 40 percent decline in Washington breeding sites. In Oregon, snowy plovers historically nested at 29 locations on the coast (C. Bruce pers. comm. 1991). Currently, there are only nine nesting locations, representing a 69 percent decline in active breeding areas. In California, there has also been a significant decline in breeding locations, especially in southern California.

a. Washington Coast

Records for snowy plovers in Washington span a full century. Most early accounts described plover abundance at specific sites with terms such as "several" or "small numbers." Although similar descriptors could still be applied today, current field efforts are more thorough than in the past. In addition, significant habitat losses have occurred, primarily through erosion and invasion of introduced beachgrass, and some sites no longer support nesting plovers. For these reasons, a decline in the Washington population is believed to have occurred, but it is difficult to quantify.

Copalis Spit (WA-1) held 6 to 12 snowy plover pairs in the late 1950's or early 1960's, according to biologist Gordon Alcorn (cited in 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 (Ralph Widrig, cited in Washington Department of Fish and Wildlife 1995). Periodic surveys since 1983 have revealed just a single plover (Washington Department of Fish and Wildlife unpubl. data).

Damon Point and Oyhut Wildlife Area (WA-2) lack snowy plover records prior to 1971, but this is due to limited visitation rather than plover absence. Between 1971 and 1983, birders reported up to six plovers during infrequent visits to Damon Point (Washington Department of Fish and Wildlife 1995). Plover research in 1985 and 1986 revealed up to 20 plovers and 8 nests at Damon Point (Anthony 1987), but no more than 5 nests have been found in subsequent years (Washington Department of Fish and Wildlife 1995, unpublished data). Intensive surveys in 1997 and 1998 revealed five or fewer plovers and no more than two nests each year (Washington Department of Fish and Wildlife unpublished data).

Westport Spit (WA-3) held low numbers of 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, which has now eroded significantly. Regular visits between 1994 and 1998 revealed no plovers (Washington Department of Fish and Wildlife, unpublished data).

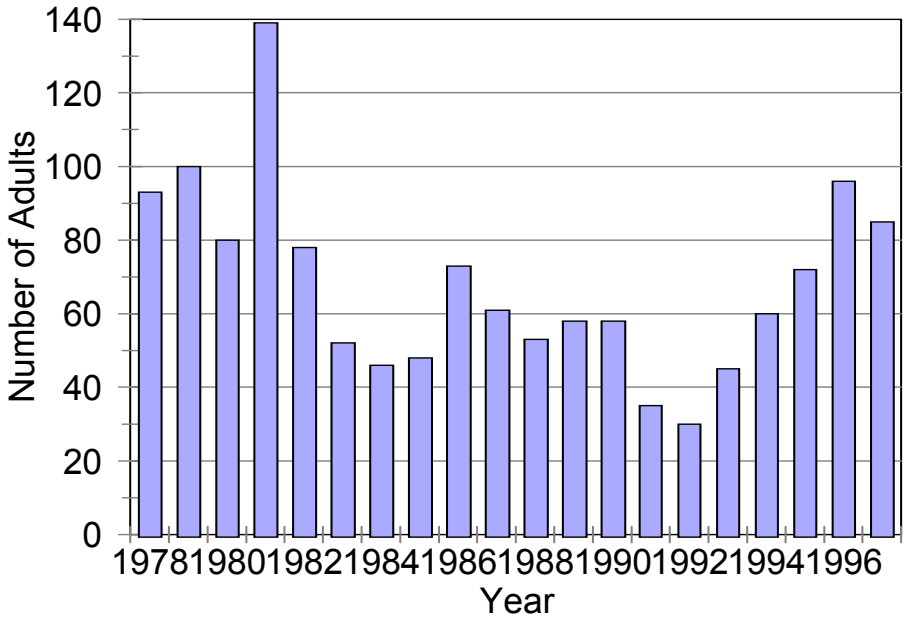
Midway Beach (WA-4) and Cape Shoalwater once contained several hundred acres of suitable snowy plover habitat, but the area lacks historical records of these birds except for specimens collected in 1914 and 1960 and labeled "Tokeland" (Washington Department of Fish and Wildlife 1995). Regular surveys between 1994 and 1998 suggested intermittent plover use, with an estimated eight plovers and six nests in 1998 (Richardson *et al*. in prep.).

Leadbetter Point (WA-5) was rarely visited by plover observers prior to 1964. In the 1960's and 1970's, birders reported up to 35 plovers. In 1967, the sighting of two chicks confirmed nesting in Washington (Washington Department of Fish and Wildlife 1995). Up to 24 plovers and between 7 and 11 nests were estimated to be present in 1978, 1979, and 1981 (Widrig 1980, 1981). Up to 23 plovers and 7 nests were found from 1985 to 1989 (Willapa National Wildlife Refuge unpublished data), and similar numbers occurred from 1995 to 1997 (Williamson 1995, 1996, 1997). In recent years, Gunpowder Sands, a dynamic shoal just north of Leadbetter Point, has supported up to 11 plovers and 2 nests between May and July (Williamson 1995, 1996, 1997).

b. Oregon Coast

In Oregon, annual surveys of snowy plovers, including both adults and young of the year, began in 1978, with counts ranging from a high of 139 to a low of 30 (Table 1). From 1978 to 1981, the mean number of plovers observed annually along the Oregon coast was 104 at 12 sites. At 10 of these sites, plovers were observed in all 4 years, while at the remaining 2 sites, plovers were recorded in 3 of 4 years. The number of plovers declined through the 1980's, and reached a low

Table 1. Histogram of the number of adult snowy plovers on window surveys of the Oregon coast during the breeding season. Window surveys estimate the number of birds seen during 1-day censuses in May to June.



Year	Number	Year	Number
1978	93	1988	53
1979	100	1989	58
1980	80	1990	58
1981	139	1991	35
1982	78	1992	30
1983	52	1993	45
1984	46	1994	60
1985	48	1995	72
1986	73	1996	96
1987	61	1997	85

from 1991 to 1993 with a mean of 33 individuals recorded annually. From 1994 to 1997, plover numbers increased, with a mean of 78 plovers observed at 7 sites. The increase in recent years is related to intensive management, including the use of exclosures to reduce predation, restoration of breeding habitat by removing European beachgrass, 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. Along the Oregon coast where intensive management has taken place, the number of snowy plovers have decreased over 25 percent since 1978 to 1981, and the number of active sites have decreased from 12 to 7. However, without intensive management, it is likely that current plover numbers would be considerably lower.

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 2). The number of snowy plovers, as indicated by all three indices in Table 2, has increased between 1993 and 1997. The increasing trend for all three indices remains consistent throughout the measurement period.

c. California Coast

i. Coastwide Perspective

The first quantitative data on the abundance of 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, Table 3). Window surveys are a one-time pass of a surveyor or team of surveyors through potential snowy plover nesting habitat during May or June. The surveyor counts all adult snowy plovers in the habitat and separates the adults into males and females when possible. An estimated 1,593 adult snowy plovers were seen (and extrapolated for one location not completely covered) on the pioneer surveys (Table 3). The surveys suggested that the 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 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 snowy plovers during the decade after the 1977 to 1980 survey. Along the mainland coast, including the shores of the Channel Islands, the decline of the snowy plover was 4.9 percent, and in San Francisco Bay about 40 percent (Table 3). The most recent coastwide survey, during the summer of 1995, was accomplished through

Table 2. Comparison of population estimates of adult western snowy plovers on the Oregon coast during the breeding season (1993 to 1997) based on three different measures of abundance. Data for B and C estimates provided by M. Stern (pers. comm. 1998).

Year	Estimates		
	A	B	C
1993	45	55 to 61	72
1994	52	67	83
1995	67	94	120
1996	87	110 to 113	134 to 137
1997	85	106 to 110	141

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.

Table 3. Number of adult snowy plovers during breeding season window surveys of the California coast.

Location	1977/80	1989	1991	1995
Del Norte County	11	8	3	0
Humboldt County	54	32	30	19
Mendocino County	15	2	0	-
Sonoma County	0	10	9	2
Marin County	40	24	25	8
San Mateo County	4	8	1	2
Northern Santa Cruz County	25	19	22	33
Monterey Bay	146	146	121	125
Point Sur	3	4	-	-
Morro Bay Area	80	126	87	85
Pismo Beach/Santa Maria River	45	123	246	124
Vandenberg Air Force Base	119	115	242	213
Jalama Beach	0	1	1	0
Oxnard Lowland	136	175	105	69
Channel Islands	(288)[1]	217	200	196
Orange County	19	21	6	9
Northern San Diego County	160	72	48	49
San Diego Bay	60	36	31	33
Tijuana Estuary	37	21	4	10
Subtotal	**1242**	**1160**	**1181**	**977**
South San Francisco Bay	351	216	(203)[2]	-
Total	**1593**	**1376**	**1384**	**-**

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

[2] 176 seen during the survey; 27 additional birds extrapolated for unsurveyed areas.

the collaboration of researchers studying snowy plovers along the California coast. This survey suggested a further 17.3 percent decline in the number of breeders along the outer coast, making a 21 percent decline since the initial surveys of 1977 to 1980. Because San Francisco Bay was not surveyed in 1995, it is not known whether numbers there have changed from 1991 levels. Between the 1977 to 1980 surveys and the 1995 survey, the snowy plover seems to have ceased nesting at Los Penasquitos, San Elijo, and Agua Hedionda Lagoons in northern San Diego County (A. Powell pers. comm. 1998); Año Nuevo State Beach and Pescadero State Beach in San Mateo County; Bolinas Lagoon in Marin County; MacKerricher Beach in Mendocino 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).

Information on numbers of snowy plovers along the coast of California since 1995 is available only for some sites. For those sites where nesting plovers are monitored and most of the birds are color banded, estimates of the total number of nesting birds have been made (Table 4). Breeding season window surveys are also available from some sites (Table 4). However, estimates from both window surveys and total nesting birds are not available for any site from 1995 to 1997.

ii. Regional Perspective

Mendocino, Humboldt, and Del Norte Counties - Numbers of breeders have declined in this northern California region since the initial Point Reyes Bird Observatory survey in 1977. In 1977, 80 adults were tallied for the region compared to 42 in 1989, 33 in 1991, and 19 in 1995. The Point Reyes Bird Observatory also conducted a survey of Humboldt County and Del Norte County beaches during the summer of 1996 (regular nesting had ceased in Mendocino County by this date) and tallied 15 adults. In 1996, snowy plovers were documented breeding on the gravel bars of the Eel River, Humboldt County, for the first time. R. LeValley (pers. comm. 1997) estimated that as many as 30 snowy plovers nested on these gravel bars in 1997. Even if some plovers had shifted from the beaches to the bars between 1977 and 1996, the total for the beaches and bars (15 + 30 = 45) is still a reduction from the 80 plovers tallied in 1977.

Table 4. Number of adult snowy plovers at selected California nesting sites, 1995 to 1997.

Location	1995	1996	1997	Data Type
Humboldt County Beaches	19	15	-	Window Survey
Point Reyes, Marin County	12	10-11	25	Total Breeders
North Santa Cruz County	27-30	22-26	22-23	Total Breeders
Monterey Bay	186-198	210-217	228-231	Total Breeders
Atascadero Beach	38	28	23	Window Survey
Morro Bay Spit	34	40	39	Window Survey
Vandenberg Air Force Base	213	230	258	Window Survey
Ormond Beach	20	19	34	Window Survey
Mugu Naval Weapons Station	40	49	26	Window Survey
Santa Rosa Island	71	78	79	Window Survey
San Miguel Island	9	3	5	Window Survey
San Nicolas Island	116	104	91	Window Survey
Bolsa Chica	8	22	21	Window Survey
San Diego County	255	272	282	Total Breeders
Total Number of snowy plovers	**1048-1063**	**1102-1114**	**1133-1137**	

San Francisco Bay - As indicated in Table 3, numbers in San Francisco Bay declined markedly between the initial survey in 1978 and follow-up surveys in 1989 and 1991. This region should be covered again to determine the snowy plover's current status.

Monterey, Santa Cruz, San Mateo, San Francisco, Marin, and Sonoma Counties - Along this segment of coastline, numbers of adults during window surveys in 1977 to 1978, 1989, 1991, and 1995 were: 215, 207, 178, and 170, respectively. Point Sur is excluded from these estimates because of a lack of data in 1991 and 1995. Thus, a decline for the region is indicated. However, the numbers of adults breeding on the beaches and salt ponds of Monterey Bay, and the beaches of northern Santa Cruz County, increased nearly 40 percent between 1993 and 1997 after management actions were undertaken to increase nesting success (Point Reyes Bird Observatory, unpublished data)

Ventura, Santa Barbara, and San Luis Obispo Counties - There is no clear evidence of an overall decline in the number of breeding snowy plovers for this region from 1978/1980 to the present. Numbers of adults during 1978, 1989, 1991, 1995, and 1998 window surveys were: 668, 757, 881, 687, and 570, respectively. While numbers for the region may not have changed overall, there have been definite changes at specific locations (Table 5). Most notable is the decline in numbers on San Miguel Island from 1978 /1980 to 1997, and the sudden increase in numbers at Vandenberg Air Force Base between 1989 and 1991, followed by the sudden decline from 1997 to1998 (Table 5).

Table 5. Breeding season surveys of 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
Atascadero Beach	0	17	2	38	28	23	26
Morro Bay Spit	80	94	69	34	40	39	55
Vandenberg Air Force Base	119	115	242	213	230	238	130
Ormond Beach	25	24	34	20	19	34	19
Mugu Naval Weapons Station	82	81	59	40	49	26	47
Santa Rosa Island	84	91	103	71	78	79	76
San Miguel Island	133	36	19	9	3	5	1
San Nicolas Island	71	90	78	116	104	91	90
Total	594	548	606	541	551	535	444

San Diego, Orange, and Los Angeles Counties - Numbers have declined during window surveys from the period 1978 to 1995. From the 276 adults tallied during the 1978 Point Reyes Bird Observatory survey, numbers declined to 150 adults during the 1989 survey and 89 on the 1991 survey. A window survey by Abby Powell, U.S. Geological Survey/Biological Resources Division, and her colleagues produced 101 adults during the summer of 1995. The 1995 estimate represented only 37 percent of the adults from the 1978 survey. Since 1995, the total number of plovers nesting in San Diego County during the course of a summer has been increasing (Table 4). Because birds move around, the number of banded birds tallied over a whole summer is greater than the number that could be found on any particular day of a window survey.

2. Current Breeding Distribution

The current Pacific coast breeding range of the snowy plover extends from Damon Point, Washington, to Bahia Magdelena, Baja California, Mexico. The population

is sparse in Washington, Oregon, and northern California. At present, fewer than 40 adults are believed to be nesting in Washington, slightly more than 100 in coastal Oregon, and fewer than 100 in California, north of the Golden Gate. When last surveyed in 1991, just over 200 adults were counted during the breeding season in San Francisco Bay. Almost all were in salt evaporation ponds in south San Francisco Bay. To the south of San Francisco Bay, the first large concentration of snowy plovers is found along the shoreline of Monterey Bay where currently 200 to 250 adults breed. Other large concentrations of nesting snowy plovers occur south of Monterey Bay. Breeding season counts of nesting snowy plovers during 1991, 1995, and 1998 ranged from 85 to 93 adults in the Morro Bay area, from 103 to 246 adults between Pismo Beach and Point Sal, from 130 to 240 on Vandenberg Air Force Base, and from 69 to 105 in the Oxnard Lowland. During the 1990's, 70 to 100 adults were consistently tallied during breeding season counts of Santa Rosa Island. Similar numbers are found on San Nicolas Island. South of Ventura County in the United States, nesting snowy plovers are confined primarily to Bolsa Chica in Orange County, where there are approximately 30 breeding adults, and to the coast of San Diego County with an estimated 282 nesting adults in 1997. Along the coast of Baja California, Mexico, most nesting snowy plovers are associated with the largest wetlands, especially Bahia San Quintin, Laguna Ojo de Liebre, and Bahia Magdelena. Probably as many snowy plovers nest along the west coast of Baja California, Mexico as along the U.S. Pacific coast (Palacios et al. 1994).

3. Habitat Carrying Capacity

There is no quantitative information on carrying capacity of beaches for snowy plovers. The structure, width, vegetation, and level of human use of beaches is quite variable, complicating such a measurement. With extensive management of approximately 55 hectares (138 acres) of mostly dried ponds in the Moss Landing Wildlife Area, Point Reyes Bird Observatory biologist Doug George has been able to document 25 active nests, 3 pairs within 5 days of initiating nests, and 10 broods simultaneously. Thus, a *peak* of 76 nesting adults were 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) (Point Reyes Bird Observatory unpublished data). If calculated over the approximate 4-

year period since management at the Moss Landing Wildlife Area commenced, the number of nesting adults would be smaller.

The numbers of nesting 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. Also, since 1995, Point Reyes Bird Observatory staff have conducted intensive management specifically for snowy plovers at the Moss Landing Wildlife Area. These measures include predator control, removal of excessive vegetation, and operation of water control structures to maintain desired water levels. These numbers also cannot be applied to some other salt ponds (e.g., San Francisco Bay) because of the need to flood larger areas within the salt pond system to keep sufficient areas from being vegetated while maintaining sufficient, suitable nesting habitat (e.g., salt pans) for snowy plovers from year to year.

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). 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. Natural factors, such as inclement weather, have also affected the quality and quantity of snowy plover habitat (U.S. Fish and Wildlife Service 1993*a*). The reasons for decline and degree of threats vary by geographic location. 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 snowy plovers are an unstable habitat, subject to the dynamic processes of accretion and erosion and

dependent on natural forces for replenishment and renewal. These habitats are highly susceptible to degradation 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 snowy plover.

Beach stabilization efforts may interfere with coastal dune formation and cause beach erosion and loss of snowy plover nesting and wintering habitat. Shoreline stabilization features such as jetties and groynes may cause significant habitat degradation by robbing sand from the downdrift shoreline (U.S. Fish and Wildlife Service 1996*a*). However, jetties can also 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 snowy plovers. Construction of these and other facilities adjacent to sand dunes also results in loss of breeding and wintering habitat by increasing human disturbance to levels where beaches are no longer suitable for snowy plovers (see Figure 5). Urban development has permanently eliminated valuable nesting habitat on beaches in southern Washington (Brittell *et al.* 1976), Oregon (Oregon Department of Fish

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

and Wildlife 1994), and California (Page and Stenzel 1981). In addition to causing direct loss of habitat, there are additional potential adverse impacts to snowy plovers from urban development. When urban areas interface with natural habitat areas, the habitat value 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). Also, construction of residential development in or near 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 snowy plover breeding and wintering habitat. Sand removal by heavy machinery can disturb incubating plovers, destroy their nests or chicks, and result in the loss of invertebrates and natural wave-cast kelp and other debris that plovers use for foraging. Mining of surface sand from the 1930's through the 1970's 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 snowy plover if it results in an increase in habitat. However, unless beach nourishment projects are properly designed and use appropriately-sized sediments, they can result in changes to beach slope from redeposit of sediments by storm waves, and result in the loss of 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), sand mobility and sand color, 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 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 snowy plovers and the color of plover mantles. Also, heavy equipment associated with beach nourishment activities may destroy nests or chicks, or disturb breeding and wintering plovers.

ii. Dredging and Disposal of Dredged Materials

Dredging is detrimental to 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 plovers. Dredging is detrimental when it promotes water-oriented developments that increase recreational access to plover habitat (e.g., marinas, boat ramps, or other facilities to support water-based recreation). Dredged materials may provide important nesting habitat for plovers such as those at Coos Bay, Oregon (Wilson-Jacobs and Dorsey 1985). Snowy plovers have also 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 snowy plover breeding and wintering habitat. Plovers often nest beside driftwood, so its removal may reduce the number of suitable nest sites. 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 snowy plovers with year-round protection from wind and blowing sand.

Driftwood removal can negatively affect snowy plover habitat. 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. 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 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 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 snowy plovers when valuable driftwood is destroyed, as described above. 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 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.

v. Water Course Diversion, Impoundment, or Stabilization

Water diversion and impoundment of creeks and rivers may negatively affect snowy plover habitat by reducing sand delivery to beaches and degrading water quality. Water diversions are a major threat to 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.

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 snowy plovers. Dry salt ponds and unvegetated salt pond levees are used as plover nesting habitat. Ponds with shallow water provide important foraging habitat for plovers. Nesting 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 (i.e., levee reconstruction and maintenance of facilities) can result in the loss of snowy plovers and alteration or disturbance of their habitat. If conducted during the snowy plover breeding season, reconstruction of salt pond levees could destroy 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 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 snowy plovers has been 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*, and thus allow for sand movement and regenerating open expanses of sand. However, *Ammophila* 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 southern California (Ventura County). 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 snowy plover breeding sites in California and all of those in Oregon and Washington (J.P. Myers, National Audubon Society, *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. It is suspected that the source of this population was the Warrenton Dunes stabilization project on the Clatsop Peninsula in Oregon near the mouth of the Columbia River by the Soil Conservation Service (now the Natural Resources Conservation Service) in 1935. 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 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. These changes have reduced the amount of potential snowy plover nesting habitat on many beaches and may hamper brood movements. In Oregon, the beachgrass community may provide habitat for snowy plover predators (e.g., skunks, weasels, coyotes, foxes, raccoons, and feral cats) that historically would have been largely precluded by the lack of cover in the dune community (Stern *et al.* 1991*b*, K. Palermo pers. comm. 1998).

On most beaches with snowy plover habitat, European beachgrass 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 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 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 the State of Oregon in the 1930's and 1940's (Wiedemann 1987).

European beachgrass spread profusely along the Washington coast, and was well established by the 1950's (Washington Department of Fish and Wildlife 1995). In 1988, the spread of beachgrass was termed an “increasing threat” to traditional 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 snowy plovers and rare plants.

In addition to the loss of nesting habitat, introduced beachgrass may also adversely affect 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 snowy plovers 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 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*), and iceplant (*Mesembryanthemum* sp.). Shore pine (*Pinus contorta*) is a native plant species that has invaded coastal dunes and resulted in similar impacts to snowy plovers.

Many nonnative weed species also occur on and along San Francisco Bay salt pond levees, resulting in unsuitable nesting habitat for snowy plovers (J. Albertson *in litt.* 1999).

d. Habitat Conversion for Other Special Status Species

It is not known whether snowy plovers historically nested in San Francisco Bay prior to the construction of salt evaporator ponds beginning in 1860 (Ryan and

Parkin 1998). However, 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 California 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 snowy plover source population, representing approximately 10 percent of the total breeding population. Feeney and Maffei (1991) observed a sizable population of snowy plovers at the Baumberg and Oliver salt ponds during the breeding and nonbreeding seasons, suggesting that these ponds are important to snowy plovers throughout the year. They suspected that these ponds are used by 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 Central and Northern California, which we are currently preparing, 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 tidal marsh dependent species listed under the Endangered Species Act. These 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 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 to salt marsh; however, snowy plovers would lose suitable nesting and wintering areas. Therefore, this ecosystem plan also includes recommendations to support habitat needs of the snowy plover and California least tern (*Sterna antillarum browni*) on some of the existing salt ponds, through the maintenance of some salt ponds to be managed to provide snowy plover nesting and feeding habitats, including playas, salt flats, islands, and sparsely-vegetated levees.

In southern California, unless carefully planned, conversion of snowy plover habitat to tidal salt marsh may result in loss of 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 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.

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

Egg collecting has been observed at several California nesting colonies (Stenzel *et al.* 1981, Warriner *et al.* 1986). Occasionally recreational birdwatchers may also harass 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 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 plovers. The long-term impacts will be to benefit 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*)

3. Disease and Predation

Predator density is a significant factor affecting the quality of 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. The snowy plover generally cannot defend itself or its nests against predation but must rely on antipredator adaptations, including (1) pale coloration of adults, eggs, and young, which acts as camouflage against detection by predators; (2) a skulking retreat from the nest at a predator's approach; (3) extreme mobility and elusiveness of precocial young; and (4) maintenance of low nesting density (Page *et al.* 1983). 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 has been identified as a major factor limiting western snowy plover reproductive success at many Pacific coast sites. Known 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 (*Canis latrans*), striped skunks (*Mephitis mephitis*), spotted skunks (*Spilogale putorius*), raccoons (*Procyon lotor*), California ground squirrels (*Citellus beecheyi*), long-tailed weasels (*Mustela frenata*), American crows (*Corvus brachyrhynchos*), common ravens (*Corvus corax*), ring-billed gulls (*Larus delawarensis*), California gulls (*Larus californicus*), western gulls (*Larus occidentalis*), glaucous-winged gulls (*Larus glaucescens*), American kestrels (*Falco sparverius*), peregrine falcons (*Falco peregrinus*), northern harriers (*Circus cyaneus*), loggerhead shrikes (*Lanius ludovicianus*), 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*).

Common ravens are known predators of snowy plover clutches at many locations, including: Coos Bay, Oregon (Wilson-Jacobs and Dorsey 1985); Salmon Creek Beach, Sonoma County (Point Reyes Bird Observatory unpublished data); Wilder State Beach, Santa Cruz County (George 1997); Santa Rosa Island (Stein 1993); San Diego County (Point Reyes Bird Observatory unpublished data); San Francisco Bay salt ponds (J. Albertson *in litt.* 1999); and Point Reyes National Seashore, where they are the main cause of nest loss (Point Reyes Bird Observatory unpubl. data). At Point Reyes, ravens took at least 34 of 60 nests in 1987, at least 38 of 60 nests in 1988, and at least 39 of 60 nests in 1989; in 1995, before protective steps were taken, they took 7 of 18 nests (Hickey *et al.* 1995). Corvids (ravens and crows) have also been a significant problem in southern California, with ravens taking a significant number of snowy plover eggs. In San Diego County, at least 22 of 179 nests were taken by ravens in 1996 (Powell *et al.* 1996), and at least 23 of 174 nests were taken by ravens and crows in 1997 (Powell *et al.* 1997). In 1991, high predation rates by common ravens occurred at the south spoil nesting area of the Coos Bay north spit, Oregon. The plovers responded by abandoning this nesting site, and moving remaining nesting efforts during the 1991 nesting season westward to the ocean beach (Stern *et al.* 1991*b*). Ravens probably also prey on snowy plover chicks, but not nearly to the extent that they do on eggs. After exclosures were used to protect plover nests from ravens on Point Reyes National Seashore in 1996, snowy plovers experienced high chick fledging rates relative to other coastal sites. At Waddell State Beach in 1994, a raven was observed taking a live killdeer (*Charadrius vociferus*) chick (D. George pers. comm. 1998), indicating they sometimes likely also take snowy plover chicks.

American crows have been documented preying on snowy plover nests at Atascadero Beach, San Luis Obispo County (Page 1990) and at Vandenberg Air Force Base, where they took at least 43 of 411 nests in 1997 (Persons and Applegate 1997). Crows were also one of the main predators of snowy plover nests at Vandenberg Air Force Base in 1998, where they took 19 nests (T. Applegate pers. comm. 1999). Crows have also been documented as predators of snowy plover eggs at locations along the Oregon coast (M. Stern pers. comm. 1999).

Gulls pose a special threat to breeding snowy plovers because they not only depredate nests and chicks, but also usurp and trample plover nesting habitat and crush eggs. Trampling of some nests by gulls has been frequently recorded at Vandenberg Air Force Base (Persons and Applegate 1997) and has been the cause of some nest loss in 13 of 16 years since 1983 at Monterey Bay (Point Reyes Bird Observatory unpublished data). Western and glaucous-winged gulls were primary predators of snowy plover chicks at Leadbetter Point (Widrig 1980). California gulls have trampled snowy plover nests and eaten eggs at San Francisco Bay locations (J. Albertson *in litt.* 1999). California gulls were major predators of snowy plover nests at Mono Lake, California (Page *et al.* 1983).

Loggerhead shrikes prey upon snowy plover chicks, but not eggs. Shrikes took at least 14 snowy plover chicks on a salt pan at the Pajaro River mouth in 1979 (Warriner *et al.* 1986). In 1996, a shrike was observed taking a chick from a hatching nest at the Salinas River National Wildlife Refuge (Page *et al.* 1997). In 1997, a shrike killed two chicks in an exclosure at Wilder State Beach (George 1997). In 1986 and 1987, loggerhead shrikes were regularly observed on the beach at the Pajaro River mouth during the chick fledging period and were suspected of taking most chicks before they reached fledging age; however, fledging success was also low in the same area in 1988 and could not be attributed to shrikes, which were not seen regularly there in that year (Page 1988). A loggerhead shrike was twice observed in one day attempting to take snowy plover chicks at San Francisco Bay salt ponds (Feeney and Maffei 1991). On these two occasions, however, the shrike was not successful because of persistent attacks by the tending male parent.

American kestrels are not known predators of snowy plover eggs. They are predators of chicks and possibly adults. A kestrel was observed capturing a 2-week-old snowy plover chick at Wilder State Beach in August 1989, and one was observed eating a snowy plover chick in the Moss Landing Wildlife Area on two occasions in August 1995 (D. George pers. comm. 1998). In 1998, a kestrel was observed hunting regularly where there were snowy plover broods in the Moss Landing Wildlife Area. During the period the kestrel was present at the pond, 43 chicks from 17 broods scheduled to fledge from June 11 to 24, had been banded. Only four chicks (9.3 percent) fledged. The kestrel disappeared unexpectedly, and

the fledging rate of broods increased dramatically. Of 105 banded chicks from 39 broods scheduled to fledge from June 25 to August 17, 67 chicks (63.8 percent) fledged. Later, Point Reyes Bird Observatory staff learned that a pair of kestrels had nested in a newly-erected nesting box about 0.4 kilometer (0.25 mile) from the brood-rearing area. Staff of Point Reyes Bird Observatory were invited to examine the contents of the nest box when it was being cleaned out and found bands for 12 snowy plover chicks in and below the box. The bands were from chicks scheduled to fledge from June 12 to June 20 (Page *et al.* 1998).

In 1997, a merlin with an adult snowy plover in its talons was observed flying from an exclosure at Salinas River National Wildlife Refuge. Within a period of a few days, 13 banded adults were found missing from the area. All were suspected of having been taken by the merlin, which was present in the area at the time. At the time of their disappearance, 10 of the 13 adults were nesting in exclosures and 3 were not (Page *et al.* 1997). Merlins are also probably effective predators of snowy plovers during the winter.

Snowy plovers are among the avian prey of the peregrine falcon (B. Walton pers. comm. 1998). In August 1996, a peregrine falcon was observed capturing a 27-day-old snowy plover chick from the ground at the Moss Landing Wildlife Area (D. George pers. comm. 1998). In San Francisco Bay, a peregrine falcon was seen taking an adult snowy plover at the Oliver North salt ponds; it was also seen at the Baumberg salt ponds, with 10 snowy plovers calling in alarm several meters (about 10 feet) away (Feeney and Maffei 1991).

Northern harriers are effective predators of snowy plover chicks. They may also take some adults. In 1987, 65 to 66 chicks hatched from 30 clutches on islands in the Salinas River. Subsequently, a harrier was observed hunting on the islands on several occasions. Of the 65 to 66 chicks, only 20 banded ones and 3 unbanded ones (34.8 to 35.4 percent) reached fledging age of 28 days. Of the 20 banded chicks, 12 were never seen off the islands and are presumed to have been eaten. Four adults caring for the chicks also disappeared. At the end of the nesting season, Point Reyes Bird Observatory staff visited the islands and found the eaten remains of two young snowy plovers and at least five other shorebirds on the ground (Point Reyes Bird Observatory unpubl. data). At the Moss Landing

Wildlife Area, a sharp drop in the fledging rate of snowy plover chicks was noticed after a harrier began foraging there. Prior to the appearance of the harrier, 61 percent of the chicks from 40 clutches fledged, compared to 23 percent of the chicks from 19 clutches subsequent to its appearance (Page *et al.* 1997).

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 and released into the southern Sacramento Valley as early as the 1870's. The completion of the Transcontinental Railroad in 1869 allowed people to rapidly transport fish and wildlife from the eastern United States. The foxes might have been imported for sport hunting (fox chasing), for farmland rodent control, or for nostalgic reasons by the new settlers (Jurek 1992, Lewis *et al.* 1995). By the 1890's, red foxes in the Sacramento Valley were becoming plentiful and were being hunted and trapped for fur. In the 1920's, red foxes were being imported for the new endeavor of fox farming. By the 1930's, red foxes were widespread in the Sacramento Valley. By the 1970's, they were occurring in the Sacramento-San Joaquin Delta, and there were early indications of red fox populations in Los Angeles County. Although the spread of this alien species had been a gradual one for a century, an explosive spread was apparent from the 1970's into the 1980's, possibly from a combination of welfare relocations by landowners, animal welfare groups, and animal control entities; releases of unwanted captives or pets; and increasing red fox habitat offered by urbanization (Lewis *et al.* 1993). The fox apparently 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 have been identified as a significant predator of snowy plover clutches in the Monterey Bay area, where they are also suspected of preying on adults and chicks. On Monterey Bay beaches, clutch hatching rates of snowy plovers declined steadily from 63 percent in 1984 to 33 percent in 1990 as red foxes

became a primary cause of clutch loss. Clutch losses attributed to red foxes rose from 4 in 1984, to 12 in 1985, to 34 in 1986. From 1986 to 1991, annual losses attributed to red foxes ranged from 22 to 57 clutches and represented 30 to 55 percent of all clutch losses. Since exclosures came into use to protect nests around Monterey Bay in 1992, losses to red foxes have ranged from zero to seven annually, and clutch hatching rates have climbed from 59 to 72 percent annually (Point Reyes Bird Observatory unpubl. data).

Coyotes are known predators of snowy plover clutches 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 62 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 plover nesting season (Page and Persons 1995). Coyotes have also been identified as predators of plover nests at Mono Lake, California (Page *et al.* 1983).

Striped skunks have been recorded as predators of snowy plover clutches at Point Reyes National Seashore (Hickey *et al.* 1995), pocket beaches in northern Santa Cruz County (George 1997), Monterey Bay (Page *et al.* 1997), Morro Bay (Hutchinson *et al.* 1987), Santa Rosa Island (Stein 1993), and Coos Bay North Spit (Stern *et al.* 1991*b*). 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 snowy plovers has been monitored at that location (Hutchinson *et al.* 1987). In the Monterey Bay area, small skunks occasionally squeeze through the fencing of exclosures and eat the plover's eggs (G. Page pers. comm. 1998).

Domestic and feral cats are widespread predators. The threat of predation of snowy plovers by cats increases when housing is constructed near snowy plover breeding habitat. As natural-appearing beaches continue to be surrounded by urban areas, snowy plovers will increasingly be subjected to this predator in the future. Cats are also one of the most common predators seen at California least tern nesting sites every year (R. Jurek pers. comm. 1999). At Venice Beach in southern California, cats are a constant threat to California least terns, which are found in habitat similar to that used by snowy plovers. This California least tern

colony had to be fenced to protect the terns from predators, including cats. When cats attempted to get over the fence, the fence had to be modified to further discourage entry by cats. Predation by cats is a major threat to snowy plovers; however, it is difficult to measure because of the difficulty in finding evidence of bird remains. Cats are known to take snowy plover adults and eggs. An adult snowy plover, found dead in 1994, was caught by a domestic cat at Buena Vista Lagoon, located between the mouth of the Santa Margarita River and Aqua Hedionda Lagoon (B. Farner pers. comm. *in* Powell and Collier 1994). During 1986, at the north spit of the Salinas River, two snowy plover clutches were lost to domestic cats (Page 1988).

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 snowy plovers. Urbanization benefits red fox population growth by eliminating coyotes, which are the red fox's most serious 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 serious predators besides the 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 1980's (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.

Continued settlement of coastal areas by humans has generally supported increased populations of predators. Unnatural habitat features such as landscaped vegetation (e.g., palm trees), telephone poles, fences, buildings, and landfills near snowy plover nesting areas attract predators and provide them with breeding sites. These alterations all combine to make the coastal environment more conducive to various native and nonnative predators that adversely affect snowy plovers.

Substantial evidence exists that human activities are affecting numbers and activity patterns of predators on snowy plovers. For example, increased depredation of 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 pers. comm. 1997). 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*b*). 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). Also, widespread urbanization has depleted native predator habitat, bringing increased predatory pressure into the few undeveloped areas that are left, including habitat for snowy plovers and other sensitive species.

Widespread urbanization has depleted native predator habitat, bringing increased predation pressure into the few undeveloped areas that are left, including habitat for the snowy plover and other sensitive species. In heavily-developed areas in particular, habitat protected for sensitive species may be a "magnet" to native predators that have lost foraging habitat elsewhere. Continuing to remove predators from these areas effectively creates a "sink," such that the need for ongoing predator removal never ends and negative ecological consequences occur over large areas beyond the boundaries of snowy plover nesting areas. Most predators having the greatest impacts on snowy plovers (e.g., coyotes, American kestrels) are territorial; if they, as individuals, can be deterred from preying on

snowy plovers, their eggs, and chicks, they may prove beneficial in excluding other conspecifics from plover nesting areas.

Signing and fencing of restricted areas on the beach may provide perches for avian predators of snowy plover adults or chicks. In 1995, corvids were known predators of plovers at the Siltcoos River area in Oregon, and there was evidence they used restrictive signs as perches (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.

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 snowy plovers will therefore not be affected by Proposition 4 (J. Albertson *in litt*. 1999).

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 by State law as a nongame species. The 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 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 snowy plovers in some cases. Section 404 of the Clean Water Act and section 10 of the Rivers and Harbors Act 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, snowy plovers have no protection status in Mexico.

To effectively recover the 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 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 snowy plover conservation actions. These partners continue to work to implement appropriate management of coastal areas for recovery of the 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.

5. Other Natural or Manmade Factors Affecting Their Continued Existence

a. Natural Events

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 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 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 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 snowy plover. It is suspected that the severe storms occurring during the El Niño atmospheric and oceanic phenomenon of 1997/1998 winter caused a 10 to 30 percent decline in the 1998 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 snowy plover population naturally varies, both spatially and temporally, because of natural changes in weather and habitat conditions from year to year. However, human influences over the past century (e.g., habitat destruction, invasion of introduced beachgrass, and elevated predation levels) have reduced the plover's ability to respond to these natural perturbations.

b. Disturbance of Breeding Plovers by Humans and Domestic Animals

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 (U.S. Fish and Wildlife Service 1993*a*). Also, human settlement and actions within coastal areas are affecting the numbers and activity patterns of predators of snowy plovers, to the detriment of the plovers. The coastal zone of the United States 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 coastal zone includes both open coastal areas and inland portions of coastal watersheds. The southern California coastal area, which constitutes the central portion of the snowy plover's coastal breeding range, attracts large crowds on a regular basis (see Figure 6).

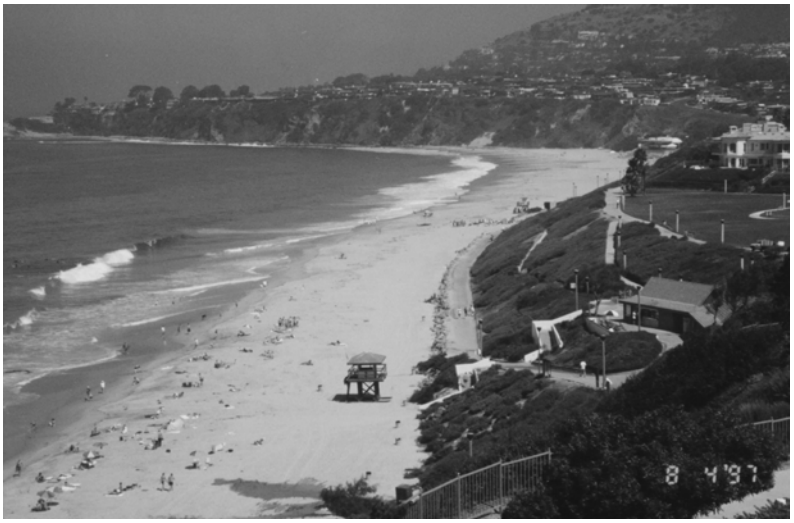


Figure 6. Recreationists at Salt Creek Beach, California (photo by Ruth Pratt, with permission).

i. Pedestrians

Pedestrians (e.g., beach walkers and joggers) can cause both direct mortality and harassment of snowy plovers. Pedestrians on beaches may crush eggs or chicks and chase snowy plovers off their nests. Separation of 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 may also cause broods of snowy plovers to run away from favored feeding areas. Trash left on the beach by pedestrians also attracts predators. In addition to public pedestrians, military personnel using the beach for maneuvers, launches, and landings can also cause many of these adverse impacts to snowy plovers.

Beach-related recreational activities that are concentrated in one location (e.g., sunbathing, picnicking, sandcastle building, and birding/photography) can negatively affect incubating adult 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 snowy plovers when they disturb plover adults

or broods, which feed at the edge of the surf. Recreational activities that occur in or over deep water may not directly affect snowy plovers; however, they can potentially be detrimental to plovers when recreationists use the beach to take a break from these activities, or as access, exit, or landing points. These recreational activities could include the beach- and water-oriented activities of surfing, kayaking, wind surfing, jet skiing, and boating, and the coastal-related recreational activity of hang gliding.

Concentrations of people may deter 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 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 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 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 snowy plover nesting areas may also 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 East coast 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 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 snowy plover nests. At Point Reyes, they found that pedestrians disrupt incubation of nests. When humans approached snowy plovers, adults left their nests 78 percent of the time when people were

within 1 to 50 meters (3 to 164 feet); 65 percent of the time when people came within 50 to 100 meters (164 to 328 feet); and 34 percent of the time when people were within 100 to 250 meters (328 to 820 feet). They also found that 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 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 plovers may benefit from a decline in wariness by plovers nesting on beaches that are subject to ongoing high levels of human disturbance (Persons and Applegate 1997).

Fahy and Woodhouse (1995) quantified the levels of recreational disturbance, their effect on snowy plovers, and the effectiveness of the Linear Restriction Program at Ocean Beach, Vandenberg Air Force Base. Randomized observations of four study plots covered 71 days, with the majority lasting 90 minutes. Overall plover responses to activities occurring within and outside the restriction area were recorded. The disturbance types that caused incubating 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 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.

Signs warn visitors not to cross the Linear Restriction Boundary into dune habitat used by plovers. Seventy percent of all disturbances were in compliance and 30 percent in noncompliance with this restriction. The disturbance types that were most and least frequently in compliance with the boundary were joggers or walkers and stationary visitors, respectively. All-terrain vehicles caused the most significant alert and flight behaviors by plovers, even though they were in compliance with the Linear Restriction. The authors of this study also predicted that "the closer the disturbance occurs to the plover, the more severe the plover response." Plover responses to disturbance types ranged from approximately 1 meter (3 feet) for flight responses to 130 meters (426 feet) for alert responses. Weekends accounted for 60 percent of all disturbances. The effectiveness of

enforcement personnel was limited; their presence was documented during only 14 percent of all identified disturbances.

At the Pajaro River mouth in California, at least 26 of 189 snowy plover clutches, representing 14 percent of the observed 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 snowy plovers declined from 25 in 1969 to 5 in 1979 to 0 by 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, 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 in 1994.

Loss of 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 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).

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.

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.

Schulz 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 snowy plovers during both the breeding and nonbreeding seasons. Unleashed pets, primarily dogs, sometimes chase snowy plovers and destroy nests. Repeated disturbances by dogs can

interrupt brooding, incubating, and foraging behavior of adult 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 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 have also 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, California, a three-egg snowy plover nest was trampled and destroyed by a dog in 1990 (D. George pers. comm. 1997). At Zmudowski State Beach, a dog stepped on and destroyed two of three eggs in one nest in 1998 (Point Reyes Bird Observatory unpublished data). Also in 1998, two of three eggs in a nest at Salinas River State Beach were destroyed by dogs (Gary Page pers. comm. 1998). The latter two instances occurred in areas protected by symbolic fencing. Feral dogs are suspected to have disturbed snowy plover nests and chicks on San Francisco Bay salt ponds in 1998 (J. Albertson *in litt.* 1999).

Even when not deliberately chasing birds, dogs on a beach may disturb snowy plovers and other shorebirds that are roosting or feeding. Page *et al.* (1977) found that 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 snowy plovers flushed from their nests as a result of disturbance by people versus people *with* dogs. At 1 to 50 meters (3 to 164 feet), people alone caused flushing 78 percent of the time, while people with dogs caused flushing 100 percent of the time. At a distance of 50 to 100 meters (164 to 328 feet), people alone caused flushing 57 percent of the time, while people with dogs caused flushing 65 percent of the time. At a distance of 100 to 250 meters (328 to 820 feet), people alone caused flushing 34 percent of the time, while

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 snowy plovers than other types of disturbances at Ocean Beach, Vandenberg Air Force Base, California.

At wintering sites such as Ocean Beach in San Francisco, California, off-leash dogs have caused frequent disturbance and flushing of snowy plovers and other shorebirds. Off-leash dogs chase wintering snowy plovers at this beach and have been observed to regularly disturb and harass birds (P. Baye pers. comm. 1997). Observations by National Park Service volunteers suggest that unleashed pets represent the most significant recreational threat to wintering 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 snowy plovers at Ocean Beach, people approaching within 15 meters (50 feet) of snowy plovers caused the plovers to run, walk, or fly in 56 percent of 185 instances. By comparison, 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.

On the East coast of the United States, dogs are also known to chase piping plovers as well as kill chicks. During a study conducted on Cape Cod, Hoopes *et al.* (1992) found that the average distance at which piping plovers were disturbed by pets was 46 meters (151 feet), compared to 23 meters (75 feet) for pedestrians. Furthermore, the birds reacted to the pets by moving an average of 57 meters (187 feet), compared to 25 meters (82 feet) when the birds were reacting to a pedestrian. The duration of the disturbance behavior stimulated by pets (53

seconds) was also significantly greater than that caused by pedestrians (29 seconds). Pets within 50 meters (164 feet) of the birds caused piping plovers to stop feeding 52 percent of the time (Hoopes *et al.* 1992). In 1994, a dog that was removed from its leash after passing piping plover chicks within an area marked by symbolic fencing swiftly returned to the fenced area and killed a plover chick (Melvin *in litt.* 1997).

iii. Motorized Vehicles

Unrestricted use of motorized vehicles on beaches is a threat to 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 dune plant species.

Driving vehicles in breeding habitat may cause destruction of eggs, chicks, and adults, abandonment of nests, and considerable stress and harassment to plover family groups. In California and Oregon, vehicle tracks have been found near nests at a number of beaches and there have been some instances of vehicles crushing nests, chicks, and adults. In the Monterey Bay area, two male snowy plovers were run over while incubating eggs (G. Page pers. comm. 1997, J. P. Myers *in litt.* 1988). At McGrath State Beach (Mandalay Bay/Santa Clara River mouth), two snowy plover chicks were found to have been crushed by vehicles (J.B. Price *in litt.* 1992). In addition to recreational vehicles, vehicles used for military activities have also incurred snowy plover mortality. Eggs at Coronado Naval Amphibious Base were run over by a vehicle, and another nest was destroyed by an air-cushioned landing craft at Camp Pendleton Marine Corps Base (Powell *et al.* 1995, 1997). A snowy plover chick may have died of exhaustion at Camp Pendleton Marine Corps Base after trying to escape disturbance by climbing over deep ruts left by amphibious tracked vehicles (Powell *et al.* 1997). At Vandenberg Air Force Base, two snowy plovers (one adult and one chick) were killed when run over by a security vehicle (Persons 1994). Off-road vehicles at Coos Bay North Spit, Oregon, ran over one clutch and scattered broods from other nests (Stern *et al.* 1990*b*). Although vehicle

traffic was prohibited on the beach west of Floras Lake, Oregon, all-terrain vehicle tracks were observed only 15 centimeters (6 inches) away from unprotected nests with eggs on two occasions during the 1993 breeding season; regular violations of the closure to vehicle traffic at the Tenmile estuary were also noted (Casler *et al.* 1993). In Washington, vehicle tracks have been noted in nesting areas at Leadbetter Point and Midway Beach (S. Richardson pers. comm. 1998). Widrig (1980) reported that, in 1978, human disturbance at Willapa National Wildlife Refuge, Leadbetter Point, was heavy at times, primarily from motorcycles and four-wheel drive vehicles. The nesting area was closed during the 1979 nesting season. The number of young fledged per nesting pair increased from 0.3 in 1978 to 1.2 in 1979.

Driving motor vehicles at night seems to be particularly hazardous to snowy plovers. Drivers of all-terrain vehicles at night have run over and killed snowy plover adults at Vandenberg Air Force Base, and State park ranger patrol vehicles have crushed snowy plover chicks at Oceano Dunes State Vehicular Recreation Area during night patrols (R. Mesta *in litt*. 1998).

Snowy plover adults and chicks have been observed using tire tracks and human footprints for loafing at Camp Pendleton and the Naval Air Base at Coronado (Powell and Collier 1994). This behavior increases their chances of being run over. 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 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).

Buick and Paton (1989) assessed the impact of off-road vehicles on nest attentiveness and nesting success of hooded plovers (*Charadrius rubricollis*), a similar plover species in south Australia. They patrolled 71 kilometers (44 miles) of beach using four-wheel-drive vehicles or motorbikes every 3 to 4 or 8 to 10 days (depending on the beach) and recorded hooded plover numbers and odometer readings. Density of vehicle tracks was determined from positions and widths of

tracks on random transects, primarily "to estimate the proportion of the beach that had been run over at least once." Based on the density of vehicle tracks observed, they found an 81 percent probability that hooded plover nests would be run over during incubation.

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.

Flemming *et al.* (1988) found that adult piping plover behavior in Nova Scotia was not appreciably altered by vehicles. However, the primary focus of their study was the effects of pedestrian disturbance on reproductive success and behavior of piping plovers.

At wintering sites, disturbance from motorized vehicles may harass 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 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 snowy plovers; however, the indiscriminate nature of mechanized beach-cleaning adversely affects snowy plovers and their habitat. Mechanized beach cleaning can be dangerous to 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 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 snowy plover nesting (Powell 1996).

v. Equestrian Traffic

Horseback riders on the beach sometimes enter coastal dunes or upper beach areas (see Figure 7), where they may crush clutches or disturb plovers. The following clutch losses in Monterey Bay were attributed to trampling by horses: one each in 1984, 1987, 1989, and 1991; two in 1986; and three in 1993 (Point Reyes Bird Observatory unpublished data). Equestrians were suspected of being the cause of no nesting at Wilder Beach in 1988 (Page 1988). During the 1994 breeding season, frequent noncompliance by equestrians was observed within the linear closure area of snowy plover nesting habitat at Vandenberg Air Force Base (Persons 1995). During Memorial Day weekend at Baker Beach, Oregon, Woolington (1985) observed that most of the horseback riders stayed on the hard-packed sand near the edge of the surf; however, she observed three riders who rode through snowy plover nesting habitat within the dune hollows. At New River, Oregon, Craig *et al.* (1992) observed a snowy plover nest that was almost destroyed by a pair of horseback riders before the plover surveyors had time to construct an exclosure around the nest. Unleashed dogs have also been associated with equestrians.

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

vi. Fishing

Impacts on snowy plover nesting may be associated with surf fishing and shellfish harvesting in and near plover habitat. The improper disposal of offal (waste parts of a butchered animals, e.g. fish), bait, and other litter attracts crows, ravens, and gulls, which are predators of plover eggs and chicks. Also, plovers may become entangled in discarded fishing lines (G. Page pers. comm. 1998). Persons and Applegate (1997) noted that flocks of gulls were often seen near parties of surf fishermen at Surf Beach, Vandenberg Air Force Base. Gull tracks were traced to trash discarded by anglers and other recreationists. They suspected that many of the snowy plover nests destroyed by gulls during 1997 were discovered while the gulls were scavenging. Fahy and Woodhouse (1995) found that stationary visitors and surf fishermen kept incubating snowy plovers off their nests longer than other types of disturbance at Ocean Beach, Vandenberg Air Force Base, probably because of the longer duration of these stationary disturbances. They also found that stationary visitors and surf fishermen were more frequently in noncompliance with the Linear Restriction than people engaged in other recreational activities. Anglers and other recreationists use dunes as toilets, attracting scavengers into nesting areas at Vandenberg Air Force Base even though the dunes are signed as closed to the public (R. Mesta *in litt.* 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 snowy plovers (K. Palermo *in litt.* 1998*a*).

Because the earliest 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 snowy plovers. Clammers near nesting areas may disturb adults and chicks; human activity in feeding areas may restrict 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 snowy plover and human activities during the spring 1995 razor clam season showed clamming had no visible impact on plovers where clamming intensity was low (Kloempken and Richardson 1995). Instances of trespassing into the snowy plover protection area were noted; however, movement of the 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 snowy plovers. At Del Monte Beach, California, a 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 plovers left the nest site with two chicks, abandoned the third chick, and were not seen again (K. Neumann 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 (Howard *et al.* 1993).

viii. Falconry, Kite Flying, and Model Airplanes

The sport of training falcons for hunting could result in losses of snowy plovers when it introduces predators to snowy plover habitats.

Biologists believe plovers perceive kites as potential avian predators. The reaction of 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 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 the duration of the movement was the longest. 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 would also have a detrimental impact to snowy plovers because 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 snowy plovers. Hatch (1997) found that all types of low-flying aircraft may potentially be perceived by plovers as predators. She also found that the general response of roosting 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 plovers frequently took flight. 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. 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. Department of Transportation, Federal Aviation Administration, 1977). Emergency operations, including those by Coast Guard helicopters, are exempted from these rules.

Helicopters can cause excessive noise, which can also disturb plovers, even at an altitude of 152 meters (500 feet). Fish and Wildlife Service and Vandenberg Air Force Base personnel have observed helicopters flush incubating snowy plovers during pre-launch security sweeps at Vandenberg Air Force Base; these helicopter flights were directed not to overfly nesting habitat, and were to be at least 152 meters (500 feet) above mean sea level (J. Watkins *in litt.* 1999). During observations of piping plovers that nest on the Breezy Point Cooperative and adjacent beaches of Gateway National Recreation Area in Queens, New York, small fixed-wing aircraft, and especially helicopters, often caused foraging piping plovers to stop feeding and crouch or run (Howard *et al.* 1992). At Camp Pendleton Marine Corps Base, California, military training aircraft (including helicopters) are only required to fly at a minimum altitude of 91 meters (300 feet) above ground level during the period April 15 to August 31, in areas that support snowy plover and California least tern habitat (D. Stadtlander pers. comm. 1999).

x. Special Events

Special events, including media events, sporting events, and beach clean-ups, which attract large crowds, have a potential for significant adverse impacts when held in or near 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 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 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 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 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 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 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

Snowy plover nests have been trampled by cattle. On Santa Rosa Island, California, 4 nests were trampled by cattle and 1 nest was trampled by horses, resulting in the loss of at least 10 eggs during a 2-year study conducted by the National Park Service in 1992 to 1993. In addition to direct mortality from livestock, incubating snowy plovers were observed to flush from nests when cattle passed within 15 meters (49 feet). On one occasion, the adult bird was off the nest for over 28 minutes when a steer laid down next to the nest. Livestock on Santa Rosa Island also frequently use a lagoon in the Skunk Point area that is an important feeding area for pre-fledged snowy plover chicks. Fouling the water and trampling its adjacent shoreline may adversely affect snowy plover foraging habitat (U.S. Fish and Wildlife Service *in litt.* 1995). On Santa Cruz Island, feral pigs may trample snowy plover habitat and disturb nesting plovers (R. Klinger pers comm. 1998).

c. Oil Spills

Oil spills threaten snowy plovers throughout their life cycle. Snowy plovers forage along the shoreline and in sea wrack (seaweed and other natural wave-cast organic debris) at the high-tide line and thereby risk exposure to oil during spills. Often, plovers get oil on their feet and transfer it to their feathers when they draw their feet into their plumage while roosting (G. Page pers. comm. 1997). Oil spills may result in contamination of snowy plover food sources when oiled wrack is left on the beach. Adverse impacts to plovers may also occur during oil clean-up and remediation activities if response teams are not careful when driving heavy equipment and vehicles or traversing on foot through plover habitat.

The loss of thermal insulation is acknowledged 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. Swallowing small amounts of preened oil may lead to physiological changes in birds, including pathological effects on the alimentary tract, blood, adrenal glands, kidneys, liver, and other organs. Reproductive performance may also be impaired. There is evidence that

ingested oil causes delayed maturation of ovaries, altered hormone levels, thinning of eggshells, reduced survival of eggs and chicks, reduced chick growth, and abandonment of nests by adults (Burger and Fry 1993). Oil transferred to eggs from plumage or feet of incubating birds can kill embryos (Albers 1977, Albers and Szaro 1978, King and Lefever 1979). Oil or other chemicals washed onto mudflats or sand beaches may also result in reduction of the availability of invertebrate prey (Kindinger 1981). Evans and Keijl (1993) found that following the Gulf War, 44 percent of 522 Kentish plovers (*Charadrius alexandrinus alexandrinus*) within areas of the Saudi Arabian coast affected by the 1991 spill were heavily oiled (i.e., more than 10 percent of plumage oiled). Heavily-oiled wading birds were found to be significantly lighter in weight than unoiled waders, and it was suspected they were unlikely to migrate successfully or breed during that year because of losses in energy reserves.

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). Crude oil is transported from offshore platforms along the California coast. Potential adverse effects to snowy plovers could occur from the oil globs commonly found on Santa Barbara and San Luis Obispo county beaches. Also, risks may be compounded or higher in these areas due to both chronic natural oil seeps and potential spills from oil platforms in these areas.

Between 1988 and 1999, at least six oil spills in California and one in Oregon resulted in adverse impacts to snowy plovers. One of these spills (or series of spills) occurred at Unocal's Guadalupe Oil Field in San Luis Obispo, California. During Unocal's 34-year period of operation, numerous spills of crude oil and diluent, a diesel-like product, occurred throughout the oil field. Over 190 separate spills were recorded between July 1984 and July 1990. We and other natural resource trustees have estimated that between 8 and 12 million gallons of diluent have been released into the soil, ground water, and marine environment. Between the period January 1988 and October 1998, natural resource trustees documented eight hydrocarbon releases into the marine environment at Unocal's Guadalupe Oil Field. These spills had adverse effects on plovers by contaminating their habitat and prey base. Remediation and monitoring of this contamination continue to result in the disturbance or harassment of nesting plovers. On

December 25, 1993, oil spilled from a ruptured oil transfer line into McGrath Lake, and then flowed out into the ocean. Approximately 2,000 barrels of oil were spilled, affecting 0.53 kilometer (0.33 mile) of riparian woodland area along a creek, McGrath Lake, and 11.2 kilometers (7 miles) of sandy beaches. Plover habitat and prey were contaminated with oil and wintering plovers were displaced during the cleanup activities (S. Henry *in litt.* 1998). In Washington, the 1988 Nestucca oil spill and the 1991 Tenyo Maru oil spill may also have affected snowy plovers.

Between 1996 to 1998, three oil spills in snowy plover habitat on National Park Service lands along the California coast resulted in oiled plovers. Affected areas were Ocean Beach, San Francisco, and Point Reyes National Seashore (on two separate occasions between 1997 and 1998). Snowy plovers were found oiled on Ocean Beach in November 1996. Staff of the Point Reyes Bird Observatory and the National Park Service trapped and banded eight of the birds, and there were two additional banded birds in the area. Oil was observed on the plumage or feet of all but one of these banded birds. Point Reyes Bird Observatory staff compared the survival of the birds from the oiled location to those from adjacent areas not affected by spilled oil through January 1997. There was no difference in the survival rate between the two groups of birds. However, the two Ocean Beach birds with the most oil on their plumage were the only two birds from Ocean Beach that disappeared prior to the end of January 1997. They were not seen again and presumably died (Point Reyes Bird Observatory unpublished data). In November 1997, at least 22 snowy plovers were observed at Limantour Estero, Marin County, with oil on their plumage during a spill that also affected other species of birds. Two of the oiled snowy plovers were banded. Neither apparently survived the winter (Point Reyes Bird Observatory unpublished data).

In September 1997, an oil spill caused by the rupture of a sub-sea pipeline occurred in Santa Barbara County near Pedernales Point, resulting in oiled snowy plovers. After this spill, Persons and Applegate (1997) observed lightly- to moderately-oiled snowy plovers at Surf Beach, Vandenberg Air Force Base. A sick plover was seen with a glob of heavy crude oil on its upper mandible. The authors expressed concern that had this spill occurred during the plover breeding

season, both the oil and cleanup effort would have had severe adverse effects on plover nests and chicks.

On February 4, 1999, the New Carissa, a 195-meter (639-foot) freighter ship designed to carry wood chips, went aground about 5 kilometers (3.1 miles) north of the North Jetty of Coos Bay, Oregon. The New Carissa grounded in shallow water a few hundred yards off lands managed by the U.S. Bureau of Land Management on the North Spit of Coos Bay. Attempts to burn fuel oil present on board the New Carissa resulted in the vessel being fractured into two pieces. On March 2, 1999, the 134-meter (440-foot) bow section of the ship was pulled away from the North Spit, with the intent of dumping it at sea. It broke free of the tow vessel later that day and landed on the beach at Governor Patterson Memorial State Park on March 3, 1999. This location was near Waldport, Oregon, about 129 kilometers (80 miles) north of the spot where the vessel first became grounded.

On March 8, the bow section of the New Carissa was successfully pulled off the beach at Governor Patterson Memorial State Park and taken out to sea where it was sunk on March 11, 1999, about 515 kilometers (320 miles) off the Oregon coast. The 61-meter (200-foot) stern section of the New Carissa is still present, just offshore of the North Spit of Coos Bay. Oil has leaked from the stern section on repeated occasions since the sinking of the bow section and resulted in a major operation between the ship's representatives and the U.S. Coast Guard to remove oil from it.

The U.S. Coast Guard has estimated that about 265,000 liters (70,000 gallons) of oil were released into marine waters during the Coos Bay phase of the New Carissa incident. Additionally, they estimated that another 7,600 liters (2,000 gallons) were released into the marine environmental during the Waldport phase of the grounding event.

Many species of birds, including the snowy plover, were soiled with oil as a result of the incident, and there were numerous mortalities. It is estimated that at least 40 to 50 snowy plovers were oiled during the incident, representing about 50 percent or more of the Oregon wintering population. One snowy plover was

found dead with oil on it, and another two that had been seen during the incident with heavy oiling, were never seen again.

d. Contaminants

Because snowy plovers are primarily insectivorous, feeding both on aquatic and terrestrial insects, the bioaccumulation of environmental contaminants on their nesting and wintering grounds may adversely affect their health and reproduction (Powell and Hothem 1997). Organochlorines have been known to cause 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 is known to cause decreased hatchability of avian eggs (Connors *et al.* 1975). Boron has been shown to reduce hatchability of waterfowl eggs in laboratory experiments; arsenic may also adversely affect avian reproduction (Hothem and Welsh 1994).

Powell and Hothem (1997) analyzed 23 snowy plover eggs collected 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. They were collected from five sites: Camp Pendleton Marine Corps Base, Batiquitos Lagoon, Naval Air Base Coronado, Sweetwater Marsh National Wildlife Refuge, and Tijuana Estuary. 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 snowy plover eggs. Median DDE and PCB concentrations were less than those normally associated with deformities or other detrimental effects on birds. Twelve metals and trace elements (As, B, Cr, Cu, Fe, Hg, Mg, Mn, Ni, Se, Sr, and Zn) 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.

Ten snowy plover eggs collected near Lake Abert, Oregon, were analyzed for organochlorine insecticides and total polychlorinated biphenyls. Concentrations

were less than 0.05 parts per million (level of detection) for all analyses except DDE, which was found in seven of the eggs at concentrations ranging from 0.05 to 0.19 parts per million, wet weight (U.S. Fish and Wildlife Service unpublished data). These DDE concentrations are less than those associated with poor reproductive success, including eggshell thinning, in other avian species (T. Buerger *in litt.* 1998).

e. Litter, Garbage, and Debris

Placement of litter, garbage, and debris in the coastal ecosystem can result in direct harm to 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 plovers.

Marine debris and contaminated materials on the beach also adversely affect 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. Plovers may become entangled in discarded fishing line, fishing nets, six-pack rings, 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 snowy plovers in the long-term, could potentially adversely affect nesting plovers since the program is conducted year-round.

f. Water Quality and Urban Run-off

Many coastal beaches used as habitat by 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 plover foraging

areas. In 1995, three dead male 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 snowy plover from this area disappeared and possibly died. 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

Snowy plover chicks die when they become entrapped within the mesh of some fences used to enclose California least tern colonies (Powell and Collier 1995). These fences also impede plover chicks from following their parents to feeding areas. Chicks may die of exposure and starvation if they cannot join their parents because of separations caused by least tern fencing. During the 1995 breeding season, six instances of chick mortality were attributed to entanglement in least tern chick fencing at Camp Pendleton, and three other chicks were found dead just outside the fenced tern colonies (Powell *et al.* 1995). During the 1996 breeding season, Powell *et al.* (1996) observed a plover family that was apparently caught in the corridor used by amphibious-tracked and other four-wheel drive vehicles at Camp Pendleton while attempting to get to a pond approximately 300 meters (984 feet) from their nesting area. Because of the small mesh size, they were unable to get through the fencing erected to keep least tern chicks from wandering into vehicular traffic, and were seen running back and forth across the corridor as vehicles drove through.

At the Channel Islands and other lands managed by the National Park Service, a decline of snowy plovers may be caused by habitat loss resulting from the large increase in numbers of marine mammals on beaches (U.S. Fish and Wildlife Service *in litt*. 1995). Breeding pinnipeds, including northern elephant seals (*Mirounga angustirostris*) and California sea lions (*Zalophus californianus*) at San Miguel Island, have occupied snowy plover nesting habitat. Beach-cast dead whales have, on occasion, posed threats to nesting 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 snowy plovers. In addition, mammal carcasses attract scavengers such as gulls and ravens that are potential predators to 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, water quality degradation, 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 both active and passive recreation (Carter 1988). Before the introduction of 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).

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. These fish and wildlife species are recognized by the U.S. Fish and Wildlife Service 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. 1361-1407), 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. In addition to the snowy plover, 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-proposed 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 snowy plover protection would provide important benefits to other sensitive species within the coastal dune ecosystem and merits serious consideration.

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 snowy plovers should benefit other sensitive beach species, such as California least terns and vice versa. Many of the same predators that take snowy plover eggs also prey on California least tern eggs. The relatively low rate of predation of snowy plover nests in San Diego County has been attributed to the predator control program by the U.S. Department of Agriculture, Wildlife Services Branch, for the management of California least terns (Powell *et al.* 1995). Opportunities may also 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.

At the same time, however, conflicts have occurred in management of snowy plovers and California least terns in southern California. These conflicts include losses of snowy plover chicks due to entanglement in the mesh of California least tern fencing. Efforts are needed to better coordinate and implement management measures to meet the habitat needs of both snowy plovers and California least terns. Potential conflicts also exist between native dune restoration and snowy plover habitat. Revegetation efforts could result in too much cover, thereby reducing the amount of suitable breeding habitat available for plovers.

Conflicting habitat requirements for 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 plovers. Where this conflict occurs, it may be necessary to discourage use by breeding pinnipeds during the 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 snowy plover, such as exclosures, are needed. Exclosures are currently the most effective and efficient way to protect nests against heavy recreational use and prolific, well-established predators, especially where reductions in predator numbers would otherwise be temporary and difficult to achieve.

F. CONSERVATION EFFORTS

Snowy plover recovery efforts have accelerated since this species 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 plover nests and broods; restrictions on dogs (even though enforcement of dogs on-leash has been problematic); closure of nesting areas to the public; and public information and outreach. These strategies represent effective means of improving snowy plover reproductive success in return for efforts expended.

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 snowy plovers. These plans include the Oregon Dunes National Recreation Area Management Plan (U.S. Department of Agriculture, Forest Service, 1994), the Coos Bay Shorelands Final Management Plan (U.S. Department of the Interior, U.S. Bureau of Land Management 1995a), The New River Area of Critical Concern Management Plan (U.S. Department of the Interior, U.S. Bureau of Land Management 1995b), the Draft Snowy Plover Management Plan for Ocean Beach, Golden Gate National Recreation Area (Hatch 1997), and the Draft Western Snowy Plover Management Plan for the Point Reyes National Seashore (White and Allen in prep.).

Wildlife protection, especially the preservation, restoration, and enhancement of threatened and endangered species and migratory birds, is the primary goal of national wildlife refuges (U.S. Fish and Wildlife Service 1982). 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 of 1966 (16 U.S.C. 668dd-668ee) and Refuge Recreation Act of 1962, as amended (16 U.S.C. 460k-460k-4) regarding compatibility of refuge activities, plover nesting areas within some national wildlife refuges are closed to public use during the breeding season.

The Washington State recovery plan for the 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 snowy plover sites from negative impacts; (b) monitoring impacts and responding on damaging activities (e.g., urban development and recreation disturbance) to minimize or eliminate their effects to 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 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 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 snowy plovers. In addition, Section 5019.62 of the California Resources Code allows the designation of State seashores. The purpose for designation of State seashores is to "preserve outstanding natural, scenic, cultural, ecological, and recreational values of the California coastline as an ecological region and to make possible the enjoyment of coastline and related recreational activities which are consistent with the preservation of the principal values and which contribute to the public enjoyment, appreciation, and understanding of those values." Within the state of California, the following State

seashores that contain 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 State seashores and recommend land acquisition for these purposes.

Special management actions for snowy plovers are conducted within the portions of 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 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. Interpretative efforts include informational signage at nesting areas, information brochures, small handout cards with photographs and information on snowy plovers, and several annual public outreach programs (e.g., slide programs and field trips), actions to engage community support for the 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 arrest 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 snowy plovers has been the use of exclosures (see 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 (Figure 8).

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

After only 1 year of exclosure use on Point Reyes National Seashore beaches, the breeding population doubled resulting in 25 snowy plovers breeding during the 1997 season (White and Hickey 1997). Use of nest exclosures at Coos Bay North Spit in Oregon (OR-15 in Appendix B) during the 1991 breeding season resulted in 69 percent nesting success, compared to only 9 percent nesting success for unprotected nests (Stern *et al.* 1991*b*). During the 1992 breeding season, nest success at southern Oregon locations was significantly higher (84 percent versus 5 percent) for nests protected with exclosures compared to unprotected nests (Craig *et al.* 1992). 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, designed to discourage entry by avian predators.

Although exclosures are contributing to improved productivity and population increases in some portions of the snowy plover's Pacific coast range, problems have been noted in some localities. Potential risks associated with exclosures include vandalism or disturbance of the birds by curiosity seekers and use of exclosures as predator perches. Also, predator exclosures may be impractical where snowy plovers nest within California least tern colonies.

Symbolic fencing is also used to protect snowy plover nests, eggs, and chicks. This fencing consists of one or two strands of light-weight string or cable, tied between posts to delineate areas where 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 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.) are also used within snowy plover habitats and near protective fencing to alert the public of the sensitivity of snowy plover nesting and wintering areas.

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

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 snowy plovers, there will always be a certain percentage who do not. Enforcement of 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 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 snowy plover habitat. Conflicting priorities and personnel turnover require perseverance to maintain effective working relationships across law enforcement jurisdictions.

c. Predation Control

At the south spoils area of Coos Bay, North Spit, 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 snowy plover nesting habitat. This 5-centimeter by 5-centimeter (2-inch by 2-inch) square wire mesh fence was installed to exclude mammalian predators, especially skunks, and to discourage human disturbance from off-highway vehicle use. The original fence that was constructed in 1991 suffered from the effects of weathering with areas of rust and numerous holes. It continued to deter vehicles but was no longer an effective barrier to predators. In February and March 1998, the U.S. Army Corps of Engineers and U.S. Bureau of Land Management jointly constructed a new 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 28.4 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 constructed across salt pond levees to block access by predators (J. Albertson *in litt.* 1999).

Exclosures are much more effective when used in conjunction with an integrated predator management program that includes removal of predators. Otherwise, they may promote better hatching success, but not fledging success if predators such as red fox 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.

Lethal and nonlethal means of predator control have been used with mixed success to protect snowy plovers on Pacific Coast beaches. Trapping the nonnative red fox has been credited with substantially increased plover abundance and productivity at Salinas River National Wildlife Refuge (E. Fernandez pers. comm. 1998). At the Don Edwards San Francisco Bay National Wildlife Refuge, losses of snowy plover nests from predation by red foxes have decreased as a result of the use of exclosures combined with predator management (J. Albertson *in litt.* 1999).

The U.S. Air Force has used electric fencing around the California least tern colony at Purisima Point, Vandenberg Air Force Base, California, where 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 snowy plovers by deterring plover predators. Because some coyotes are still able to get through the fence, supplemental predator control of coyotes is still necessary (N. Read pers. comm. 1999).

Aversive techniques have also been used with some success on predators of piping plovers. Electric fencing around nest exclosures has been successfully used on “smart” predators, such as foxes, that have figured out how to dig under,

climb, or jump over exclosures to reach piping plover eggs. The Maine Audubon Society has used a single strand of electrified wire around an exclosed nest where foxes were present. The single-strand electric wire, which is placed approximately 23 centimeters (9 inches) from the bottom of the exclosure, gives the fox an electric shock. The fox becomes conditioned to the associated shock with the exclosure and, as a result, avoids the exclosure. Fox tracks found at one of these electrically-wired nest exclosures indicated that the fox ran away from the exclosure. Subsequently, the exclosed and also the unprotected nests at the site were not disturbed (A. Hecht *in litt.* 1998).

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. Implementation of 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 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. In this study, conducted from April to June 1992 at Camp Pendleton, California, methiocarb-treated eggs were used under an experimental pesticide use permit issued by the California Department of Pesticide Regulation. The authors found this technique was potentially useful for reducing nest predation, provided the eggs are placed at the target site 2 to 3 weeks prior to egg-laying by terns, and the territorial ravens exposed to treated eggs near the tern colonies are allowed to remain to defend the area from untrained raven intruders. However, one raven was found dead and necropsy substantiated that it obtained a lethal dose of methiocarb by ingesting two entire treated eggs. Because some ravens may swallow whole treated eggs, there is potential for inadvertent mortality, which would defeat the purpose of this technique.

Care must be taken to design and conduct taste aversion experiments in a way that will avoid detrimental impacts to sensitive species. In 1995, another aversive conditioning study was conducted at Camp Pendleton, California. The taste aversion experiment, conducted by the U.S. Department of Agriculture, Wildlife Services Branch, involved placing quail eggs along a transect through the California least tern colony. At least one snowy plover nest was lost to ravens at Camp Pendleton in 1995. Raven tracks were observed following the line-transect of quail eggs put out as part of the taste aversion experiment, and the tracks stopped at a plover nest located within 5 meters (16 feet) of the transect (Powell and Collier 1995).

With proper research, techniques that have been used to deter predators of other wildlife species may prove beneficial to snowy plovers. At Vandenberg Air Force Base, strategic placement of crow and gull carcasses around the perimeter of a California least tern colony has been fairly successful. Persons and Applegate (1996) reported that gulls, suspected of being predators of snowy plovers at the Purisima Beach, Vandenberg Air Force Base, left the site after gull carcasses were used as deterrents. Plovers may have benefitted from this effort incidentally (N. Read pers. comm. 1998).

d. European Beachgrass Control

Experiments to find cost-effective methods to control or eradicate European beachgrass are ongoing. Various methods have been used, including manual digging, mechanical removal, salting, burning, cutting, and use of herbicides.

Since 1993, there have been multiple projects on the North Spit of Coos Bay, Oregon, to control beachgrass on old dredged material disposal sites and to clear and maintain adjacent areas. The U.S. Bureau of Land Management has cleared over 60 hectares (150 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 plovers to nest that is large enough to lessen possible detection of nests and chicks by predators. Many of the cleared areas were used almost immediately by nesting plovers or for brood rearing activities.

Habitat restoration work not only benefits snowy plovers, but other species as well. Wetland loss has accelerated on the North Spit as beachgrass has become better established. A project objective is to retain and enhance existing sedge wetland features present on the east part, thereby providing habitat for other shorebirds and wildlife species that will benefit from this effort. Pink sand-verbena has also been reintroduced to some of the sites.

Control methods employed at various times and places have included hand pulling, spraying of herbicide, hummock removal with front-end loaders, subsoiling with a winged subsoiler (essentially a heavy duty three-point plow), discing with a standard farm tractor and disk, burning, and saltwater irrigation. 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 maintenance will always be required.

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 was completed with 1,700 inmate-hours of labor and required approximately 280 inmate-hours per hectare cleared (113 inmate-hours per acre). The total cost of the project was $11,200; most of these costs covered the crew supervisor's salary and transport vehicle charges. Pitchforks seemed to be the most effective tool used; shovels tended to cut the roots and garden trowels typically broke during the work. The project revealed that sturdy hand trowels would be a valuable tool for hand pulling treatments (Oregon Department of Fish and Wildlife 1996). 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; but the grass was relatively easy to remove by hand (Oregon Department of Fish and Wildlife 1996).

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 pers. comm. 1997).

In Oregon, the New River Spit is another key nesting area for the snowy plover that is managed by the U.S. Bureau of Land Management. In October 1998, using a front-end loader equipped with a 2.7 cubic meter (3.5 cubic yard) bucket, the U.S. Bureau of Land Management opened up and widened the front of four overwashes, removing much of the European beachgrass and built-up sand within the overwash with the intention of allowing ocean wave action/surge to enter the overwash areas during winter storms, thus scouring out some of the remaining grass, sand, and debris that were not removed. Also, because the overwashes are adjacent to one another, and there is some connection between them, water and sand movement may occur from one overwash into the next, possibly creating additional pockets of suitable habitat for nesting snowy plovers, and for movement of plover broods. Operation of the loader created approximately 0.4 hectare (1 acre) of open sand habitat in each of the four overwashes, for a total of 1.6 hectares (4 acres). The use of a front-end loader has its limitations, such as with the removal of some of the taller hummocks. A model D-6/7 or 8 Caterpillar would be more effective in taking hummocks down, and with a bucket attachment, larger loads could possibly be removed more quickly and deposited in the beach surf zone. Both machines have the ability, through back-blading, to smooth and recontour the work area. The total cost of the project was approximately $10,000 (E.Y. Zielinski and R.W. Williams *in litt.* 1999).

At the Oregon Dunes National Recreation Area, the U.S. Forest Service employs a combination of mechanical, manual, an herbicide treatments to control European beachgrass. The National Recreation Area contains about 2,400 hectares (6,000 acres) of European beachgrass and now has few remaining examples of intact native plant communities (Pickart 1997). Heavy equipment is used in combination with manual and chemical control. 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*).

At the Oregon Dunes National Recreation Area, 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*).

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 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 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).

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 snowy plover nesting areas may need to be limited to the period outside the breeding season in certain areas to avoid disturbing nesting 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 every bit 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 snowy plover breeding sites. 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, a management plan is being developed as an interim measure by the California Department of Parks and Recreation, Off-Road Vehicle Division, to address what effects current management measures have on hatching and fledging rates, as well as recruitment

into the snowy plover population (D. Noda *in litt.* 1996). However, as a result of a violation under section 9 of the Endangered Species Act involving a portion of the park not covered by the Fish and Wildlife Service biological opinion and the required habitat management plan, 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 District of the California Department of Parks and Recreation. We hope that the San Simeon District will also seek coverage under this habitat conservation plan.

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 it is likely that other species will be covered. The California Department of Parks and Recreation is currently considering what species they want covered under the habitat conservation plan. This plan will evaluate the effects that recreation and park management activities are having on the covered species. Successful development of this Plan will provide a template for other districts of the California Department of Parks and Recreation to follow for coastal conservation issues on State parks throughout California.

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 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, snowy plovers, and other wildlife (E.Y. Zielinski and R.W. Williams *in litt.* 1999).

On some beaches at Willapa National Wildlife Refuge, where off-road vehicles are prohibited, violations still occur. During the mid-March to mid-September snowy plover nesting season, off-road vehicles are prohibited at Willapa National Wildlife Refuge, covering Leadbetter Point and Gunpowder Sands, Willapa Bay, Washington. However, a rash of night-time intrusions onto the beach occurred in late May and early June 1995 (Williamson 1995). Because of such violations, diligent surveillance and enforcement by applicable agencies is extremely important.

f. Population Monitoring

The Point Reyes Bird Observatory has been monitoring the distribution and breeding success of snowy plovers since 1977. The Point Reyes Bird Observatory is a nonprofit organization devoted to biological research for avian conservation. The current monitoring of breeding snowy plovers in Marin, Monterey, and Santa Cruz Counties, and at Vandenberg Air Force Base, is conducted by Point Reyes Bird Observatory contractors and staff. These monitoring efforts were funded in part by the National Park Service. The U.S. Geological Survey, Biological Resources Division, has monitored snowy plovers in San Diego County since 1994. These monitoring efforts were funded in part by the U.S. Marine Corps (monitoring at Camp Pendleton Marine Corps Base) and U.S. Navy, Southwest Division (monitoring at Naval Air Station, North Island, and San Clemente Island in 1997). Additional funding for surveys in Orange, Los Angeles, and San Diego Counties was obtained from the California Department of Fish and Game in 1995. The Oregon Natural Heritage Program and The Nature Conservancy have conducted snowy plover monitoring since 1990; this work has been supported by the Oregon Department of Fish and Wildlife, the U.S. Bureau of Land Management, the U.S. Forest Service, and the U.S. Fish and Wildlife Service. Some public land managers conduct varying degrees of plover population monitoring. The California Department of Parks and Recreation, Off-Road Vehicle Division, conducts annual monitoring at the Pismo/Oceano Dunes State Vehicular Recreation Area (J. Didion *in litt.* 1999).

Monitoring efforts by the Point Reyes Bird Observatory, Oregon Natural Heritage Program, and U.S. Geological Survey, Biological Resources Division, also

include banding of snowy plovers at some locations (see Figure 10). Banding provides important additional data, including information on snowy plover survival and plover migration patterns.

Figure 10. Banding a 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 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 CA-36 in Appendix B) for snowy plovers by reducing the water levels during the breeding season. In the future, the

Refuge anticipates that it may have to reduce vegetation in this area to increase habitat quality for plovers.

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 the U.S. Fish and Wildlife Service for conservation purposes. The area will be managed by the Humboldt Bay National Wildlife Refuge for natural resources, including the 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 snowy plover nesting and wintering area.

i. Use of Volunteers

Volunteers contribute to the conservation of snowy plovers and their habitat at many beach locations, including Morro Bay and Oceano Dunes State Vehicular Recreation Area. Volunteers and docents assist public land managers in many ways (see Appendix K), including informing park visitors about threats to the 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 snowy plovers in Monterey Bay. This program is mainly a volunteer effort by local citizens who assist in protecting snowy plovers through monitoring, reporting, and educational activities (D. Dixon *in litt*. 1998). Similar opportunities to coordinate volunteers for snowy plover conservation could be realized through the Coast Watch Program sponsored by the National Oceanic and Atmospheric Administration and local Adopt-a-Beach programs.

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 snowy plovers (see 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 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 snowy plover 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 the U.S. Fish and Wildlife Service 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. Recent projects funded by the California Department of Fish and Game, using section 6 funds, include (1) control of excessive predation of snowy plovers and California least terns by American peregrine falcons (funded in fiscal year 1998 for $15,000) and (2) development of a corvid management plan to benefit snowy plovers, California least terns, and marbled murrelets (funded in fiscal year 1998 for $20,000). In the State of Washington, section 6 funds have been used for funding purchase and installation of signs for protection of nesting areas, enforcement of closures, and conducting nest surveys and monitoring. Current proposals include funding these activities on an expanded basis and identifying areas to improve plover habitat suitability through experimental beachgrass control. Future proposals may include predator exclosures, should predation prove to be a limiting factor, and signing and monitoring of newly-established habitat. In Oregon, section 6 funds have been used for nest exclosures for snowy plovers, monitoring nesting success, population monitoring, and habitat management (i.e., European beachgrass control).

3. Conservation Efforts on Private Lands

Private landowners interested in conservation efforts for 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 snowy plover and California least tern (D. Pearson pers. comm. 1996).

4. Federal Regulatory Program

a. Critical Habitat

We proposed designation of critical habitat for the snowy plover in March 1995 (U.S. Fish and Wildlife Service 1995*b*). It is important to understand what critical habitat means, the status of the proposal, 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" means "to use and 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.

On March 2, 1995, we published a proposed rule to designate critical habitat 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 have 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). Critical habitat is most likely to be useful as a tool for conserving snowy plovers where habitat is not currently occupied and it is difficult to demonstrate that an action will result in take of plovers using the site.

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 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 snowy plover before December 1, 1999 (U.S. District Court, Central District of California 1998). The final rule designating critical habitat was published on December 7, 1999 (U.S. Fish and Wildlife Service 1999).

Critical habitat requires Federal agencies to evaluate the effects that any activities they fund, authorize, or carry out may have on listed species. Agencies are required to ensure that such activities are not likely to jeopardize the survival of a listed species or adversely modify (e.g., damage or destroy) its critical habitat. By consulting with the U.S. Fish and Wildlife Service under section 7 of the Endangered Species Act, Federal agencies can usually minimize or avoid any potential conflicts; activities have almost always been allowed to proceed in some form (U.S. Fish and Wildlife Service 1993*c*). Because our 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.

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 under provisions of sections 9 and 10 of the Endangered Species Act.

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. The recovery units described in this recovery plan include but are not restricted to the 28 areas designated as critical habitat: Damon Point, Leadbetter Point, Bayocean Spit, Heceta Head-Sutton Creek, Siltcoos River North, Siltcoos River-Threemile Creek, Umpqua River-Horsfall Beach, Horsfall Beach-Coos Bay, and Bandon Park-Floras Lake in Recovery Unit 1; Humboldt Coast-Lagoon Beaches and Eel River Beaches in Recovery Unit 2; Bodega Bay, Dillon Beach, Half Moon Bay Beaches, Santa Cruz Coast Beaches, Monterey Bay Beaches, and Point Sur Beach in Recovery Unit 4; Arroyo Hondo Creek Beach, Arroyo Laguna Creek Beach, Morro Bay Beaches, Pismo Beach/Nipomo Dunes, Point Sal-Point Conception, Santa Barbara Coast Beaches, Oxnard Lowlands, and San Nicolas Island Beaches in Recovery Unit 5; and Malibu Lagoon, Mission Beach and Bay, and South San Diego Coast Beaches in Recovery Unit 6. As part of our efforts to conserve snowy plovers in these recovery units, we will consult with federal agencies under section 7 to ensure federally funded or permitted actions do not adversely modify critical habitat. However, implementation of the

recovery tasks in this plan (e.g., monitoring, habitat improvement, nest protection, recreation management) will 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.

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 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 plan 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 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 Endangered Species Act by carrying out programs for the conservation of endangered and threatened species listed under the Act". 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 the U.S. Fish and Wildlife Service 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 snowy plovers along the Pacific coast, thereby triggering a section 7 consultation, include permits for sand management activities on Federal lands (National Park Service, U.S. Department of the Interior); disposal of dredged materials (U.S. Army Corps of Engineers); 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 (33 U.S.C. 1251-1376), as amended, and section 10 of the Rivers and Harbors Act of 1899 (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. 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.

In September 1994, 14 Federal agencies, including the U.S. Fish and Wildlife Service, U.S. Bureau of Land Management, National Park Service, U.S. Forest Service, U.S. Coast Guard, U.S. Army Corps of Engineers, National Marine Fisheries Service, and Department of Defense, signed a Memorandum of Understanding affirming their commitments to carry out programs for the conservation of species listed under the Endangered Species Act and the ecosystems upon which they depend, including implementing appropriate recovery actions that are identified in recovery plans (U.S. Fish and Wildlife Service 1994). Compliance with this Memorandum of Understanding would advance recovery of the snowy plover by promoting improved management of snowy plovers on Federal lands and leadership by Federal agencies in recovery unit working groups.

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" (emphasis added). 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 snowy plovers.

Executive Order 11988, Floodplain Management, and Executive Order 11990, Protection of Wetlands, provide protective policies that apply to 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 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 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 development 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 the U.S. Fish and Wildlife Service 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 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 snowy plovers.

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 snowy plover habitats in the State of Oregon, which owns not only to the mean high tide line, which is snowy plover foraging habitat, but also into the vegetation line, which is essentially the dry sand area used by 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 snowy plover as a threatened species); therefore, many do not reflect protective measures specifically for the 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 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 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 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 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 plover habitat during the nesting season is detrimental to or incompatible with plover conservation.

However, this goal also recognizes that many shorelands have unique or exceptional natural area values, includes the objective of reducing adverse impacts associated with use of coastal shorelands to fish and wildlife habitat, 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. 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 snowy plovers while allowing recreation.

State regulations, policies, and goals for the States of California, Oregon, and Washington provide many protective measures for 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 snowy plover. To minimize these conflicts, this recovery plan recommends that the California Coastal Commission, Oregon Department of Land Conservation and Development, State of Washington Parks and Recreation Commission, Oregon Parks and Recreation Department, California Department of Parks and Recreation, and Oregon Department of Fish and Wildlife (regarding the Oregon Endangered Species Act) review their local coastal programs, regulations, policies, and goals for consistency with this recovery plan and implement any necessary revisions (see Task 3.1.7).

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 snowy plover have been completed or are currently under way.

In November 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 snowy plover. Ocean Beach experiences tremendous visitor use year-round because of its proximity to San Francisco, yet it supports high numbers of

nonbreeding 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 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 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 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 plovers.

Our Arcata Fish and Wildlife Office is informally consulting with gravel operators 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 snowy plover breeds on the Eel River gravel beds. Impacts to snowy plover associated with gravel mining operations will be assessed based on nesting surveys, and may require take authorization through formal consultation. The Arcata Fish and Wildlife Office is also working with Humboldt County, the California Department of Fish and Game, and the California Department of Parks and Recreation to implement additional protections for nesting plovers at MacKerricher State Park, Clam Beach and the Eel River Wildlife Area. These measures include installation of nest exclosures, signing, and development of educational material for kiosks. We are also providing technical assistance to Redwood National Park and MacKerricher State Park on exotic vegetation management programs (J. Watkins *in litt.* 1999, J. Watkins pers. comm. 2001).

Our Ventura Fish and Wildlife Office is attempting to initiate a regional approach to habitat conservation planning for snowy plovers and other listed species along Monterey Bay in Monterey County, California. Currently, there are several proposed development projects within the cities of Marina and Sand City and each of these cities is preparing a “city wide” habitat conservation plan for their respective jurisdictions. We have expressed concerns about these projects being presented in a piecemeal fashion, which does not allow an adequate assessment of their cumulative effects, and we have recommended a regional approach through preparation of a regional habitat conservation plan. This plan would provide greater conservation benefits to the snowy plover. In addition to the adverse effects of development on snowy plovers and their habitat, recreation on the extensive public lands along Monterey Bay is also adversely affecting 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.

In January 2001 the Ventura Fish and Wildlife Office released a draft biological opinion on Vandenberg Air Force Base’s proposed beach management plan for the snowy plover, concluding that the plan would "likely jeopardize the continued existence of the western snowy plover and adversely modify its critical habitat." 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. 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; as of early April, opening of the beach and full implementation of conservation measures had not yet taken place (S. Henry pers. comm. 2001).

The 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 habitat conservation plan will evaluate the effects that recreation and park management activities are having on the covered species, including the snowy plover.

In the past, several instances were documented of 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. Through the years, reproductive success for snowy plovers has been poor on Santa Rosa Island. Ravens occurred regularly in the area associated with the cattle operation. It remains to be seen whether removal of cattle will change this trend. Deer and elk, occasional users of snowy plover nesting beaches, will remain on the island until 2011.

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 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 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 plovers. Many general plans, coastal zone programs, and comprehensive plans prepared by local governments contain land use designations that are protective of 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 plovers.

Whereas 43 percent of the respondents include regulatory policies that protect snowy plover habitat (e.g., sandy beach) in their general plans, local coastal programs or comprehensive plans, only 3 of the 34 respondents (8 percent), have developed regulatory policies specifically to protect the plover. These respondents included the City of Half Moon Bay, California, and Coos and Curry Counties, Oregon. Only 8 of the 34 respondents (23 percent) specifically explain the threatened status of the snowy plover, identify 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 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, 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 snowy plover habitat.

8. Interagency Coordination

Since 1992, the Western Snowy Plover Working Team for Oregon has been meeting at least twice a year to coordinate plover recovery efforts. This working group has provided a forum for the participation of affected Federal and State agencies, conservation organizations, user groups, and environmental groups in discussion, implementation, and adjustment of recovery efforts in Oregon. Items addressed include monitoring needs, predator control, signage, exclosures,

nonnative vegetation removal, and public outreach and education. This group also facilitates funding partnerships for monitoring and management programs, thus promoting the best use and leveraging of limited funds. It also acts as the main forum for discussing and tracking the status and trends of the Oregon/Washington snowy plover subpopulation.

In 1998, an interagency effort in Oregon produced a slide show and portable display to educate beach visitors about snowy plover conservation. Outdoor education specialists and/or 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 plover, the reasons for its decline, and actions needed for its recovery, emphasizing the contribution that beach visitors can make.

In California, biannual plover coordination meetings are held among Federal and State agencies and Point Reyes Bird Observatory staff to track the breeding population of plovers in the Monterey Bay area. Meetings of this working group have been ongoing since 1991. Management needs such as exclosures, symbolic fencing, predator control, removal of exotic vegetation, and acquisition of key sites are considered and planned through this forum.

II. RECOVERY

A. RECOVERY OBJECTIVE

The objective of this recovery plan is to ensure the long-term viability of the U.S. Pacific coast western snowy plover population so that this population can be removed from the Federal list of endangered and threatened species.

B. RECOVERY CRITERIA

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

Criterion 1. Maintain for 10 years an average of 3,000 breeding adults distributed among 6 recovery units as specified below:

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 50 percent increase in the Pacific coast population size. They are about 15 percent below the "Management

Goal Breeding Numbers" identified in Appendices B and C, which represent target populations under an intensive management scheme. The recovery criteria for population size and distribution for the U.S. Pacific Coast population of the western snowy plover represents 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 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. This criterion is primarily connected to improvement in listing factor 1 (the present or threatened destruction, modification, or curtailment of their habitat or range), and secondarily to listing factors 3 (disease and predation) and 5 (other natural or manmade factors affecting their continued existence).

Criterion 2. Maintain a 5-year average productivity of at least one fledged chick per male 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). This criterion is primarily connected to improvement in listing factors 3 (disease and predation) and 5 (other natural or manmade factors affecting their continued existence), and secondarily to listing factor 2 (overutilization for commercial, recreational, scientific, or educational purposes).

Criterion 3. Have in place participation plans among cooperating agencies, landowners, and conservation organizations to assure 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 participation plans is listed under Task 3.1.2. (Table 6) at the end of this chapter, which outlines the recovery actions recommended to meet these recovery criteria, and in the stepdown narrative section, which describes each action in detail. The stepdown narrative lists all subtasks necessary to fulfill the main recovery task. It also represents a prioritization of measures to be implemented. This criterion is primarily connected to improvement in listing factor 4 (the inadequacy of existing regulatory mechanisms).

C. RECOVERY STRATEGY

1. Principles for Recovery

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

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

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 snowy plover to be a single management entity, and population goals and objectives are based on that premise. The recovery team recommends that no state, geographic region, or subpopulation of the Pacific coast population of the snowy plover be considered for delisting separately from the others.

b. Intensive, ongoing management of snowy plovers and their habitats is essential for recovery, and mechanisms to continue this management after delisting to prevent a reversal of population increases following delisting under the Endangered Species Act.

c. Annual monitoring of snowy plover populations and reproductive success is essential for adaptive management and to determine the success of recovery efforts.

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, 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 snowy plover. As of 1988, approximately 34 percent of the breeding plover population in California occurred on Federal lands (J.P. Myers *in litt.* 1988). Within San Diego County, 72 to 87 percent of snowy plover nests were located on Federal properties from 1994 to 1997; the majority were located on military bases (Powell *et al.* 1997). In 1988, at least 50 percent of the plover's breeding habitat was under Federal agency jurisdiction in Oregon (J.P. Myers *in litt.* 1988). However, the State of Oregon also has jurisdiction over much of this 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 site 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 snowy plover cannot be recovered simply through general habitat protection or complying with required section 7 consultations. The snowy plover *must be actively monitored and managed for the full purposes of recovery* or its population size will continue to decline. Federal agencies alone cannot assure recovery of the snowy plover, but they need to significantly increase their current monitoring and management

efforts now to assure survival and recovery of this species. Reasons why Federal agencies should take this lead role include the following: (1) some Federal agencies, including military agencies, do not have a recreational mandate and, thus, may have fewer competing uses to their conservation responsibilities; (2) 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; and (3) in general, Federal agencies have larger budgets and more resources to allocate for monitoring, management, research, and other programs that could benefit plovers and their habitat. Protection of 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 (e.g., exclosures) 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 snowy plovers and their habitats. Intensive management for snowy plovers occurs at a number of state-owned plover habitat areas. The snowy plover cannot be preserved simply through general habitat protection. Snowy plovers must be actively monitored and managed to achieve recovery goals on State lands or their population size will continue to 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 processes is critical. All Appendix B locations should be identified as environmentally sensitive habitat areas requiring protective measures for the 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 snowy plover habitat should provide technical assistance and information to local governments (see Tasks 3.1.6, 3.1.7 and 5.2). We can provide detailed maps of current 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 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 snowy plover conservation through facilitating or allowing the monitoring of 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 snowy plover protection and recovery. Appendix H includes a summary of conservation tools and strategies available to landowners, nonprofit organizations, and regulatory agencies that may be adopted to protect snowy plover habitat.

4. Funding Sources

Grants under section 6 of the Endangered Species Act provide states with resources to implement a wide array of recovery activities that include population monitoring and habitat restoration. Appendix I includes a summary of some other potential sources of funds for implementation of recovery actions for the snowy plover. Appendix I includes only a partial list of potential funding sources. Other funding opportunities may be possible.

An essential mechanism for recovery of the snowy plover is the development and implementation of participation plans for each of the six recovery units (see Task 3.1.2). A key element of these participation plans is the long-term commitment by participating agencies to seek annual, ongoing funding for snowy plover management and monitoring activities so that funding within agency budgets can be secured.

In many areas a significant portion of 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 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 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 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 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 to be part of the overall cost of the project or program. Applying this traditional construct to recreation

projects and programs could significantly promote snowy plover recovery in several ways. First, it would require impacts to 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 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 snowy plover is the formation of working groups for each of the six recovery units (see Appendix A), covering the following areas: (1) Oregon and Washington; (2) Northern California (Del Norte, Humboldt, and Mendocino Counties); (3) San Francisco Bay (locations within Counties of Napa, Alameda, Santa Clara, and San Mateo); (4) Monterey Bay (including coastal areas along Counties of Monterey, Santa Cruz, San Mateo, San Francisco, Marin, and Sonoma); (5) San Luis Obispo, Santa Barbara, and Ventura Counties; and (6) Los Angeles, Orange, and San Diego Counties (see Task 3.1.1). Representation from the full contingency of Federal, State, local, and private landowners and other parties who have a stake in snowy plover conservation within each of these six recovery units will be needed to advance the recovery actions recommended in this recovery plan. The Monterey and Oregon working groups should be expanded and used as models for establishing new working groups. Working group membership should include land managers, environmental groups, user groups, and groups involved in conservation projects (including local chapters of the National Audubon Society, Sierra Club, Native Plants Society, Americorps, California Conservation Corps, Boy Scouts, Surfrider Foundation, and other recreational use groups). These groups could provide large networks of volunteers who could be mobilized to assist public resource agencies in the

implementation of management measures for protection and recovery of the snowy plover.

It is expected that many agencies and individuals on the recovery team will continue to participate in the working groups, which are ongoing or will be developed for the six recovery units. Through evaluation, communication, and coordination, members of each of the six working groups should manage the 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 the recovery leader within our Sacramento 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 leader should coordinate and communicate with each recovery unit to support recovery efforts and assure implementation of the recovery plan (see Tasks 3.1.1 through 3.1.4, 6, and 7). A coordinated international conservation program with Mexico should also be established to protect snowy plover populations and their habitat in that country (see Task 8).

Table 6. Recovery Task Outline

1 Monitor and manage breeding habitat of the Pacific coast population of western snowy plovers to maximize survival and productivity.

1.1 Monitor the snowy plover breeding population.

1.1.1 Annually monitor population size and distribution at breeding locations in each recovery unit.

1.1.2 Monitor productivity.

1.1.3 Monitor annual survival.

1.1.4 Monitor snowy plover breeding activities at all breeding sites to identify factors limiting abundance of breeding birds, clutch hatching success, and chick fledging success.

1.1.5 Develop training and certification programs for snowy plover survey coordinators.

1.1.6 Improve submittal system for monitoring data.

1.1.7 Evaluate and update lists of important breeding areas as data become available.

1.1.8 Coordinate monitoring of snowy plovers and California least terns.

1.2 Maintain natural coastal processes that perpetuate high quality breeding habitat.

1.2.1 Avoid development that will destroy or degrade snowy plover breeding habitat.

1.2.2 Avoid interference with natural processes of inlet formation, migration, and closure.

1.2.3 Avoid interference with natural processes of erosion and deposition of sand dunes.

1.2.4 Avoid beach stabilization projects.

1.2.5 Remediate and compensate the disruption of natural processes by creating and enhancing existing and potential breeding habitat.

1.2.5.1 Remove nonnative and other invasive vegetation from existing and potential breeding sites.

1.2.5.2 Deposit dredged material to enhance or create nesting habitat, and evaluate impacts from beach nourishment activities.

1.2.5.3 Create, manage, and enhance coastal ponds and playas for breeding habitat.

1.3 Prevent disturbance of breeding snowy plovers by people and domestic animals.

1.3.1 Prevent pedestrian disturbance.

1.3.1.1 Seasonally close, fence, post, use exclosures, monitor, and enforce regulations in areas used by breeding snowy plovers as appropriate.

1.3.1.2 Develop and implement necessary State and local ordinances, administrative rules, and regulations to enforce closed areas on beaches used as breeding habitat.

1.3.1.3 Locate access points and trails well away from snowy plover nesting habitat.

1.3.1.4 Implement and enforce pet restrictions.

1.3.1.5 Prevent disturbance from disruptive recreational activities where breeding snowy plovers are present.

1.3.1.6 Prevent driftwood removal.

1.3.1.7 Implement and enforce anti-littering regulations.

1.3.2 Prevent disturbance, mortality, and habitat degradation by off-road vehicles, including beach-raking machines.

1.3.3 Implement and enforce restrictions on horseback riding in nesting areas.

1.3.4 Provide wardens, agents, or officers to enforce protective measures in breeding habitat.

1.3.5 Develop and implement training programs for enforcement personnel and others who work in snowy plover breeding habitat.

1.3.6 Ensure that enforcement efforts do not endanger snowy plovers, their nests, eggs, or chicks.

1.4 Prevent excessive predation of snowy plovers.

1.4.1 Remove litter and garbage from beaches manually, not by raking machines.

1.4.2 Remove predator perches and unnatural habitats.

1.4.3 Erect predator exclosures to reduce snowy plover egg predation where appropriate.

1.4.4 Remove predators where warranted and feasible.

1.4.5 Remove bird and mammal carcasses in snowy plover nesting areas.

1.5 Protect snowy plovers and their breeding habitat from oil or chemical spills.

1.6 Replace exotic dune plants with native dune vegetation where it is likely to improve breeding habitat for snowy plovers.

1.7 Compensate the loss of snowy plover breeding habitat associated with recovery efforts for other sensitive species, including those within the San Francisco Bay recovery unit.

1.8 Discourage pinnipeds from usurping snowy plover nesting areas.

2 Monitor and manage wintering and migration areas to maximize snowy plover population survival.

2.1 Monitor known and potential wintering locations.

2.1.1 Monitor snowy plover abundance and distribution at wintering locations in each recovery unit.

2.1.2 Identify factors limiting the quality of wintering locations.

2.1.3 Quantify wintering habitat needs of snowy plovers along the Pacific coast.

2.1.4 Evaluate and update lists of important wintering areas as data become available.

2.2 Prevent human degradation and disturbance of snowy plover wintering habitat.

2.2.1 Protect wintering habitat from impacts of water diversion/impoundment and shoreline stabilization, navigation, and development projects.

2.2.2 Protect wintering habitat from disturbance by people and domestic animals.

2.2.3 Develop and implement necessary State and local ordinances, administrative rules, and regulations to enforce closed areas on beaches used as snowy plover wintering habitat.

2.2.4 Provide trained wardens, agents, or officers to enforce protective measures in snowy plover wintering habitat.

2.2.5 Protect snowy plover wintering habitat from degradation due to oil or chemical spills.

2.2.6 Protect wintering habitat from degradation by removing litter manually instead of using raking machines.

2.3 Compensate loss of snowy plover wintering habitat associated with recovery efforts for other sensitive species.

2.4 Protect snowy plovers during migration.

2.4.1 Identify important migration stop-over habitat.

2.4.2 Identify and mitigate any factors that may be adversely affecting migratory stop-over habitat for snowy plovers.

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

3.1 Develop and implement regional cooperative participation networks and programs.

3.1.1 Establish snowy plover working groups for each of the six recovery units.

3.1.2 Develop and implement regional participation plans for each of the six recovery units.

3.1.3 Provide intensive management and protection of snowy plovers on all Federal and State lands.

3.1.4 Develop and implement management plans for all Federal and State lands.

3.1.4.1 Develop and implement management plans for Federal lands.

3.1.4.2 Develop and implement habitat conservation plans on State wildlife areas, State ecological reserves, and State beaches.

3.1.5 Encourage and assist local governments and appropriate private landowners to develop and implement habitat conservation plans.

3.1.6 Assist local governments in developing and implementing local land use protection measures.

3.1.7 Encourage 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 review local coastal programs and policies for consistency with the snowy plover recovery plan.

3.1.8 Obtain long-term agreements with private landowners.

3.1.9 Identify snowy plover habitat for acquisition.

3.1.10 Ensure that any section 10(a)(1)(B) and section 7(a)(2) permits contribute to Pacific coast western snowy plover conservation.

4 Undertake scientific investigations that facilitate recovery efforts.

4.1 Investigate effective and cost-efficient methods for habitat restoration by removal of introduced beachgrass.

4.2 Develop and test new predator management techniques to protect snowy plover nests and chicks.

4.2.1 Develop higher-efficiency nest exclosures.

4.2.2 Develop California least tern enclosures that prevent harm to snowy plovers.

4.2.3 Investigate ecology of native predators.

4.2.4 Investigate predator management at the landscape level.

4.2.5 Investigate techniques for identifying predators.

4.2.6 Investigate aversive methods to discourage snowy plover predators.

4.3 Improve methods of monitoring population size and reproductive success of snowy plovers.

4.3.1 Improve methods of monitoring snowy plover population size.

4.3.2 Develop sampling methods for annually estimating reproductive success.

4.3.3 Monitor snowy plover survival rates.

4.4 Identify snowy plover brood habitat and map brood home ranges.

4.5 Identify components of high-quality snowy plover brood rearing habitat.

4.6 Determine causes of adult snowy plover mortality.

4.7 Improve techniques for banding snowy plovers.

4.8 Identify effects of oil spills on snowy plovers.

4.9 Monitor levels of environmental contaminants in snowy plovers.

5 Undertake public information and education programs.

5.1 Develop and implement public information and education programs.

5.2 Inform the Federal, State, and local resource/regulatory agencies and local planning departments of threats to breeding and wintering snowy plovers and their habitats.

5.3 Develop and maintain updated information and education materials on snowy plovers.

5.4 Alert landowners and beach-goers about access restrictions within snowy plover habitats.

5.5 Provide trained personnel to facilitate protective measures, provide public education, and respond to emergency situations.

5.6 Develop protocols for handling sick, dislocated, injured, oiled, and dead birds or salvaged eggs.

5.7 Establish a distribution system and repository for information and education materials.

5.8 Establish a reporting and distribution system for annual monitoring data.

6 Review progress towards recovery annually and revise recovery efforts as appropriate.

7 Dedicate U.S. Fish and Wildlife Service staff and funding for the Sacramento Fish and Wildlife Office to coordinate recovery implementation.

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

8.1 Develop a joint effort between the United States and Mexico to protect snowy plover populations and their habitats.

8.2 Encourage research and monitoring of breeding and wintering plovers in Baja California, Mexico, by universities and authorities of Mexico.

8.3 Encourage development and implementation of public information and conservation education in Mexico for snowy plovers.

III. STEPDOWN NARRATIVE OF RECOVERY ACTIONS

1 Monitor and manage breeding habitat of the Pacific coast population of the western snowy plover to maximize survival and productivity. To assure the long-term viability of snowy plover populations, their breeding habitat should be monitored and managed in a systematic, ongoing fashion. This effort 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. 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. A summary of current and needed management activities on breeding and wintering locations is provided in Appendix C.

1.1 Monitor the snowy plover breeding population. Systematic, ongoing monitoring of breeding birds should be undertaken at the recovery-unit level to measure progress towards recovery and identify management and protection efforts that are needed.

1.1.1 Annually monitor population size and distribution at breeding locations in each recovery unit. Comprehensive range-wide window surveys of breeding locations (listed in Appendix B) should be conducted annually to determine population trends and fluctuations. 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 survey correction factors should be estimated (Task 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.

1.1.2 Monitor productivity. Key productivity data for understanding population trends (i.e., young fledged per adult male) have been obtained for the coast of Oregon since 1993, the shoreline of Monterey Bay since 1984, and the coast of San Diego County, California, since 1995. These areas encompass the majority of individuals in the northernmost, most central, and southernmost outer coast recovery units, and collection of comparable data should continue annually at these locations. Productivity, expressed as young fledged per male, should also be collected from all other recovery units; however, to minimize the banding of birds (because there are insufficient band combinations for the entire population), methods to sample productivity across the breeding range should be developed as an alternative to marking all individuals at all sites (Task 4.3.2).

1.1.3 Monitor annual survival. Useful information on the survival rates of adult and juvenile snowy plovers have been obtained for the coast of Oregon since 1991, the Monterey Bay area since 1984, and the San Diego County coast since 1994. This monitoring samples the snowy plover's range within these areas and collection of comparable data should continue annually. Monitoring annual survival rates at other selected sites within each recovery unit should also be done (Task 4.3.3).

1.1.4 Monitor snowy plover breeding activities at all breeding sites to identify factors limiting abundance of breeding birds, clutch hatching success, and chick fledging success. Monitoring numbers and reproductive success of breeding birds is necessary to identify factors detrimental to plovers and needed management adaptations. See Appendix J (Monitoring Guidelines).

1.1.5 Develop training and certification programs for snowy plover survey coordinators. Classroom and field training are required for observers who survey for 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 snowy plover

range. Classroom topics should include, but not be limited to: (1) biology, ecology, and behavior of breeding 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 the existing recovery permit; and (7) 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.

1.1.6 Improve submittal system for monitoring data. Initially, range-wide survey data will be limited to results from two annual window surveys. As population and demographic monitoring guidelines evolve (Tasks 4.2.1, 4.2.2, and 4.2.3), 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.

Sightings of banded snowy plovers provide information on the wintering sites of breeding birds, use of multiple sites by breeding and wintering plovers, and survival and dispersal of 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.

1.1.7 Evaluate and update lists of important breeding areas as data become available. As new breeding areas are discovered, the current list of important breeding habitats should be expanded or refined as appropriate.

1.1.8 Coordinate monitoring of snowy plovers and California least terns. Coordination with least tern monitors and managers is needed in all areas where snowy plovers share breeding sites with California least terns. Protocols for monitoring California least terns should be revised so that 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 snowy plovers. Section 10(a)(1)(A) permits, issued under the authority of the Endangered Species Act for 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 snowy plovers need to be aware of species' differences in nest spacing, brood-rearing, foraging behavior, time of breeding, vulnerability to disturbance, and monitoring and banding techniques.

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

1.2 Maintain natural coastal processes that perpetuate high quality breeding habitat. The dynamic nature of beach strand habitats as storm-maintained ecosystems should be recognized and maintained.

1.2.1 Avoid development that will destroy or degrade snowy plover breeding habitat. Conflicts between sensitive species and property protection should be avoided by constructing houses, resorts, parking lots, access roads, bike paths, and other facilities in areas of low vulnerability to flooding and erosion and as far away from snowy plover breeding habitat

as possible. This site selection will in turn avert the need to stabilize shorelines to protect property.

Planners should weigh the economic and environmental costs of maintaining beach access in sensitive areas such as breeding habitats, and compare them with costs and environmental effects of alternative access points in less sensitive areas. Fragmentation and degradation of snowy plover breeding habitat caused by construction of walkways, piers, and other structures should also be avoided.

Beach development should be avoided through establishment of conservation easements, fee title acquisition, zoning, and other means. 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 forewarned 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, (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 plovers, their eggs, and chicks, (4) lights for parking areas and other facilities should not shine on plover habitat (5) sources of noise that would disturb snowy plovers should be avoided, and (6) the establishment of predator perches and nesting sites should be avoided when designing facilities.

1.2.2 Avoid interference with natural processes of inlet formation, migration, and closure. Construction of rock jetties should be avoided when it would result in eroded beaches and sandspits. Inlet stabilization and breaches of beach or dune habitat should also be discouraged if these actions would interfere with natural inlet formation, closure, and migration processes that maintain availability of snowy plover habitat.

1.2.3 Avoid interference with natural processes of erosion and deposition of sand dunes. Sand removal and dredging should be avoided

when they would alter the natural patterns of erosion and deposition of coastal dunes. Water diversion and impoundment of creeks and rivers should be avoided when they would reduce sand delivery to beaches or interfere with maintenance of open habitat at river and creek mouths.

1.2.4 Avoid beach stabilization projects. The natural processes of overwash and blowouts that perpetuate characteristics of preferred breeding habitat should be allowed to continue unimpeded. Construction of seawalls should be avoided. Plantings of introduced beachgrass (*Ammophila* spp.), iceplant (*Mesembryanthemum* sp. and *Carpobrotus* sp.), and other nonnative vegetation for beach stabilization should be avoided.

1.2.5 Remediate and compensate the disruption of natural processes by creating and enhancing existing and potential breeding habitat. Adverse impacts to snowy plover breeding habitat from artificial beach stabilization projects should be remediated and compensated 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. Emphasize creation of habitat in areas that would preclude or reduce recreational impacts.

1.2.5.1 Remove nonnative and other invasive vegetation from existing and potential breeding sites. 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 oceanside nesting areas to bayside feeding flats. Particular attention should be given to the eradication of introduced beachgrass (*Ammophila* spp.) within coastal dunes. Prioritized removal and control strategies for introduced beachgrass

are needed for each recovery unit. These strategies should include early intervention to prevent expansion into breeding areas where it has not yet spread or is in early stages of spreading. Attention should also 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 snowy plovers.

1.2.5.2 Deposit dredged material to enhance or create nesting habitat, and evaluate impacts from beach nourishment activities. Near-shore (littoral drift) and on-shore disposal of dredged material seems to be beneficial for perpetuating high quality snowy plover nesting habitat and should be encouraged. However, monitoring of habitat characteristics before, during, and after projects is needed, particularly in cases of large operations occurring on sites where 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.

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 snowy plovers. Consideration should be given to whether the projected long-term benefits are likely to occur.

1.2.5.3 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 snowy plover habitats. Emphasize creation of habitat in areas that would preclude or reduce recreational impacts.

1.3 Prevent disturbance of breeding snowy plovers by people and domestic animals. Disturbance by humans and domestic animals causes significant adverse impacts to breeding snowy plovers. Management techniques described below can reduce impacts of beach recreation on snowy plovers, but they must be implemented annually as long as the demand for beach recreation continues. Land managers should evaluate whether recreational activities pose a threat to snowy plovers and implement appropriate enforcement measures. As information is gathered, it should be incorporated into conservation efforts. Because human disturbance is a primary factor affecting snowy plover reproductive success, land managers should give the highest priority to implementation of these management techniques. Management plans (Tasks 3.1.4.1, 3.1.4.2, and 3.1.5) should include appropriate human access and domestic animal restrictions to prevent disturbance of snowy plover breeding areas.

1.3.1 Prevent pedestrian disturbance. Management measures to protect 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, snowy plover habitat should be closed during the breeding season. Other areas should also be closed when necessary to adequately protect breeding snowy plovers.

1.3.1.1 Seasonally close, fence, post, use exclosures, monitor, and enforce regulations in areas used by breeding 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 encourage use of the area for plover courtship and prenest site selection, to prevent obliteration of scrapes, crushing of eggs or chicks, and repeated flushing of incubating adults. 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) should be fenced or posted before plovers begin nest-site selection. 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. To provide broods with access to foraging areas, closures should cover the area down to and including the water line, where practical.

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, and Task 1.4.3). However, it should be recognized that exclosures provide nest protection, but survival of chicks to flying age cannot be ensured without prohibition of disturbance by humans and domestic animals. Symbolic fences (one or two strands of light-weight string tied 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 or posting of prime brood-rearing areas to exclude or reduce numbers of pedestrians should also be implemented to contribute to the survival and well-being of unfledged chicks. Areas where territorial plovers are observed should also be closed or symbolically fenced 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.

Land managers should monitor and enforce violations within all closed and restricted areas, with particular attention to areas where nests or broods are present.

1.3.1.2 Develop and implement necessary State and local ordinances, administrative rules, and regulations to enforce closed areas on beaches used as breeding habitat. For areas where beach closures are necessary in breeding habitat, appropriate ordinances, administrative rules, and regulations should be developed by State and local governments to enable law enforcement officers to conduct necessary enforcement actions. Local courts should uphold citations of violations of these local ordinances. Often, snowy plover habitats extend across administrative boundaries. In such cases, area law enforcement agencies are encouraged to coordinate procedures and authorities to most effectively ensure compliance. Closed areas should be posted with signs designating the State or municipal law, ordinance, or other regulation governing the closed area.

1.3.1.3 Locate access points and trails well away from snowy plover nesting habitat. 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 snowy plover habitat as possible.

1.3.1.4 Implement and enforce pet restrictions. It is preferable that land managers prohibit pets on beaches and other habitats where snowy plovers are present, or traditionally nest or winter, because any noncompliance with leash laws can cause serious adverse impacts to 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 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.

1.3.1.5 Prevent disturbance from disruptive recreational activities where breeding snowy plovers are present. Fireworks should be prohibited on beaches where plovers nest. When fireworks displays are situated to avoid disturbance to snowy plovers, careful planning should also be conducted to assure that spectators will not walk through and throw objects into plover nesting and brood-rearing areas. Sufficient personnel must also be on-site during these events to enforce plover protection measures and prevent use of illegal fireworks in the vicinity of the birds.

Falconry and flying of kites and model airplanes should be prohibited in areas where nesting plovers are present. Sports such as ball- and frisbee-throwing should be prohibited within hitting and throwing distance of 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 snowy plover nesting areas during the nesting season.

Special events, including sporting events, media events, and beach clean-ups, attract large crowds and require special attention. Special events targeted for snowy plover nesting areas should not be held during the plover nesting season. Early planning and coordination with local resource agencies should be emphasized.

Land managers should report suspected violations of aviation regulations in 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 potential for take of snowy plovers in nesting areas. Aircraft operations within snowy plover habitat should require a minimum altitude of 152 meters (500 feet) for aircraft and a 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.

1.3.1.6 Prevent driftwood removal. 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.

1.3.1.7 Implement and enforce anti-littering regulations. Litter should be removed from snowy plover breeding areas to avoid attracting predators. Littering ordinances should be enforced year-round. Tasks 1.4.1 and 2.2.6 emphasize the need to remove litter and garbage from beaches manually (not by raking machines) year-round to protect breeding and wintering snowy plovers. Task 1.4.1 also emphasizes that land managers should supply covered or scavenger-proof trash receptacles at access points and away from snowy plover habitat, and that receptacles should be routinely emptied. Land managers should also provide toilets at access points and away from snowy plover habitat to encourage people from using the dunes.

1.3.2 Prevent disturbance, mortality, and habitat degradation by off-road vehicles, including beach-raking machines. Recreational off-road vehicles should be prohibited or restricted at 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 snowy plover use of beaches occurs year-round.

Essential vehicles within 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 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.

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 snowy plovers. Task 1.4.1 emphasizes the need to remove litter and garbage from beaches manually (not by raking machines) during the nesting season, that land managers should supply covered or scavenger-proof trash receptacles at access points and away from snowy plover habitat, and that receptacles should be routinely emptied. Retain plover habitat components such as kelp and driftwood (see Task 1.3.1.6).

1.3.3 Implement and enforce restrictions on horseback riding in nesting areas. Strategies to reduce adverse impacts to nests from

commercial and private equestrian use of 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 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.

1.3.4 Provide wardens, agents, or officers to enforce protective measures in breeding habitat. Wardens are especially needed on heavily-used beaches during the peak recreational season, which coincides with the 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 snowy plovers, such as illegally-parked vehicles, trespassing off-road vehicles, pedestrians, pets in restricted areas, falconry, illegal or unauthorized activities (e.g., fireworks, beach fires), pets off leash, and littering. Patrols and enforcement are needed to ensure compliance (e.g., Vandenberg Air Force Base linear restriction) and to make sure restrictive measures are successful. Specific actions to be implemented include patrols in protected areas (see Task 1.3.6) and car patrols to prevent illegal driving and parking.

1.3.5 Develop and implement training programs for enforcement personnel and others who work in snowy plover breeding habitat. Federal, State, and local enforcement personnel and others who work in plover habitat should be trained to conduct thorough investigations into potential violations of the Endangered Species Act and other wildlife conservation statutes. Training should be coordinated with the local Fish and Wildlife Service Law Enforcement office. It is essential that wardens, whether professional or volunteers, be thoroughly trained in procedures for conducting patrols in a manner that minimizes risk to plovers; have at least rudimentary knowledge of snowy plovers for

public education purposes; and 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 snowy plovers is encountered.

1.3.6 Ensure that enforcement efforts do not endanger snowy plovers, their nests, eggs, or chicks. 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 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.

1.4 Prevent excessive predation for 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 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 cognizant of the adverse consequences to listed species if needed predator control measures are prohibited or restricted.

1.4.1 Remove litter and garbage from beaches manually, not by raking machines. 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. If trash cans have to be placed on the beach, predator-proof trash containers should be used. 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. Emptying cans in the evening instead of leaving them overnight is preferable. Fish-cleaning stations should be located well away from plover breeding areas.

Although removal of trash from the beach reduces predation threats, beach-raking should be avoided year-round to protect breeding and wintering snowy plovers. Trash should be selectively removed from the beach manually, but natural materials, including shells, seaweed, and driftwood, should be left intact.

In areas where large amounts of nonnative woody debris, such as giant reed (*Arundo donax*), has washed onto beaches and significantly reduced the amount of nesting habitat, a large portion of the debris (but not all) should be removed. However, this removal should not be done during the nesting season.

1.4.2 Remove predator perches and unnatural habitats. Planners should not allow unnatural habitats to be placed near snowy plover nesting locations. Where feasible, land managers should remove from 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).

1.4.3 Erect predator exclosures to reduce snowy plover egg predation where appropriate. Current guidelines for the use of predator exclosures to protect nesting snowy plovers are contained in Appendix F. Exclosures are a valuable tool for countering human-abetted predation threats to 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 1 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. String (twine) may be needed on top of exclosures to deter avian predators.

1.4.4 Remove predators where warranted and feasible. 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 snowy plover adult, chick, or egg predation (which cannot be countered with predator exclosures) are occurring. Nonnative predators should be eliminated in all instances from plover nesting habitat. Native predators should be removed or controlled by nonlethal means whenever possible.

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 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 plovers. Removal of native predators should focus on problem individuals rather than populations. State permits must also be obtained to capture and relocate mammals (e.g., raccoons, skunks, and opossums).

Gulls should be discouraged from establishing and expanding nesting colonies at snowy plover nesting areas, and land managers should determine whether existing gull colonies warrant removal. At some sites, placement of crow and gull carcasses around plover nest site perimeters may discourage these predators. Therefore, attempts should be made to try scare gulls (i.e., gull carcasses for deterrents) prior to removal of gulls. If removal is not warranted, exclosures around plover nests should be used to prevent large flocks of roosting gulls from trampling plover nests.

1.4.5 Remove bird and mammal carcasses in snowy plover nesting areas. Where practical and not disturbing to 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.

1.5 Protect snowy plovers and their breeding habitat from oil or chemical spills. Land managers should develop oil/chemical spill emergency response plans that provide for protection of known plover breeding areas. The U.S. Coast Guard should update their emergency response measures to include protective measures for the snowy plover. In the event of a spill in the vicinity of a 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., Task 1.3.2 regarding essential vehicles).

If 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 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.

1.6 Replace exotic dune plants with native dune vegetation where it is likely to improve breeding habitat for snowy plovers. Land managers should make special efforts to reestablish native dune plants in 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 (see Task 1.2.5.1). 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 make sure they that the amount of vegetative cover is compatible with suitable breeding habitat for plovers.

1.7 Compensate the loss of snowy plover breeding habitat associated with recovery efforts for other sensitive species, including those within the San Francisco Bay Recovery Unit. When snowy plover breeding habitat will be adversely affected by management and recovery actions for other sensitive species, all efforts should be made to conserve snowy plover habitat. Where this is not possible, any loss of snowy plover habitat values should be fully compensated. Within coastal beach-dune habitats in Washington, Oregon, and California, compensation efforts should emphasize the removal of beachgrass (*Ammophila* spp.) for lost snowy plover breeding habitat resulting from management for other sensitive species.

To compensate for the loss of existing 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 snowy plover breeding habitat. Currently, most 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 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 Central and Northern California Coast Tidal Marsh Recovery Plan (U.S. Fish and Wildlife Service in prep.). Habitat enhancement for snowy plovers should

be phased in with scheduled tidal marsh restoration for other listed species. During this interim period, land owners should make all efforts to achieve the recovery criteria of 500 breeding adults within the San Francisco Bay Recovery Unit by intensively managing existing snowy plover breeding habitat.

Replacement of snowy plover breeding habitat in San Francisco Bay should concentrate on areas where the necessary components of 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 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, including the Oliver Brothers salt ponds (north and south of Highway 92), Alviso salt ponds, other salt pond systems between the San Mateo Bridge and Redwood Creek, Napa salt ponds, and the Redwood City and Napa crystallizers. The area to be managed for 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 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.

1.8 Discourage pinnipeds from usurping snowy plover nesting areas.
Land managers should monitor pinniped colonies adjacent to snowy plover breeding habitat and seek to keep breeding pinnipeds from occupying snowy plover nesting areas during the plover breeding season. Where conflicts occur, breeding pinnipeds should be discouraged from hauling out at plover breeding areas or be relocated, if feasible. Implementation of this task 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. 1361-1407).

2 Monitor and manage wintering and migration areas to maximize snowy plover population survival. Wintering and migration habitats should be monitored and managed to maximize survival and recruitment of snowy plovers into the breeding population.

2.1 Monitor known and potential wintering locations. All known wintering locations (listed in Appendix B of this plan) are considered currently important to 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 may also support migrating snowy plovers. There is a need for better information about wintering sites, including spatial and temporal use patterns, feeding areas, habitat trends, and threats.

2.1.1 Monitor snowy plover abundance and distribution at wintering locations in each recovery unit. Comprehensive range-wide window surveys of wintering locations listed in Appendix B should be conducted annually to determine population trends and fluctuations (Appendix J, Monitoring Guidelines).

2.1.2 Identify factors limiting the quality of wintering locations. Land managers should monitor the response of snowy plovers to potentially adverse factors at wintering locations (listed in Appendix B), including natural coastal formation processes, dredging, and other channel maintenance projects. 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 sought. Impacts of recreational use by humans and their pets should also be monitored.

2.1.3 Quantify wintering habitat needs of snowy plovers along the Pacific coast. The amount of habitat needed to support wintering snowy

plovers along the Pacific coast should be determined. This effort should include estimating the numbers of snowy plovers that can be supported at wintering locations listed in Appendix B and identifying important site characteristics. This task will require consideration of wintering habitat capacity along the Pacific coast of the United States and Mexico, and quantifying the combined interior and coastal populations.

2.1.4 Evaluate and update lists of important wintering areas as data become available. As new snowy plover wintering areas are discovered and data needed to assess the carrying capacity, essential characters, and juxtaposition of wintering habitats become available, the current list of important wintering locations should be expanded or refined as appropriate.

2.2 Prevent human degradation and disturbance of wintering habitat. The Pacific coast population of the western snowy plover is sensitive to changes in adult and juvenile survival rates (see Appendix D). Furthermore, recovery of this species is contingent on availability of wintering habitat for more than the current number of snowy plovers (see recovery criteria).

2.2.1 Protect wintering habitat from impacts of water diversion/impoundment and shoreline stabilization, navigation, and development projects. Coastal development, beach stabilization, resource extraction, and water diversion and/or impoundment projects should be carefully assessed for impacts to wintering snowy plovers. Recommendations from 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.

2.2.2 Protect wintering habitat from disturbance by people and domestic animals. Snowy plover 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. Appropriate protection and enforcement measures should be incorporated into conservation efforts. Management plans (Tasks 3.1.4.1, 3.1.4.2, and 3.1.5) should include appropriate human/domestic animal access restrictions to prevent disturbance of snowy plovers.

2.2.3 Develop and implement necessary State and local ordinances, administrative rules, and regulations to enforce closed areas on beaches used as snowy plover wintering habitat. For areas where beach closures are necessary in wintering habitat, appropriate ordinances, administrative rules, and regulations should be developed by State and local governments to enable law enforcement officers to conduct necessary enforcement actions. Often, snowy plover wintering habitat extends across administrative boundaries. In such cases, area law enforcement agencies are encouraged to coordinate procedures and authorities to most effectively ensure compliance. Closed areas should be posted with signs designating the State or municipal law, ordinance, or other regulation that is being violated.

2.2.4 Provide trained wardens, agents, or officers to enforce protective measures in snowy plover wintering habitat. Wardens should be used to enforce protective measures on snowy plover wintering habitat. Enforcement personnel and others who work in plover habitat should be trained to conduct thorough investigations into potential violations of the Endangered Species Act and other wildlife conservation statutes.

2.2.5 Protect snowy plover wintering habitat from degradation due to oil or chemical spills. 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 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 snowy plovers. In the event of a spill in a known 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 snowy plovers.

If snowy plovers or their habitats 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 snowy plover habitat should collect baseline data on behavior, distribution, abundance, and habitat use by plovers. The baseline data 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.

2.2.6 Protect wintering habitat from degradation by removing litter from beaches manually, instead of using raking machines. Beach-raking of snowy plover wintering habitat should be avoided because it removes plover food sources. Trash should be selectively removed from the beach manually, but natural materials, including shells, seaweed, and driftwood, should be left intact.

2.3 Compensate the loss of snowy plover wintering habitat associated with recovery efforts for other sensitive species. When snowy plover wintering habitat will be adversely affected by management and recovery actions for other sensitive species, all efforts should be made to conserve snowy plover habitat. Where conservation of habitat is not possible, any loss of snowy plover habitat should be fully compensated.

2.4 Protect snowy plovers during migration. Additional information on 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.

2.4.1 Identify important migration stop-over habitat. Identify any important migration stop-over areas used by migrating but not by breeding or wintering snowy plovers.

2.4.2 Identify and mitigate any factors that may be adversely affecting migratory stop-over habitat for snowy plovers. Further investigations of factors that may affect the well-being of snowy plovers during migratory stop-overs should be investigated and mitigated, particularly at sites that receive heavy use or face threats to their suitability as stop-over habitat.

3 Develop mechanisms for long-term management and protection of snowy plovers and their breeding and wintering habitat. Long-term management and protection will be needed on Federal and nonFederal lands. Development of long-term protection mechanisms should include opportunities for participation of various stakeholders in development of management options.

3.1 Develop and implement regional cooperative participation 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. From these networks and programs, participation plans (see Task 3.1.2) should be developed and implemented to expedite and increase the chances of recovery for the western snowy plover (see Figure 12, flow chart of recovery planning and implementation efforts).

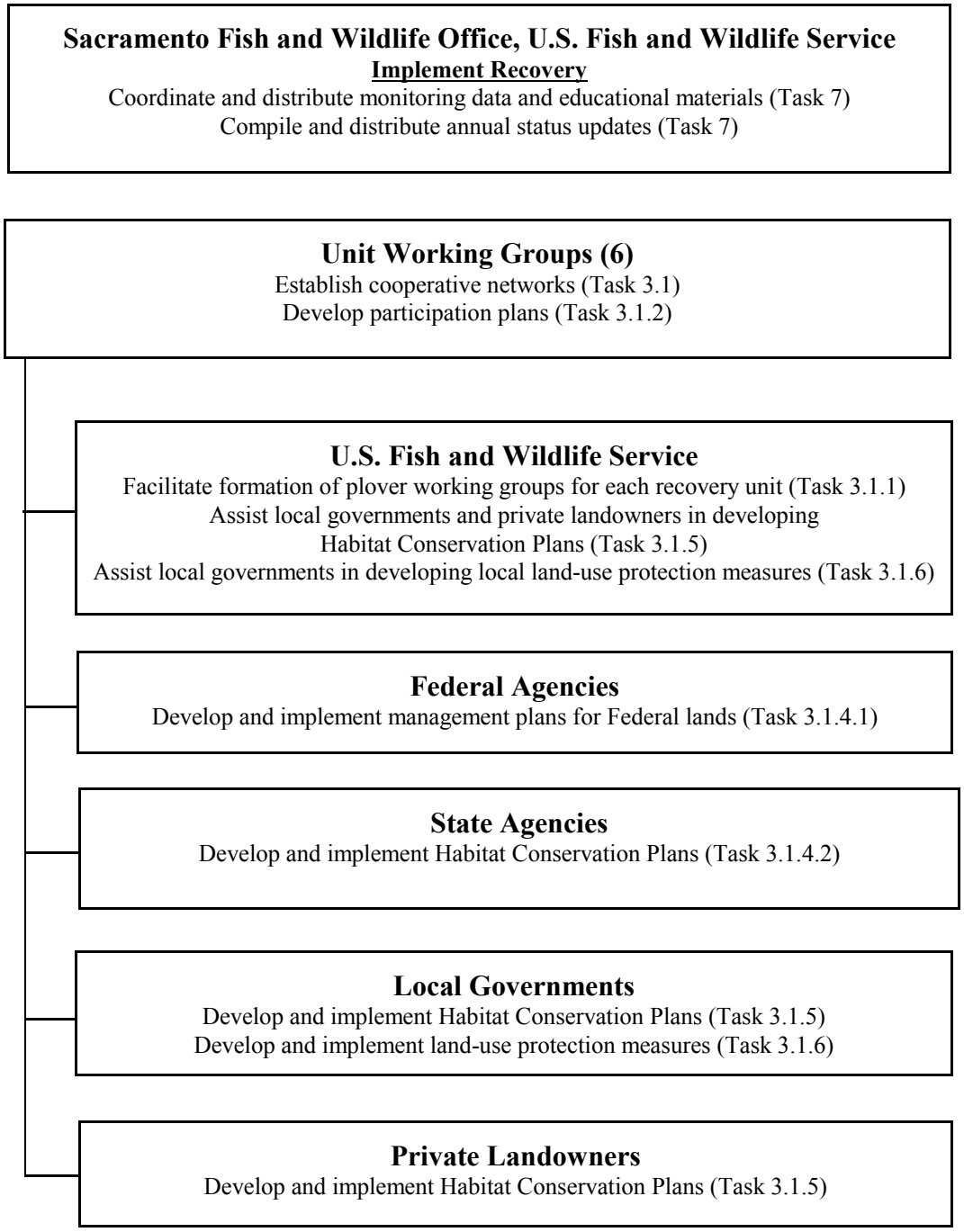


Figure 12. Flow chart of recovery planning and implementation efforts.

3.1.1 Establish snowy plover working groups for each of the six recovery units. To facilitate regional cooperative programs, working groups should be established for each of the six recovery units, covering the following areas: (1) Oregon and Washington; (2) northern California (Del Norte, Humboldt, and Mendocino Counties); (3) San Francisco Bay (locations within the counties of Napa, Alameda, Santa Clara, and San Mateo); (4) Monterey Bay (including coastal areas along the counties of Monterey, Santa Cruz, San Mateo, San Francisco, Marin, and Sonoma); (5) San Luis Obispo, Santa Barbara, and Ventura Counties; and (6) Los Angeles, Orange, and San Diego Counties. Working groups should be patterned after the Western Snowy Plover Working Teams for Oregon and Monterey Bay. The Teams should be composed of representatives from the Federal, State, local, and private sectors; and meet regularly to assess 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 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. Public outreach should also 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.

The following U.S. Fish and Wildlife Service field offices should facilitate the formation of new working groups and exchange of information among working groups: (1) Western Washington Fish and Wildlife Office, Lacey, Washington; (2) Newport Fish and Wildlife Office, Newport, Oregon; (3) Arcata Fish and Wildlife Office, Arcata, California; (4) Sacramento Fish and Wildlife Office, Sacramento, California; (5) Ventura Fish and Wildlife Office, Ventura, California; and (6) Carlsbad Fish and Wildlife Office, Carlsbad, California.

3.1.2 Develop and implement regional participation plans for each of the six recovery units. Participation plans should be developed by each of the six recovery unit working groups to implement recovery actions and

maintain the snowy plover populations, after delisting. Plans should identify and prioritize specific recovery activities for each location identified in Appendix B, while considering the needs of the entire Pacific coast population. They 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 snowy plover's habitat needs (including an information and education strategy specific to area demographics and recreational activities); (3) economic incentives for conservation of snowy plovers on private lands; and (4) all actions necessary to maintain snowy plover productivity after delisting. Participation plans may also identify ways in which recovery actions for snowy plovers will be covered as part of coastal ecosystem plans or other conservation measures.

3.1.3 Provide intensive management and protection of snowy plovers on all Federal and State lands. Federal and State land managers should protect and intensively manage all breeding and wintering locations (listed in Appendix B) that occur on Federal and State lands. Intensive management programs for snowy plovers at national wildlife refuges should be implemented and annually evaluated to ensure they provide sufficient plover protection. Intensive management programs should also 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).

3.1.4 Develop and implement management plans for all Federal and State lands. Federal and State land managers should develop and implement management plans for all breeding and wintering locations (listed in Appendix B).

3.1.4.1 Develop and implement management plans for Federal lands. Federal agencies should develop or update, as appropriate, site-

specific management plans that address threats to 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 should also 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).

3.1.4.2 Develop and implement 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 habitat conservation plans to minimize and mitigate impacts to 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 snowy plovers.

3.1.5 Encourage and assist local governments and appropriate private landowners to develop and implement habitat conservation plans. We should provide assistance in the development of habitat conservation plans to: (1) county and city governments that manage 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.

3.1.6 Assist local governments in developing and implementing local land use protection measures. Federal and State agencies should assist local governments in developing 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. Technical assistance such as maps of snowy plover habitats,

identification of local threats, and recommended site-specific protective measures should be provided to coastal planners.

3.1.7 Encourage 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 review local coastal programs and policies for consistency with the snowy plover recovery plan. We should encourage 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 to review local coastal programs and policies for consistency with the snowy plover recovery plan. This review should include protection of snowy plover habitats, cumulative impacts to snowy plovers, and policies or restrictive measures recommended in this recovery plan.

We should encourage and assist the California Coastal Commission and Oregon Department of Land Conservation and Development to ensure that Local Coastal Plans, Local Comprehensive Plans, and Implementing Measures for coastal planning jurisdictions are updated, through periodic review or plan amendment, to reflect the recovery plan. Encourage the California Coastal Commission to implement its Regional Cumulative Assessment Program. We should also work with the Oregon Parks and Recreation Department to ensure coordination between Local Comprehensive Plans and that agency's management of the ocean shore and to evaluate and account for cumulative impacts across planning jurisdictions.

We should coordinate with the Oregon Department of Fish and Wildlife during their periodic statutory review of the Oregon Endangered Species Act, to assure consistency with this recovery plan.

3.1.8 Obtain long-term agreements with private landowners. Agreements between Federal and State agencies and private landowners interested in snowy plover conservation should be developed and implemented. Landowners should be apprised 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 snowy plovers, permission should be sought from landowners to conduct on-site surveys. If surveys identify plover populations, landowners should be apprised of their significance and offered incentives to continue current land uses that support species habitat.

3.1.9 Identify snowy plover habitat for acquisition. Federal, State, and private conservation organizations should acquire 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 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.

3.1.10 Ensure that section 10(a)(1)(B) and section 7(a)(2) 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 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 snowy plover population. The recovery plan should also guide the evaluation of impacts to snowy plovers under section 7(a)(2) permits issued pursuant to 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. No short-term or long-term losses to plover habitats should be allowed. The section 10(a)(1)(B) permit process may be a valuable mechanism for developing the long-term protection agreements called for in Tasks 3.1.4.2 and 3.1.5, especially where significant population growth has already occurred and productivity exceeds l.0 fledged chick per male.

4 Undertake scientific investigations that facilitate recovery efforts. Major gaps remain in our understanding of useful protection measures and conservation efforts.

4.1 Investigate effective and cost-efficient methods for habitat restoration by removal of introduced beachgrass. Land managers should summarize methods used to date for removal of introduced beachgrass. They should also pursue field studies 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.

4.2 Develop and test new predator management techniques to protect 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 enclosures that prevent harm to snowy plovers. Resource managers should investigate modified designs for California least tern enclosures to minimize snowy plover mortality. These modifications should include mesh sizes that do not ensnare plover chicks and allow them to move freely in and out of fenced areas. Fences must be erected prior to the snowy plover nesting season.

4.2.3 Investigate ecology of native predators. The ecology of problematic avian predators (e.g., ravens and shrikes) and native mammals (e.g., coyotes and gray foxes) should be investigated to gain an understanding of how to control their impact on snowy plover nesting areas during the plover breeding season.

4.2.4 Investigate predator management at the landscape level. Resource managers should investigate landscape-level management of predators in the vicinity of snowy plover nesting areas. This management could include removal of predator nest sites on lands surrounding snowy plover breeding areas.

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

4.2.6 Investigate aversive methods to discourage snowy plover predators. Information is needed on the applicability and usefulness of aversive techniques for conditioning predators not to prey on snowy plover eggs, chicks, or adults. 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 there seem to be obstacles to development of effective aversion techniques that can be efficiently applied in the field, there are substantial potential advantages to be realized from aversive techniques that can reduce predation with minimum

disruption to native predator populations that are important to overall ecosystem balance, and that might be conducted at times when plovers are not present.

4.3 Improve methods of monitoring population size and reproductive success of snowy plovers. Methods used to monitor 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 snowy plover population size. Not all 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 plovers present at a site. When a window survey is completed, the ratio of the total number of plovers to the number of 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. 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 Monitor snowy plover survival rates. 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 Identify 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. Traditionally-used brood habitat should be identified and protected. Determine home ranges of snowy plovers through radio telemetry studies.

4.5 Identify components of high-quality 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.

4.6 Determine causes of adult snowy plover 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.

4.7 Improve techniques for banding snowy plovers. Improve the technique for banding birds to reduce injuries. Because 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 should also be considered. Experimentation with new techniques must be conducted cautiously and may need to include pre-testing on nonlisted surrogate species.

4.8 Identify effects of oil spills on snowy plovers. Research should be conducted on the direct and indirect effects of oil spills on 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.

4.9 Monitor levels of environmental contaminants in 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.

5 Undertake public information and education programs. Expanded efforts are needed to increase public awareness of the needs of 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.

5.1 Develop and implement public information and education programs. Millions of beach recreationists come in contact with 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 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 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 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 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 snowy plovers. Members of the six recovery unit working groups should develop new 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 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 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 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 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, dislocated, 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 dislocated 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 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 snowy plovers at our website (www.rl.fws.gov). 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. Our Sacramento 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 snowy plover population's range.

6 Review progress towards recovery annually and revise recovery efforts as appropriate. Communication, evaluation, and coordination play a major role in 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 Sacramento Fish and Wildlife Office.

7 Dedicate U.S. Fish and Wildlife Service staff and funding for the Sacramento Fish and Wildlife Office to coordinate snowy plover recovery implementation. We should assure the availability of long-term funding for a staff position in the Sacramento Field and Wildlife Office, the lead field office responsible for preparation and implementation of this recovery plan. The primary responsibility of this staff position is implementation of the 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 snowy plover issues; compilation and distribution of annual population status updates to all working groups; coordination with our other field offices in Region 1 regarding snowy plover conservation actions, consultations, habitat conservation plans, and permits; facilitating establishment of, and 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 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 tasks 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 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 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 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 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 snowy plovers.

IV. IMPLEMENTATION

The following Implementation Schedule outlines actions needed and responsible parties for the recovery program in the United States portion of the Pacific coast population of the western snowy plover over the next 5 years and over the estimated 25-year period needed for its recovery. 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 snowy plover could occur in 20 to 35 years. With dedicated, proactive efforts toward improvements in snowy plover management in the near-term, and subsequent management at a maintenance level commensurate with fulfillment of the recovery criteria, the recovery team estimates recovery would occur in approximately 25 years.

Total costs that could be projected are $28,588,000, representing the recovery team's best estimate of funds needed to implement certain tasks over a 25-year period. However, these costs only represent a portion of the overall costs because the cost of many other tasks cannot be estimated at this time. For example, costs associated with the key and costly task requiring intensive protection and management on Federal and State lands (Task 3.1.3) should be determined by members of each of the six recovery unit working groups.

It should be recognized that expenditure of funds for recovery of the 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 snowy plover habitat, it also recognizes that management strategies that protect 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 tasks that should be undertaken within the next 5 years. This schedule will be reviewed annually until the recovery objective is met, and priorities and tasks will be subject to revision. Tasks of higher priority are presented first.

Referenced tasks in the "Comments/Notes" column are explained in the Stepdown Narrative section.

Key to Acronyms used in the Implementation Schedule

Definition of task 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 task durations and costs:

Annual - A task that will be implemented each year.

Continual - A task that will be implemented on a routine basis once begun.

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

As needed - A task that will be implemented on an "as needed" basis.

Unknown - Either task 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
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
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 tasks in Implementation Schedule are considered lead agencies for those tasks.

IMPLEMENTATION SCHEDULE

Western Snowy Plover Pacific Coast Population Recovery Plan

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
1	Annually monitor population size and distribution at breeding locations in each recovery unit.	1.1.1	annual	LMAO, CO, CI	1,000	40	40	40	40	40	100 window survey days, at $192 per biologist day, 2 biologists per breeding location. Task needed to determine fulfillment of recovery criteria.
1	Monitor productivity.	1.1.2	annual	LMAO, CO, CI	See Task 1.1.4						Part of Task 1.1.4. Task implementation needed to ascertain fulfillment of recovery criteria.
1	Monitor snowy plover breeding activities at all breeding sites to identify factors limiting abundance of breeding birds, clutch hatching success and chick fledging success.	1.1.4	annual	LMAO	16,000	640	640	640	640	640	Needed for adaptive management.

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
1	Avoid development that will destroy or degrade plover breeding habitat.	1.2.1	ongoing	ES, LMAO, CO, CI	Unknown						Contingent on number and types of projects proposed.
1	Avoid interference with natural processes of inlet formation, migration, and closure.	1.2.2	ongoing	ES, CE, LMAO	Unknown						Contingent on number and types of projects proposed.
1	Avoid interference with natural processes of erosion and deposition of sand dunes.	1.2.3	ongoing	ES, CE, LMAO	Unknown						Contingent on number and types of projects proposed.
1	Avoid beach stabilization projects.	1.2.4	ongoing	ES, CE, LMAO	Unknown						Contingent on number and types of projects proposed.
1	Remove nonnative vegetation from existing and potential breeding sites.	1.2.5.1	continual	LMAO	TBD						Incorporate into ongoing management and Task 3.1.3. Cost range for mechanical, manual and/or chemical control: $1000 to $87,000 per hectare ($400 to $35,000 per acre).

Priority No.	Task Description	Task Number	Task 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.	1.2.5.3	ongoing	ES, RW, CE, CDFG, NASA, HARD, LMAO	TBD						Incorporate into ongoing management. See Task 1.7.
1	Seasonally close, fence, post, use exclosures, monitor and enforce regulations in areas used by breeding snowy plovers as appropriate.	1.3.1.1	annual	LMAO, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3. Cost estimate for symbolic fencing: Materials (posts/cables): $5,900 per kilometer ($9,500 per mile); Labor: 15 person hours per kilometer (24 person hours per mile).
1	Develop and implement necessary State and local ordinances, administrative rules and regulations to enforce closed areas on beaches used as breeding habitat.	1.3.1.2	continual	ES, LE, LMAO, CCC, CDFG, CDPR, ODFW, ODLCD, OPRD, WDFW, WDNR, WSPRC, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3. Cost estimate for ordinance signs: $20 per sign through California Prison Industries. Need one introductory sign at each access point; one sign every 100 meters (328 feet) at closure areas with symbolic fence; and two signs (one 50 meters (164 feet)) north and one 50 meters south of exclosure.

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
1	Locate access points and trails well away from plover nesting habitat.	1.3.1.3	continual	LMAO, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3.
1	Prevent disturbance from disruptive recreational activities where breeding snowy plovers are present.	1.3.1.5	annual	LMAO, CO, CI, FAA	TBD						Incorporate into ongoing management and Task 3.1.3.
1	Prevent disturbance, mortality, and habitat degradation by off-road vehicles, including beach-raking machines.	1.3.2	annual	LMAO, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3. Approximately $53,000 spent on management of Pismo Dunes State Vehicular Recreation Area. Expect cost savings with manual removal of trash due to equipment and fuel cost savings.
1	Provide wardens, agents or officers to enforce protective measures in breeding habitat.	1.3.4	continual	LE, LMAO, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3. Cost depends on intensity of use.

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
1	Erect predator exclosures to reduce egg predation where appropriate.	1.4.3	continual	LMAO, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3. Cost estimates for exclosures: Materials (wire, posts): $105 per unit; Tools (one-time cost): $30 per kilometer ($48 per mile); Labor: 6 person hours for installation/removal per unit.
1	Remove predators where warranted and feasible.	1.4.4	as needed	LMAO, CO, CI, WS, CDFG	2,500	100	100	100	100	100	Incorporate into ongoing management and Task 3.1.3.
1	Protect snowy plovers and their breeding habitat from oil or chemical spills.	1.5	as needed	LMAO, CO, CI, USCG	Unknown						Incorporate into ongoing management and Task 3.1.3. Costs contingent on number and magnitude of spills.
1	Protect wintering habitat from degradation due to oil or chemical spills.	2.2.5	as needed	ES, USCG, LMAO	Unknown						Incorporate into ongoing management and Task 3.1.3. Contingent on number and magnitude of spills.

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
1	Establish snowy plover working groups for each of the six recovery units.	3.1.1	continual	ES, LMAO, CO, C I, P	2,285	96	96	91	91	91	Essential mechanism to advance plover recovery. Includes biannual meeting costs and $5,000 during FY1 and FY2 for FWS field office staff to establish new working groups.
1	Provide protection and intensive management of all breeding and wintering locations on Federal and State lands.	3.1.3	continual	RW, ARMY, BLM, CE, NASA, NAVY, NPS, USAF, USFS, USMC, CDFG, CDPR, ODFW, OPRD, WDFW, WDNR, WSPRC	TBD						PVA shows that intensive management is needed for recovery. Represents other tasks; costs should be determined through working groups.
1	Dedicate U.S. Fish and Wildlife Service staff and funding for the Sacramento Fish and Wildlife Office to coordinate recovery implementation.	7	continual	ES	2,000	80	80	80	80	80	

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
2	Ensure that enforcement efforts do not endanger snowy plovers, their nests, eggs or chicks.	1.3.6	continual	LE, LMAO, CO, CI	See Task 1.3.5						Part of Task 1.3.5.
2	Replace exotic dune plants with native dune vegetation where it is likely to improve breeding habitat for snowy plovers.	1.6	continual	LMAO, CO, CI	TBD						Concentrate on removal of nonnative vegetation (Task 1.2.5.1). Estimated cost for planting native vegetation: $30,000 per hectare ($12,000 per acre) for planting, re-planting, and follow-up costs.
2	Compensate the loss of plover breeding habitat associated with recovery efforts for other sensitive species, including those within the San Francisco Bay recovery unit.	1.7	ongoing	ES, RW, CE, LMAO	TBD						For San Francisco Bay recovery unit, this task should be phased in (see Task 1.7).

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
2	Protect wintering habitat from impacts of water diversion/ impoundment and shoreline stabilization, navigation, and development projects.	2.2.1	ongoing	ES, CE, LMAO, CCC, CDFG, CDPR, ODFW, ODLCD, OPRD, WDFW, WDNR, WSPRC CO, CI	Unknown						Contingent on number and types of projects proposed.
2	Compensate the loss of plover wintering habitat associated with recovery efforts for other sensitive species.	2.3	ongoing	ES, RW, CE, LMAO	TBD						
2	Develop and implement regional participation plans for each of the six recovery units.	3.1.2	continual	ES, LMAO	TBD						Essential mechanism to advance snowy plover recovery (see Task 3.1.2 in step-down narrative).

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
2	Assist local governments in developing and implementing local land use protection measures.	3.1.6	ongoing	ES, CCC, CDFG, CDPR, ODFW, ODLCD, OPRD,WDNR, WDFW, WSPRC, CO, CI	TBD						
2	Investigate effective and cost-efficient methods for habitat restoration by removal of introduced beachgrass.	4.1	continual	ES, LMAO, RSCH	TBD						
2	Develop higher-efficiency nest exclosures.	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.
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).

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
2	Improve methods of monitoring population size.	4.3.1	continual	ES, LMAO, RSCH	TBD						Part of Tasks 1.1.1, 1.1.2 and 1.1.3.
2	Develop sampling methods for annually estimating reproductive success.	4.3.2	as needed	ES, RSCH	30	5	25	0	0	0	
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.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
2	Review progress towards recovery annually and revise recovery efforts as appropriate.	6	continual	ES, RW, ARMY, BLM, CE, NASA, NAVY, NPS, USAF, USFS, USMC, CDFG, CDPR, ODFW, ODPR, WDFW, WDNR, WSPRC, LMAO	1,150	46	46	46	46	46	Preparation and follow-up efforts needed for Task 3.1.1.
3	Monitor annual survival.	1.1.3	continual	LMAO, RSCH	TBD						Do concurrently with Task 4.2.3.
3	Develop training and certification programs for snowy plover survey coordinators.	1.1.5	continual	ES, LMAO, RSCH	TBD						
3	Improve submittal system for monitoring data.	1.1.6	continual	ES, LMAO, BBL, PRBO	575	23	23	23	23	23	Needed to coordinate bands and compile data.

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
3	Evaluate and update lists of important breeding areas as data become available.	1.1.7	continual	LMAO	TBD						
3	Coordinate monitoring of snowy plovers and California least terns.	1.1.8	annual	ES, RW, NAVY, USMC, USAF, CDFG, CDPR, WS, BRD	450	18	18	18	18	18	Coordinate at biannual pre- and post-season California least tern monitoring meeting.
3	Deposit dredged material to enhance or create nesting habitat, and evaluate impacts from beach nourishment activities.	1.2.5.2	as needed	ES, CE, LMAO	TBD						
3	Implement and enforce pet restrictions.	1.3.1.4	annual	LMAO, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3.
3	Prevent driftwood removal.	1.3.1.6	annual	LMAO, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3.

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
3	Implement and enforce anti-littering regulations.	1.3.1.7	annual	LMAO, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3.
3	Implement and enforce restrictions on horseback riding in nesting areas.	1.3.3	annual	LMAO, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3.
3	Develop and implement training programs for enforcement personnel and others who work in plover breeding habitat.	1.3.5	continual	LE, LMAO, CO, CI	200	8	8	8	8	8	Annual training cost estimate: $8,000 per year.
3	Remove litter and garbage from beaches manually, not by raking machines.	1.4.1	continual	LMAO, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3.
3	Remove predator perches and unnatural habitats.	1.4.2	continual	LMAO, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3.

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
3	Remove bird and mammal carcasses in snowy plover nesting areas.	1.4.5	as needed	LMAO, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3.
3	Discourage pinnipeds from usurping snowy plover nesting areas.	1.8	as needed	NPS, LMAO, NMFS	TBD						Specific to sites that attract breeding pinnipeds.
3	Monitor snowy plover abundance and distribution at wintering locations in each recovery unit.	2.1.1	annual	LMAO, CO, CI	575	23	23	23	23	23	57 window survey days at $192 per biologist day, 2 biologists per wintering location.
3	Identify factors limiting the quality of wintering locations.	2.1.2	continual	LMAO, CO, CI	TBD						Incorporate into ongoing monitoring and management and Task 3.1.3.
3	Quantify wintering habitat needs of snowy plovers along the Pacific coast.	2.1.3	continual	LMAO, RSCH	TBD						Incorporate into ongoing monitoring and management and Task 3.1.3.

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
3	Evaluate and update lists of important wintering areas as data becomes available.	2.1.4	continual	ES, LMAO	TBD						Incorporate into ongoing monitoring and management and Task 3.1.3.
3	Protect wintering habitat from disturbance by people and domestic animals.	2.2.2	continual	LMAO, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3.
3	Develop and implement necessary State and local ordinances, administrative rules and regulations to enforce closed areas on beaches used as wintering habitat.	2.2.3	annual	ES, LMAO, CCC, CDFG, CDPR, ODFW, ODLCD, OPRD, WDFW, WDNR, WSPRC, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3. See Task 1.3.1.2 for unit costs of ordinance signs.

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
3	Provide wardens, agents or officers to enforce protective measures in wintering habitat.	2.2.4	continual	LE, LMAO, CO, CI	100	4	4	4	4	4	Annual training cost estimate: $4,000/year.
3	Protect wintering habitat from degradation by removing litter from beaches manually, not by raking machines.	2.2.6	annual	LMAO, CO, CI	TBD						Incorporate into ongoing management and Task 3.1.3.
3	Identify important migration stop-over habitat.	2.4.1	continual	ES, LMAO	TBD						Incorporate into ongoing monitoring and management and Task 3.1.3.
3	Identify and mitigate any factors that may be adversely affecting migratory stop-over habitat for snowy plovers.	2.4.2	continual	ES, LMAO, RSCH	TBD						Incorporate into ongoing monitoring and management and Task 3.1.3.

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
3	Develop and implement management plans for Federal lands.	3.1.4.1	ongoing	RW, ARMY, BLMCE, NASA, NAVY, NPS, USAF, USMC, USFS	TBD						
3	Develop and implement Habitat Conservation Plans on State wildlife areas, State ecological reserves, and State beaches.	3.1.4.2	continual	CDFG, CDPR, ODFW, OPRD, WDFW, WDNR, WSPRC	TBD						
3	Encourage and assist local governments and appropriate private landowners to develop and implement Habitat Conservation Plans.	3.1.5	ongoing	ES, CO, CI, P, EBRPD, HARD, MPOSD, MPRPD, PGH, PO, SL, TNC, SDRPJPA	TBD						

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
3	Encourage 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 review local coastal programs and policies for consistency with snowy plover recovery plan.	3.1.7	as needed	ES, CCC, ODLCD, ODFW, OPRD, CDPR, WSPRC	TBD						

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
3	Obtain long-term agreements with private landowners.	3.1.8	as needed	ES, CDFG, CDPR, ODFW, OPRD, WDFW, WSPRC, LMAO, P	TBD						
3	Identify habitat for acquisition.	3.1.9	ongoing	ES, RW, LMAO	TBD						
3	Ensure that any section 10(a)(1)(B) and section 7(a)(2) permits contribute to Pacific coast western snowy plover conservation.	3.1.10	ongoing	ES, Federal agencies	TBD						
3	Investigate ecology of native predators.	4.2.3	as needed	ES, RW, LMAO, WS, CDFG, RSCH, CO, CI, P	150						Annual expenditures (FY1 through FY5) TBD.

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
3	Investigate predator management at the landscape level.	4.2.4	as needed	ES, RW, LMAO, WS, RSCH, CO, CI, P	150						Annual expenditures (FY1 through FY5) TBD.
3	Investigate techniques for identifying predators.	4.2.5	continual	LMAO, RSCH	TBD						Incorporate into ongoing monitoring and management and Task 3.1.3.
3	Investigate methods to deter predators from using signs and fencing as predator perches.	4.1.7	as needed	LMAO, RSCH	TBD						
3	Investigate aversive methods to discourage snowy plover predators.	4.2.6	as needed	ES, LMAO, RSCH	TBD						
3	Monitor plover survival rates.	4.3.3	continual	ES, LMAO, RSCH	TBD						Do concurrently with Task 1.1.3.

Priority No.	Task Description	Task Number	Task 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	continual	ES, LMAO, RSCH, CO, CI, P	See Task 1.1.4						Part of Task 1.1.4.
3	Identify components of high-quality brood rearing habitat.	4.5	continual	ES, LMAO, RSCH, CO, CI, P	900						Requires 3-year intensive study at 4-6 sites in WA, OR and CA. Annual expenditure (FY1 through FY5) TBD.
3	Determine causes of adult snowy plover mortality.	4.6	ongoing	LMAO, RSCH	See Task 1.1.4						Part of Task 1.1.4.
3	Improve techniques for banding snowy plovers.	4.7	ongoing	RSCH, PRBO, BRD, BBL	3						Part of Task 1.1.4. Total estimated cost to produce new bands: $3,000.
3	Identify effects of oil spills on snowy plovers.	4.8	as needed	RSCH, BRD, LMAO	TBD						

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
3	Monitor levels of environmental contaminants in snowy plovers.	4.9	as needed	ES, RSCH, BRD	TBD						Depends on number and type of samples. Cost range: $80-600 per sample depending on type of contaminant.
3	Apprise Federal, State and local resource/ regulatory 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 Tasks 3.1.3 and 5.1. See Appendix K

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
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 Tasks 3.1.3 and 5.1. 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 Tasks 3.1.3. and 5.1. See Appendix K.
3	Develop protocols for handling sick, dislocated, injured, oiled, and dead birds or salvaged eggs.	5.6	as needed	LMAO, CO, CI	TBD						Accomplish through section 10(a)(1)(A) permit.
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 Tasks 3.1.3, 5.1, and 7. See Appendix K.

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
3	Establish a reporting and distribution system for annual monitoring data.	5.8	annual	ES	500	20	20	20	20	20	
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						

Priority No.	Task Description	Task Number	Task Duration	Responsible Parties	Total Costs	Cost Estimate (in $1,000 units) FY1	FY2	FY3	FY4	FY5	Comments/Notes
3	Encourage development and implementation of public information and conservation education in Mexico.	8.3	continual	ES, IA, PA	TBD						

Total Cost of Recovery through 2025: $28,588,000 plus additional costs that cannot be estimated at this time.

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APPENDIX A

LOCATIONS OF CURRENT OR HISTORICAL SNOWY PLOVER BREEDING AND WINTERING AREAS

The following maps (Figures A-1 through A-7) show the general locations of current or historical snowy plover breeding or wintering areas on the U.S. Pacific coast. Location numbers on the maps are referenced to the numbers in parentheses shown after the location names found in the left-hand column of Table 7 (Appendix B) and Table 8 (Appendix C). Detailed maps of each of these locations are given in Appendix L.

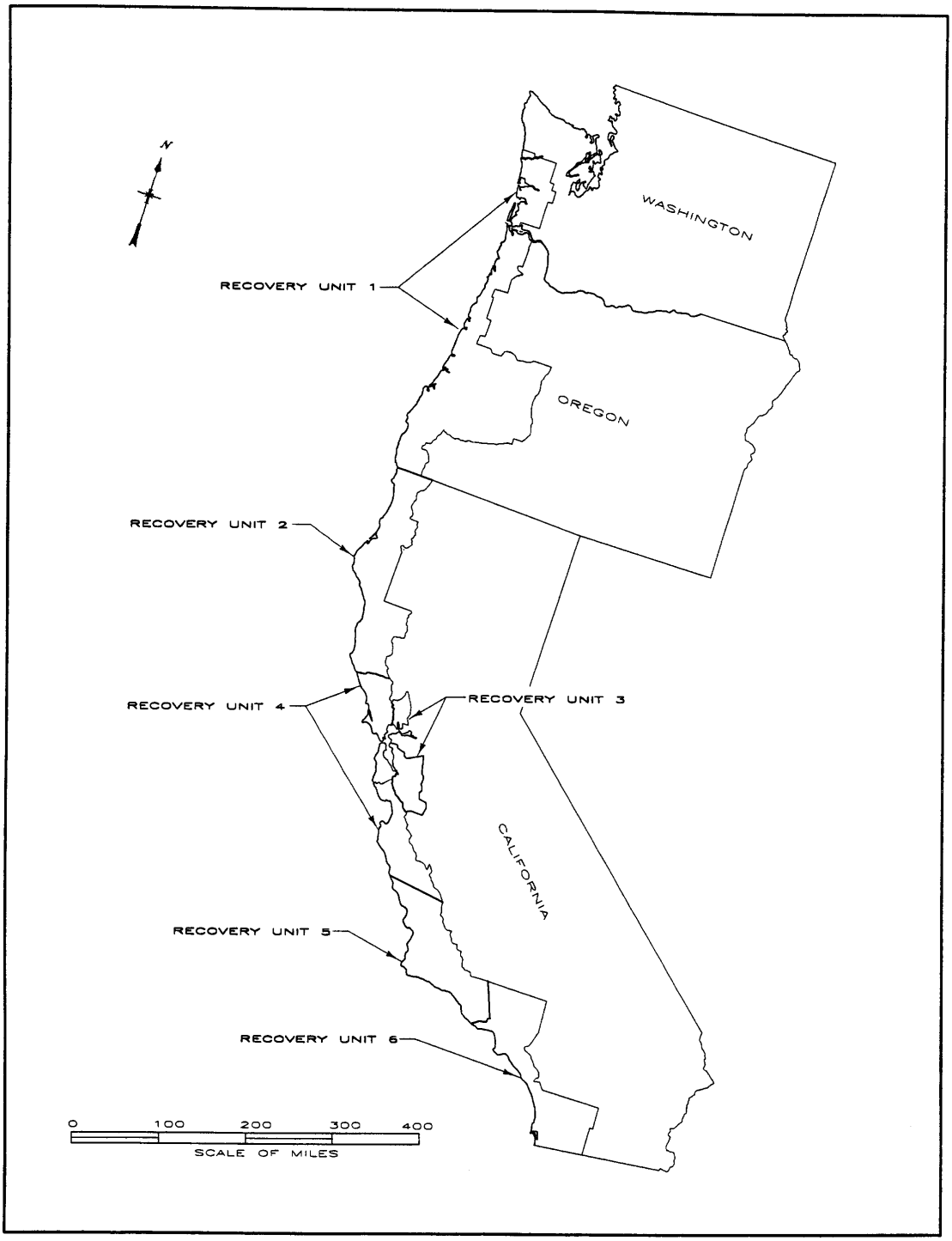

Figure A-1. Recovery Units 1 to 6 - Washington, Oregon and California

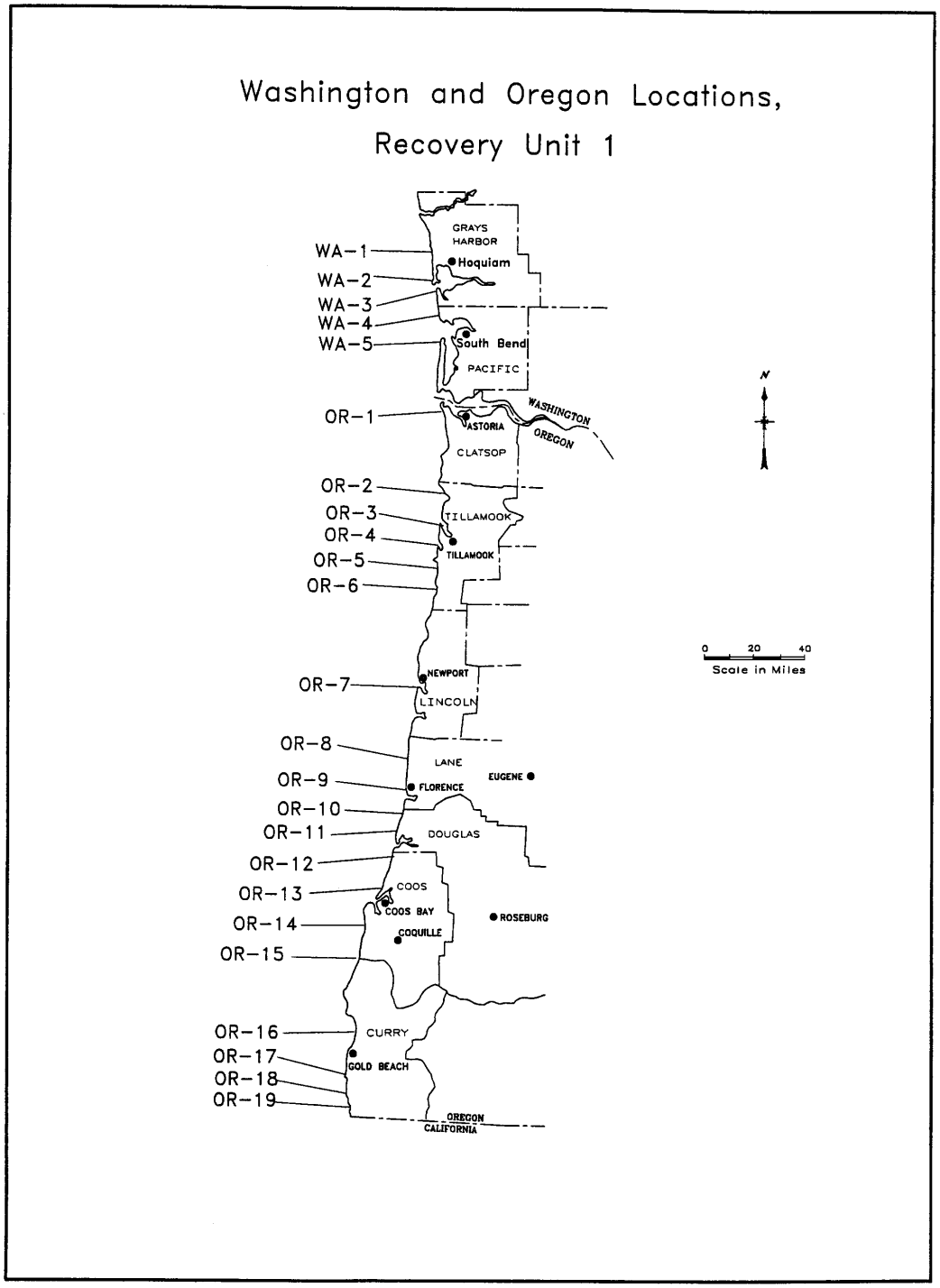

Figure A-2. Recovery Unit 1 - Washington and Oregon

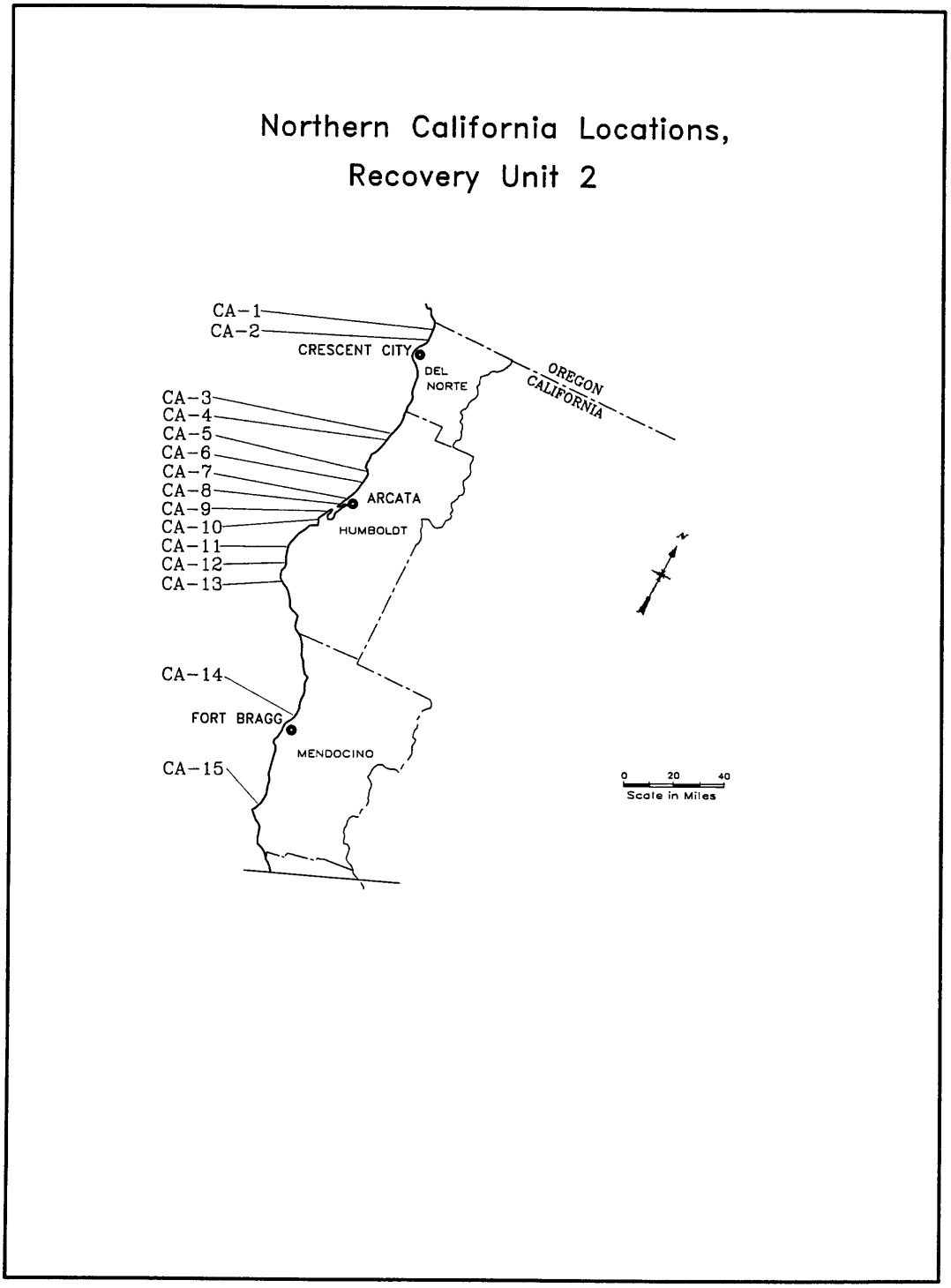

Figure A-3. Recovery Unit 2 - Northern California (Del Norte, Humboldt and Mendocino Counties)

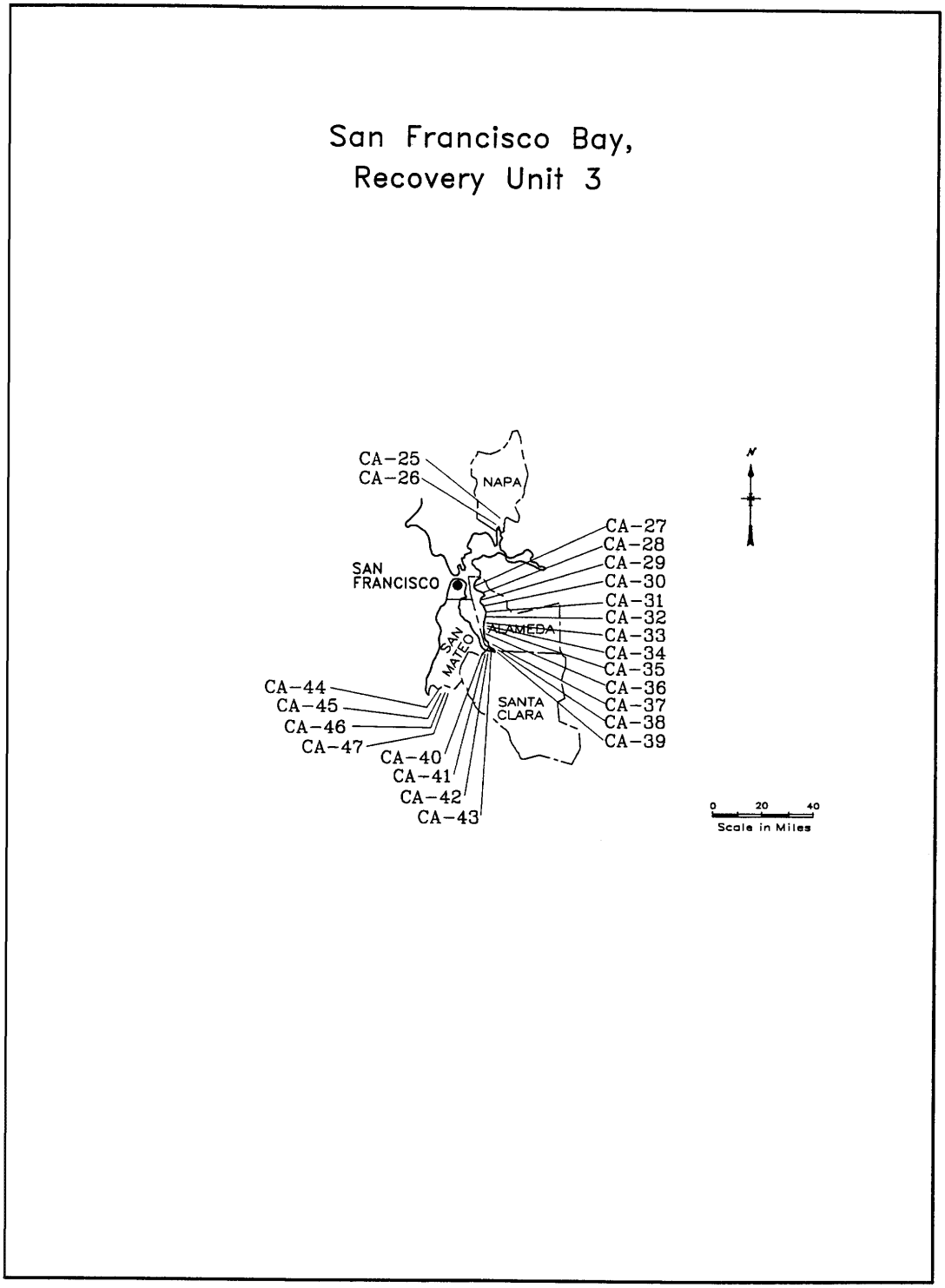

Figure A-4. Recovery Unit 3 - San Francisco Bay (Napa, Alameda, Santa Clara and San Mateo Counties)

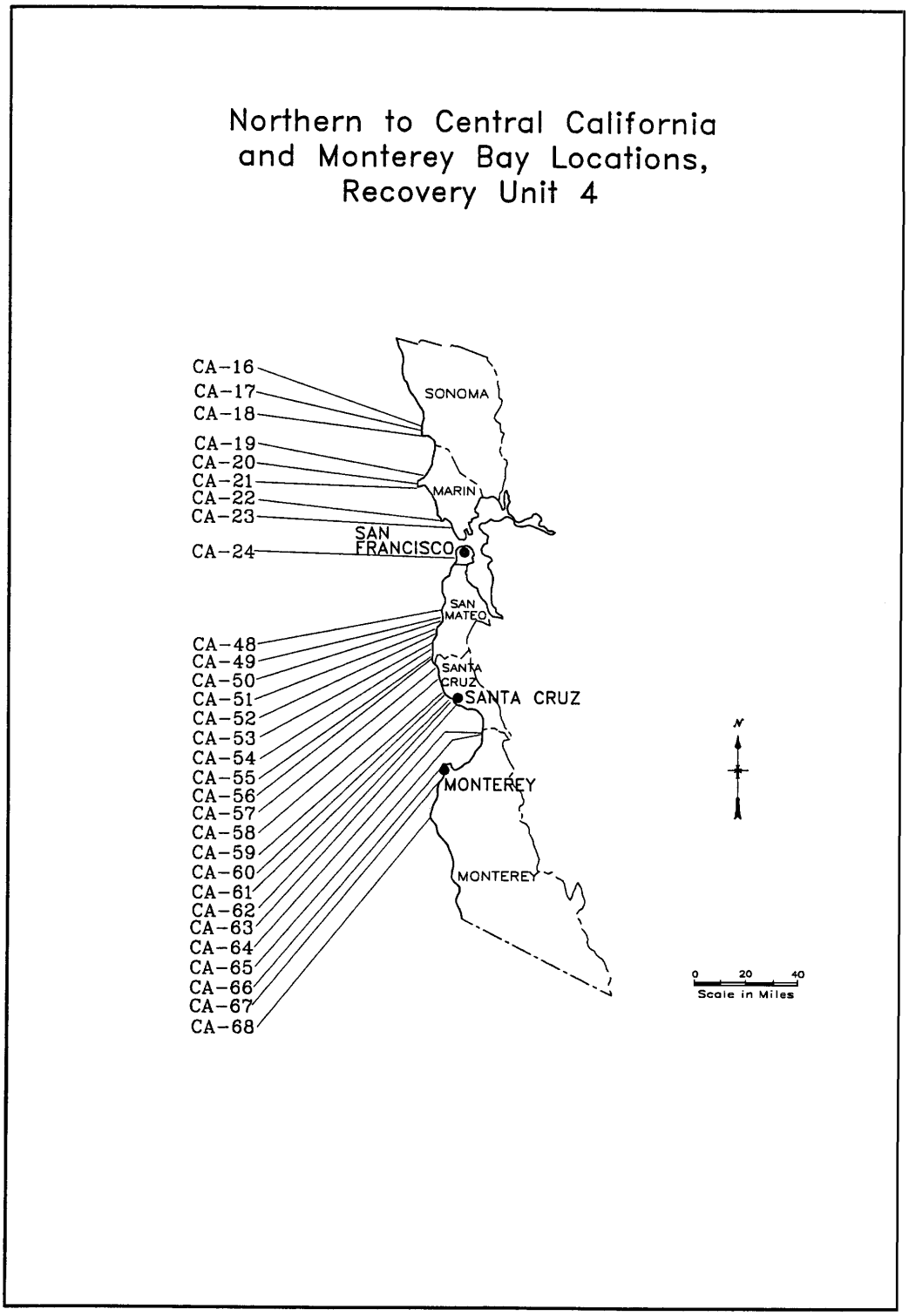

Figure A-5. Recovery Unit 4 - Northern to Central California and Monterey Bay (Sonoma, Marin, San Mateo, Santa Cruz and Monterey Counties)

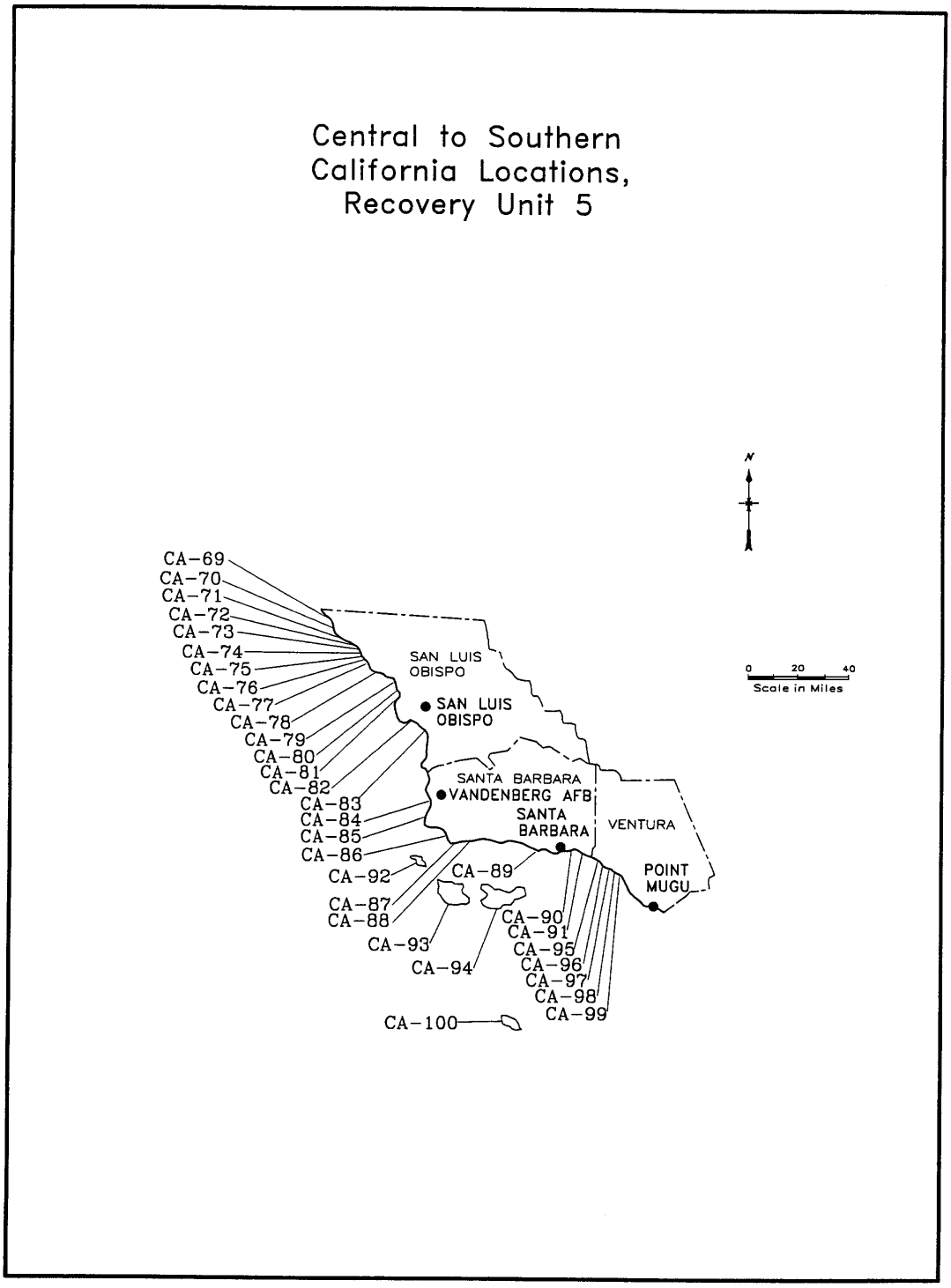

Figure A-6. Recovery Unit 5 - Central to Southern California (San Luis Obispo, Santa Barbara and Ventura Counties)

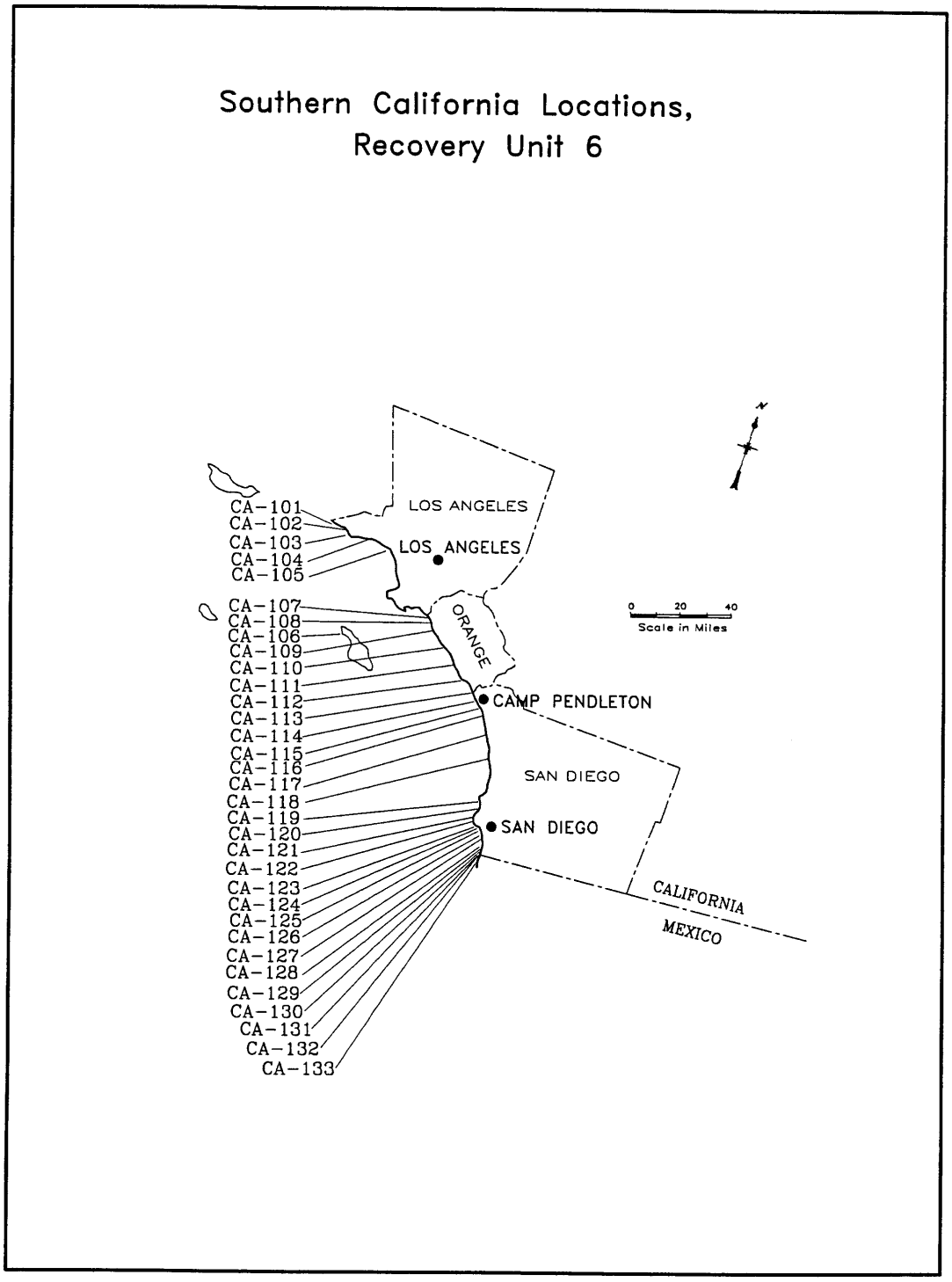

Figure A-7. Recovery Unit 6 - Southern California (Los Angeles, Orange and San Diego Counties)

APPENDIX B

INFORMATION ON SNOWY PLOVER BREEDING AND WINTERING LOCATIONS

This appendix provides information on numbers of breeding and wintering snowy plovers at specific locations along the U.S. Pacific coast (Table B-1). These locations are important for the recovery of the Pacific coast population of the western snowy plover. Locations are mapped in Appendix A (Figures A-1 through A-7) and Appendix L.

WASHINGTON

Data on numbers of snowy plovers nesting at primary areas (WA-2 and WA-5) in Washington are from years in which at least 20 surveys were completed at a given location. At Leadbetter Point/Gunpowder Sands (WA-5), this includes 1986 and 1994 to 1997. At Damon Point/Oyhut Wildlife Area (WA-2), this includes 1985, 1986, and 1992 to 1997. Data on nesting at Midway Beach (WA-4) are from window surveys in 1994 and 1995 and intensive monitoring in 1998. Breeding numbers were estimated by: (1) determining for each year which was greater, (a) the highest single-survey adult tally for May and June, or (b) the highest single-survey tally of males plus the highest single-survey tally of females for May and June; and then (2) reporting the lowest and highest estimates among all years.

Data on numbers of snowy plovers wintering in Washington are from November through February, 1977 to 1998. Sources include: (1) coordinated coastwide surveys between 1995 and 1998; (2) Christmas Bird Count data; (3) shorebird surveys completed by Buchanan (1992); and (4) incidental observations as summarized by the Washington Department of Fish and Wildlife (1995).

OREGON

Information on numbers of nesting snowy plovers at specific locations along the Oregon coast are derived from breeding season surveys conducted annually from 1990 to 1997 by the Oregon Department of Fish and Wildlife and

various cooperators. Surveys typically occurred in early June, and consisted of single-day counts of adult plovers at each site with all sites inventoried in a 1- to 2-day period. Winter numbers were from surveys conducted annually between 1990 to 1997 by the Oregon Department of Fish and Wildlife and various cooperators. Surveys typically occurred in January or February, and consisted of single-day counts of adult snowy plovers at each site with all sites inventoried in a 1- to 2-day period.

CALIFORNIA

Numerical information on nesting snowy plovers at specific locations along the California coast are derived from:

1. four coast-wide May/June surveys coordinated by the Point Reyes Bird Observatory during 1977/80, 1989, 1991 and 1995;

2. a supplemental Point Reyes Bird Observatory survey of Del Norte and Humboldt Counties in May 1996;

3. intensive monitoring of breeding plovers by Point Reyes Bird Observatory in Marin and Sonoma Counties from 1986 to 1989 and from 1995 to 1997, and in Santa Cruz and Monterey Counties from 1994 to 1997;

4. U. S. Air Force surveys of nesting snowy plovers at Vandenberg Air Force Base (CA- 84) and the Santa Ynez River mouth (CA-85) by Phil Persons from 1994 to 1997;

5. U. S. National Park Service summer surveys on San Miguel Island (CA-92) from 1987 to 1997 and Santa Rosa Island (CA-93) from 1989 to 1997;

6. U. S. Navy summer surveys of San Nicolas Island (CA-100) from 1989 to 1997;

7. an estimate of the number of snowy plovers on Santa Cruz Island (CA-94) from surveys conducted 1994 to 1996 by The Nature Conservancy (R. Klinger pers. comm. 1997);

8. intensive monitoring of nesting snowy plovers in San Diego County by Abby Powell, U.S. Geological Survey, Biological Resources Division, and her colleagues from 1994 to 1998;

9. an estimate of the number of snowy plovers nesting at Salt Pond 7A levee (CA-25) in 1992 and at Little Island (CA-26) during 1989 to 1991 and 1993 (R. Leong pers. comm. 1997);

10. an estimate of the number of nesting snowy plovers at the Oakland Airport (CA-30) in 1996 and at Bay Farm Island (CA-29) from 1993 to 1995 (L. Feeney pers. comm. 1997);

11. an estimate of the number of snowy plovers nesting at Alameda Naval Air Station (CA-27) from 1982 to 1983 (L. Collins pers. comm. 1998); and

12. anecdotal information on a few sites provided by additional observers.

In the following table, breeding numbers from the four Point Reyes Bird Observatory coast wide-surveys, the supplemental Point Reyes Bird Observatory 1996 survey of Humboldt and Del Norte Counties, and the National Park Service and Navy surveys of the three Channel Islands are pooled and presented without parentheses as minimum and maximum numbers. Information for the Eel River Mouth to Van Duzan River (CA-11, not covered on the Point Reyes Bird Observatory surveys) is an estimate of the number of adults breeding there during summer 1997 (R. LeValley pers. comm. 1998). Numbers in parentheses for sites CA-16 and CA-20 to CA-23 represent maximum numbers of adults estimated to have nested there from 1980 to 1997. Numbers in parentheses for sites CA-63 to CA-65 indicate the range in numbers believed to have nested from 1994 to 1997. Also in parentheses are the number of adults estimated to have nested at site CA-

68 in 1997. For sites CA-84 and CA-85, Point Reyes Bird Observatory data for surveys prior to 1994 are supplemented in parenthesis by the range of annual maxima on May/June surveys conducted by Phil Persons between 1994 to 1997. For Orange and San Diego Counties, numbers derived from studies by Abby Powell and her colleagues between 1994 to 1997 are enclosed with parentheses and marked with an asterisk.

Numerical information on wintering snowy plovers along the California coast was collected primarily by volunteers of Point Reyes Bird Observatory. To represent the number of wintering birds at California locations we used their maximum annual counts between 1 November and 28 February for the winters 1985/86 through 1996/97. For locations with data from at least 6 of the 12 winters, the range from the second lowest to the second highest yearly count is presented in the table. For locations with 5 or fewer years of data (designated sparse), the lowest and the highest yearly counts are given and supplemented, in parentheses, with the range of maximum counts for winters 1979/80 to 1984-85 as summarized in Page *et al.* (1986). The range of winter numbers for the Jetty Road to Aptos (CA-63) and Monterey to Moss Landing (CA-65) sites in Monterey Bay were estimated from maximum annual November to February winter counts from 1985/86 to 1996/97 at the following locations: Sunset State Beach (1-116), Pajaro River Mouth (71-85), Moss Landing State Beach (42-153), Salinas River State Beach near Potrero Road (1-98), north spit of the Salinas River (7-100), Salinas River National Wildlife Refuge (7-80) and Del Monte (54-87). For most Orange and San Diego County locations, information collected by Abby Powell and her colleagues during the winters of 1994/95 to 1997/98 are enclosed in parentheses and designated by an asterisk. The range of winter numbers for Naval Air Station North Island was based on an estimate of wintering snowy plovers from surveys conducted from 1994 to 1997 by the U.S. Navy. The range of winter numbers for San Miguel Island was based on incidental observations by National Park Service and National Marine Fisheries Service personnel during the winters of 1993/94 to 1997/98. The range of winter numbers for Santa Rosa Island was based on maximum annual winter counts conducted November 20 through December 5 from 1993 to 1997. The range of winter numbers for Santa Cruz Island was based on an estimate of wintering snowy plovers from surveys conducted during 1994 to 1996 by The Nature Conservancy. The estimate of wintering snowy plovers at the

Eel River North Spit and Beach (CA-10) reflects the highest-count data (January 1995) from Mark Fisher, California Department of Fish and Game (M. Fisher *in litt.* 1995).

Acknowledgments for Washington:

Don Williamson for data from Leadbetter Point.
Jim Atkinson for data from Leadbetter Point.
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Karen Sargent Kloempken for data from Damon Point.
Dianne Howard for data from Damon Point.
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Acknowledgments for California:

Paige Martin for data from San Miguel and Santa Rosa Island.
Grace Smith for data from San Nicolas Island.
Rob Klinger for data from Santa Cruz Island.
Nancy Read and Phil Persons for data from Vandenberg AFB and Santa Ynez River mouth.
Leora Feeney for data from Oakland Airport and Bay Farm Island.
Robin Leong for data from Salt Pond 7A levee and Little Island.
Laura Collins for data from Alameda Naval Air Station.
Mark Fisher for data from Eel River, North Spit and Beach.
Ron LeValley for data from Eel River Mouth to Van Duzan River.
U.S. Navy (Elizabeth Copper) for data from Naval Air Station North Island.

MANAGEMENT GOALS

Table B-1 also provides guidance on management goals for breeding locations. Management Goal Breeding Numbers represent population targets of

breeding adults that, in the view of the snowy plover recovery team's technical subteam, can be achieved under a very intensive management scheme. Collectively, these numbers are about 15 percent higher than the recovery criteria subpopulation sizes, but lower than potential carrying capacity. These numbers are not federally mandated and are meant to be flexible, considering variations in habitat conditions, and management opportunities from year to year and from location to location. Although they are management targets, not absolute numbers, landowners/managers should consistently aim to reach these goals annually.

Management Goal Breeding Numbers for individual sites within the San Francisco Bay recovery unit (Sites CA-25 through CA-47) cannot be determined at this time because management goals for the snowy plover must be considered in concert with habitat restoration needs for other listed species. The overall management goal for San Francisco Bay locations is 500 breeding snowy plovers and 809 hectares (2,000 acres) of managed salt ponds (see Task 1.7). Locations which show a "0" under Management Goal Breeding Numbers currently support primarily wintering and/or migrating snowy plovers. Task 2 of the Stepdown Narrative provides guidance on monitoring and managing wintering and migration habitats.

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LeValley, R., Mad River Biologists, Arcata, CA.

C. In Litt. References

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Table B-1. Numbers of Snowy Plovers Breeding and Wintering at U.S. Pacific Coast Locations and Management Goals at These Locations

LOCATION	BREEDING NUMBERS (Adult Birds)	MANAGEMENT GOAL BREEDING NUMBERS (Adult Birds)	WINTERING NUMBERS	HECTARES (ACRES)[1]	KILOMETERS (MILES) OF COASTLINE
WASHINGTON, Grays Harbor County					
Copalis Spit (WA-1)	0 (for at least 30 yrs.)	10	0	169 (417)	2.6 (1.6)
Damon Point/Oyhut Wildlife Area (WA-2)	5-13	20	0	394 (974)	8.2 (5.1)
Westport, Units 1-2 (WA-3)	0 (for at least 15 yrs.)	8	0	36 (89)	3.2 (2.0)
WASHINGTON, Pacific County					
Midway Beach (WA-4)	0-6	10	0-8	100 (246)	2.6 (1.6)
Leadbetter Point/Gunpowder Sands (WA-5)	11-23	30	0-28	516 (1,275)	3.7 (2.3)
OREGON, Clatsop County					
Columbia River to Necanicum River (OR-1)	0	4	0	605(1,495)	21.6 (13.4)
OREGON, Tillamook County					
Nehalem Spit (OR-2)	0	4	0	189(468)	6.9 (4.3)
Bayocean Spit (OR-3)	0-10	16	0-5	235 (581)	8.4 (5.2)
Netarts Spit (OR-4)	0	4	0	103 (254)	5.2 (3.2)
Sand Lake Spits (OR-5)	0	4	0	150 (371)	10.6 (6.6)
Nestucca Spit (OR-6)	0	4	0	141 (348)	5.8 (3.6)
OREGON, Lincoln County					
South Beach, Newport (OR-7)	0	4	0	17 (43)	3.1 (1.9)
OREGON, Lane County					
Heceta Head to Siuslaw River (OR-8)	0-5	12	0-14	176 (435)	9.7 (6.0)

LOCATION	BREEDING NUMBERS (Adult Birds)	MANAGEMENT GOAL BREEDING NUMBERS (Adult Birds)	WINTERING NUMBERS	HECTARES (ACRES)[1]	KILOMETERS (MILES) OF COASTLINE
Siuslaw River to Siltcoos River (OR-9)	0-5	2	1-23	247 (610)	16.6 (10.3)
OREGON, Lane/Douglas Counties					
Siltcoos River to Threemile Creek (OR-10)	0-9	20	0-10	253 (625)	15.2 (9.4)
OREGON, Douglas County					
Threemile Creek to Umpqua River (OR-11)	0-2	4	0-1	1146 (2,833)	17.1 (10.6)
OREGON, Douglas/Coos Counties					
Umpqua River to Horsfall Beach (OR-12)	3-10	20	0-22	308 (761)	26.3 (16.3)
OREGON, Coos County					
Horsfall Beach to Coos Bay, Units 1-3 (OR-13)	2-36	54	0-19	461 (1,138)	16.8 (10.4)
Whiskey Creek to Coquille River (OR-14)	0-2	0 (see Task 2)	0-2	140 (347)	10.3 (6.4)
OREGON, Coos/Curry Counties					
Bandon State Park to Floras Lake (OR-15)	7-46	54	0-26	645 (1,595)	20.6 (12.8)
OREGON, Curry County					
Euchre Creek (OR-16)	0	4	0	47 (115)	3.7 (2.3)
Pistol River (OR-17)	0	4	0	64 (158)	4.7 (2.9)
Sixes River Mouth (OR-18)	0	4	0	38 (95)	1.5 (0.9)
Elk River Mouth (OR-19)	0	4	0	70 (172)	3.7 (2.3)
CALIFORNIA, Del Norte County					
Smith River Mouth (CA-1)	0-6	8	Unknown	291 (718)	9.4 (5.8)
Lake Earl (CA-2)	0-8	10	sparse 0 (0-3)	402 (993)	10.0 (6.2)
CALIFORNIA, Humboldt County					
Gold Bluffs Beach (CA-3)	0	0 (see Task 2)	sparse 0 (0-9)	333 (822)	14.2 (8.8)

LOCATION	BREEDING NUMBERS (Adult Birds)	MANAGEMENT GOAL BREEDING NUMBERS (Adult Birds)	WINTERING NUMBERS	HECTARES (ACRES)[1]	KILOMETERS (MILES) OF COASTLINE
Stone Lagoon (CA-4)	0	0 (see Task 2)	sparse 1-7 (7-14)	43 (106)	2.6 (1.6)
Big Lagoon (CA-5)	0-13	16	sparse 0	124 (307)	6.1 (3.8)
Clam Beach/Little River (CA-6)	2-7	6	11-32	134 (331)	4.2 (2.6)
Mad River Mouth and Beach (CA-7)	0-17	12	0-7	453 (1,120)	14.4 (8.9)
Humboldt Bay, North Spit (CA-8)	1-11	8	sparse 0-10 (0-3)	390 (964)	12.9 (8.0)
Humboldt Bay, South Spit (CA-9)	0-7	30	7-22	186 (460)	7.9 (4.9)
Eel River, North Spit and Beach (CA-10)	0-11	20	0-78	159 (392)	10.8 (6.7)
Eel River Mouth to Van Duzen River (CA-11)	(26)	40	0	---	20.5 (12.7) (river)
Eel River, South Spit and Beach (CA-12)	0-9	20	3-79	235 (581)	9.4 (5.8)
McNutt Gulch (CA-13)	0	10	sparse 10	149 (369)	10.0 (6.2)
CALIFORNIA, Mendocino County					
MacKerricher Beach, Units 1-2 (CA-14)	0-15	20	23-37	278 (687)	8.2 (5.1)
Manchester Beach (CA-15)	0	0 (see Task 2)	1-4	197 (486)	8.4 (5.2)
CALIFORNIA, Sonoma County					
Salmon Creek (CA-16)	0-19 (18)	10	1-43	49 (120)	3.9 (2.4)
Bodega Harbor (CA-17)	0	0 (see Task 2)	16-48	107 (265)	2.1 (1.3)
Doran Spit (CA-18)	0	0 (see Task 2)	23-59	26 (64)	2.7 (1.7)
CALIFORNIA, Marin County					
Dillon Beach (CA-19)	0	0 (see Task 2)	31-72	17 (43)	2.3 (1.4)
Point Reyes Beach (CA-20)	6-29 (50)	50	46-71	366 (905)	18.1 (11.2)
Drakes Spit (CA-21)	0-7 (4)	4	53-87	13 (33)	1.1 (0.7)

LOCATION	BREEDING NUMBERS (Adult Birds)	MANAGEMENT GOAL BREEDING NUMBERS (Adult Birds)	WINTERING NUMBERS	HECTARES (ACRES)[1]	KILOMETERS (MILES) OF COASTLINE
Limantour Spit (CA-22)	0-8 (9)	10	35-70	119 (293)	8.5 (5.3)
Bolinas Spit/Stinson Beach (CA-23)	0-6 (6)	0 (see Task 2)	6-22	30 (73)	3.1 (1.9)
CALIFORNIA, San Francisco County					
Ocean Beach (CA-24)	0	0 (see Task 2)	30-50	50 (124)	5.2 (3.2)
California, Napa County					
Salt Pond 7A Levee (CA-25)	0-4	Unknown (see Task 1.7)	Unknown	0.8 (2)	0.0 (0.0)
Little Island (CA-26)	2-12	Unknown (see Task 1.7)	Unknown	15 (37)	0.0 (0.0)
CALIFORNIA, Alameda County					
Alameda Naval Air Station (CA-27)	0-2 (irreg.)	Unknown (see Task 1.7)	Unknown	1.8 (4.5)	0.0 (0.0)
Alameda South Shore (CA-28)	Unknown	Unknown (see Task 1.7)	Formerly 50+	19 (46)	3.4 (2.1)
Bay Farm Island (CA-29)	0-2 (irreg.)	Unknown (see Task 1.7)	Unknown	4.9 (12)	0.0 (0.0)
Oakland Airport, Units 1-2 (CA-30)	12-16	Unknown (see Task 1.7)	Unknown	22 (55)	0.0 (0.0)
Oliver Salt Ponds, North of Hwy. 92 (CA-31)	34-41	Unknown (see Task 1.7)	sparse 50-100	55 (136)	0.0 (0.0)
Oliver Salt Ponds, South of Hwy. 92 (CA-32)	2	Unknown (see Task 1.7)	Unknown	15 (36)	0.0 (0.0)
Baumberg Salt Ponds (CA-33)	34-157	Unknown (see Task 1.7)	sparse 60-320	164 (405)	0.0 (0.0)
Turk Island Salt Ponds (CA-34)	2-31	Unknown (see Task 1.7)	Unknown	38 (95)	0.0 (0.0)
Coyote Hills Salt Ponds (CA-35)	17-70	Unknown (see Task 1.7)	Unknown	29 (71)	0.0 (0.0)
Dumbarton Salt Ponds (CA-36)	9-37	Unknown (see Task 1.7)	Unknown	31 (76)	0.0 (0.0)
Plummer Creek Salt Pond (A-37)	0-40	Unknown (see Task 1.7)	Unknown	123 (303)	0.0 (0.0)
Mowry Salt Ponds (CA-38)	4-10	Unknown (see Task 1.7)	Unknown	8.5 (21)	0.0 (0.0)
Warm Springs Salt Pond (CA-39)	1-7	Unknown (see Task 1.7)	Unknown	109 (269)	0.0 (0.0)

LOCATION	BREEDING NUMBERS (Adult Birds)	MANAGEMENT GOAL BREEDING NUMBERS (Adult Birds)	WINTERING NUMBERS	HECTARES (ACRES)[1]	KILOMETERS (MILES) OF COASTLINE
CALIFORNIA, Santa Clara County					
Knapp Salt Pond (CA-40)	0-10	Unknown (see Task 1.7)	Unknown	30 (74)	0.0 (0.0)
Alviso Salt Ponds (CA-41)	5-17	Unknown (see Task 1.7)	Unknown	78 (192)	0.0 (0.0)
Moffett Field (CA-42)	0-2	Unknown (see Task 1.7)	Unknown	22 (55)	0.0 (0.0)
Crittenden Marsh (CA-43)	0-6	Unknown (see Task 1.7)	Unknown	33 (81)	0.0 (0.0)
CALIFORNIA, San Mateo County					
Ravenswood Salt Pond Levee (CA-44)	1-6	Unknown (see Task 1.7)	Unknown	0.4 (1)	0.0 (0.0)
Redwood City Salt Pond (CA-45)	4-9	Unknown (see Task 1.7)	Unknown	1.6 (4)	0.0 (0.0)
Redwood Creek (CA-46)	0-3	Unknown (see Task 1.7)	Unknown	6.1 (15)	0.0 (0.0)
Middle Bair Island (CA-47)	3	Unknown (see Task 1.7)	Unknown	85 (209)	0.0 (0.0)
Pacifica Beach (CA-48)	0	0 (see Task 2)	7-19	11 (27)	1.1 (0.7)
Pillar Point (CA-49)	0	0 (see Task 2)	3-35	2.4 (6)	0.3 (0.2)
Half Moon Bay Beaches (CA-50)	0-7	10	24-45	23 (56)	2.3 (1.4)
Tunitas Beach (CA-51)	Unknown	4	Unknown	6.1 (15)	0.8 (0.5)
San Gregorio Beach (CA-52)	0	0 (see Task 2)	0-5	5.7 (14)	0.5 (0.3)
Pomponio Beach (CA-53)	0	0 (see Task 2)	sparse 1-2 (2-40)	6.1 (15)	0.6 (0.4)
Pescadero Beach (CA-54)	0-4	6	8-35	23 (58)	1.1 (0.7)
Gazos Creek (CA-55)	0-2 (irreg.)	4	5-33	20 (51)	1.8 (1.1)
Año Nuevo, Units 1-3 (CA-56)	0-9 (irreg.)	10	0-8	20 (49)	2.1 (1.3)
CALIFORNIA, Santa Cruz County					
Waddell Creek (CA-57)	0-11	10	32-50	7.3 (18)	1.1 (0.7)
Scott Creek Beach (CA-58)	0-8	8	16-114	18 (45)	1.1 (0.7)

LOCATION	BREEDING NUMBERS (Adult Birds)	MANAGEMENT GOAL BREEDING NUMBERS (Adult Birds)	WINTERING NUMBERS	HECTARES (ACRES)[1]	KILOMETERS (MILES) OF COASTLINE
Laguna Creek Beach (CA-59)	0-5	8	11-47	4.5 (11)	0.5 (0.3)
Baldwin Creek Beach (CA-60)	0	0 (see Task 2)	sparse 0-8	6.5 (16)	0.3 (0.2)
Wilder Ranch Beach (CA-61)	8-16	16	33-52	8.9 (22)	0.5 (0.3)
Seabright Beach (CA-62)	0	0 (see Task 2)	20-53	10 (25)	0.8 (0.5)
CALIFORNIA, Santa Cruz/Monterey Counties					
Jetty Road to Aptos (CA-63) Sunset and Manressa State Beaches Pajaro River mouth (Beach Rd. to Zmudowski State Beach Parking Area 26) Moss Landing State Beach (Zmudowski State Beach parking lot to mouth of Elkhorn Slough)	8-38 (13-37)	Total: 54 18 26 10	estimate 150-250	217 (536)	13.7 (8.5)
CALIFORNIA, Monterey County					
Elkhorn Slough Mudflat/Salt Pond (CA-64) (a/k/a Moss Landing Wildlife Area)	6-47 (70)	80	25-95	115 (283)	0.0 (0.0)
Monterey to Moss Landing (CA-65) Salinas River State Beach Molera/Potrero (Salinas State Beach from the mouth of Elkhorn Slough to northern boundary of Monterey Dunes Colony) Monterey Dunes (beach in front of Monterey Dunes property) North Salinas (beach from south boundary of Monterey Dunes property to north boundary of Salinas River National Wildlife Refuge; mouth of Salinas River) Salinas River National Wildlife Refuge Martin property beach Lone Star beach and interior areas Reservation Road (Reservation Road to Stilwell Hall on Fort Ord) Sand City/Del Monte (southern boundary of Fort Ord to City of Monterey)	61-104 (90-125)	Total: 162 10 12 20 40 12 32 16 20	estimate 120-190	515 (1,272)	24.2 (15.0)

LOCATION	BREEDING NUMBERS (Adult Birds)	MANAGEMENT GOAL BREEDING NUMBERS (Adult Birds)	WINTERING NUMBERS	HECTARES (ACRES)[1]	KILOMETERS (MILES) OF COASTLINE
Asilomar Beach, Units 1-2 (CA-66)	0	0 (see Task 2)	0-37	17 (43)	1.5 (0.9)
Carmel River Mouth (CA-67)	0	0 (see Task 2)	9-31	28 (69)	1.1 (0.7)
Point Sur (CA-68)	3-4 (20)	20	4-65	42 (103)	1.5 (0.9)
CALIFORNIA, San Luis Obispo County					
San Carpoforo Creek (CA-69)	0-9	10	18-36	22 (54)	1.0 (0.6)
Arroyo Hondo Creek (CA-70)	0	0 (see Task 2)	sparse 0-42	8.9 (22)	1.0 (0.6)
Pt. Sierra Nevada (CA-71)	0	0 (see Task 2)	0-10	8.5 (21)	0.5 (0.3)
Arroyo de la Cruz (CA-72)	0	0 (see Task 2)	0-15	8.9 (22)	0.5 (0.3)
Sidney's Lagoon (CA-73)	0	0 (see Task 2)	sparse (0-20)	3.2 (8)	0.3 (0.2)
Piedras Blancas, Units 1-2 (CA-74)	0	0 (see Task 2)	2-8	11 (28)	1.1 (0.7)
Arroyo Laguna Creek (CA-75)	0-6	6	28-91	2.0 (5)	0.3 (0.2)
Pico Creek (CA-76)	0	0 (see Task 2)	sparse (0-8)	9.3 (23)	0.8 (0.5)
San Simeon Beach (CA-77)	0	0 (see Task 2)	17-52	15 (38)	1.5 (0.9)
Villa Creek (CA-78)	Unknown	0 (see Task 2)	sparse (0-16)	8.5 (21)	0.5 (0.3)
Toro Creek (CA-79)	0-16	16	23-98	9.3 (23)	0.8 (0.5)
Atascadero Beach (CA-80)	0-38	40	67-152	109 (269)	3.5 (2.2)
Morro Bay Beach (CA-81)	34-94	110	53-148	331 (818)	11.1 (6.9)
Avila Beach (CA-82)[2]	0	0 (see Task 2)	sparse 12 (0-6)	11 (28)	1.1 (0.7)
CALIFORNIA, San Luis Obispo/Santa Barbara Counties					
Pismo Beach/Nipomo Dunes (CA-83)	123-246	350	sparse 173-314	857 (2,117)	19.2 (11.9)

LOCATION	BREEDING NUMBERS (Adult Birds)	MANAGEMENT GOAL BREEDING NUMBERS (Adult Birds)	WINTERING NUMBERS	HECTARES (ACRES)[1]	KILOMETERS (MILES) OF COASTLINE
CALIFORNIA, Santa Barbara County					
Vandenberg Air Force Base (CA-84) (a/k/a Minuteman Beach)	90-145 (131-160)	250	177-265	421 (1,041)	12.7 (7.9)
Santa Ynez River Mouth/Ocean Beach (CA-85) (a/k/a Vandenberg Air Force Base)	10-97 (75-118)	150	79-233	185 (457)	7.4 (4.6)
Jalama Beach (CA-86)	0-1	0 (see Task 2)	11-87	21 (53)	1.9 (1.2)
Hollister Ranch (CA-87)	8	10	Unknown	149 (369)	12.3 (7.6)
Devereaux Beach (CA-88)	0-2 (irreg.)	4	81-147	25 (62)	3.1 (1.9)
Goleta Beach (CA-89)	0	0 (see Task 2)	sparse 0-6 (6-72)	37 (91)	3.7 (2.3)
Point Castillo/Santa Barbara Harbor (CA-90)	0	0 (see Task 2)	19-52	29 (72)	4.8 (3.0)
Carpinteria Beach (CA-91)	0	0 (see Task 2)	0-24	4.5 (11)	0.8 (0.5)
San Miguel Island, Units 1-8 (CA-92)	(5-68)	30	(15-200)	226 (559)	15.8 (9.8)
anta Rosa Island, Units 1-11 (CA-93)	(71-121)	130	250-320	650 (1,606)	21.3 (13.2)
Santa Cruz Island, Units 1-2 (CA-94)	24-36	20	24-36	45 (110)	3.5 (2.2)
CALIFORNIA, Ventura County					
San Buenaventura Beach (CA-95)	0	0 (see Task 2)	26-47	37 (92)	3.9 (2.4)
Mandalay Bay/Santa Clara River Mouth (CA-96)	9-70	60	28-33	198 (490)	7.9 (4.9)
Hollywood Beach (CA-97)	0-5 (irreg.)	4	sparse 6-23	30 (75)	1.9 (1.2)
Ormond Beach (CA-98)	20-34	50	sparse 0-123 (38-44)	104 (257)	4.7 (2.9)
Mugu Lagoon Beach (CA-99)	40-82	110	sparse 12-62 (100-127)	215 (532)	10.5 (6.5)
San Nicolas Island, Units 1-15 (CA-100)	(78-116)	150	185	166 (411)	12.9 (8.0)

LOCATION	BREEDING NUMBERS (Adult Birds)	MANAGEMENT GOAL BREEDING NUMBERS (Adult Birds)	WINTERING NUMBERS	HECTARES (ACRES)[1]	KILOMETERS (MILES) OF COASTLINE
CALIFORNIA, Los Angeles County					
Zuma Beach (CA-101)	0	0 (see Task 2)	41-82	56 (138)	4.5 (2.8)
Corral Beach (CA-102)	0	0 (see Task 2)	sparse 1-7 (8)	10 (25)	1.1 (0.7)
Malibu Lagoon/Beach (CA-103)	0	0 (see Task 2)	27-60	19 (48)	0.8 (0.5)
Santa Monica Beach (CA-104)	0	0 (see Task 2)	sparse 0-18 (0-4)	190 (469)	9.4 (5.8)
Dockweiler to Hermosa Beach (CA-105)	0	0 (see Task 2)	9-34	224 (554)	13.2 (8.2)
San Clemente Island, Units 1-5 (CA-106)	0-2* (irreg.)	0 (see Task 2)	(20-50)*	25 (63)	2.9 (1.8)
CALIFORNIA, Orange County					
Huntington Beach (CA-107)	0-2 (irreg.)	0 (see Task 2)	5-33 (20-50)*	208 (515)	13.9 (8.6)
Bolsa Chica Wetlands (CA-108)	8-21 (10-30)*	50	1-44 (40-60)*	522 (1,289)	0.0 (0.0)
Newport Beach (CA-109)	0	0 (see Task 2)	sparse 0-6 (0-4)	138 (342)	8.4 (5.2)
Crystal Cove (CA-110)	(0)*	0 (see Task 2)	11-21 (10-30)*	31 (76)	5.0 (3.1)
Salt Creek Beach (CA-111)	0	0 (see Task 2)	23-29	19 (48)	2.6 (1.6)
Doheny Beach/Dana Point (CA-112)	(0)*	0 (see Task 2)	0-23 (10-30)*	36 (90)	4.0 (2.5)
CALIFORNIA, Orange/San Diego Counties					
San Onofre Beach (CA-113)	(0-2)* (irreg.)	15	2-16 (10-30)*	52 (128)	4.4 (2.7)
CALIFORNIA, San Diego County					
Aliso/French Creek Mouth (CA-114)	(3-6)*	40	(10-30)*	31 (77)	2.3 (1.4)
Santa Margarita River Estuary (CA-115)	33-74 (35-75)*	160	25-64 (30-60)*	151 (373)	4.7 (2.9)

LOCATION	BREEDING NUMBERS (Adult Birds)	MANAGEMENT GOAL BREEDING NUMBERS (Adult Birds)	WINTERING NUMBERS	HECTARES (ACRES)[1]	KILOMETERS (MILES) OF COASTLINE
San Luis Rey River Mouth (CA-116)	0	0 (see Task 2)	sparse 0-15 (0-14)	14 (34)	1.0 (0.6)
Agua Hedionda Lagoon/Beach (CA-117)	0-54 (0)*	10	0-20 (0-20)*	174 (431)	2.3 (1.4)
South Carlsbad Beach (CA-118)	(0)*	0 (see Task 2)	0-30*	53 (130)	4.7 (2.9)
Batiquitos Lagoon (CA-119)	6-13 (6-30)*	70	(10-30)*	276 (681)	0.0 (0.0)
San Elijo Lagoon/Beach (CA-120)	0-23 (0)*	10	3-28 (0-10)*	219 (542)	1.9 (1.2)
San Dieguito Lagoon/Beach (CA-121)	0-6 (0)*	10	6-52 (0-10)*	137 (338)	2.1 (1.3)
Los Penasquitos Lagoon/Beach (CA-122)	0-1 (0)*	10	0-34 (10-30)*	54 (133)	1.6 (1.0)
Mission Bay, Bonita Cove (CA-123)	(0-2)* (irreg.)	0 (see Task 2)	50-80 (0-80)*	34 (84)	3.2 (2.0)
Mission Bay, Fiesta Island (CA-124)	(0)*	10	(0-20)*	16 (39)	1.5 (0.9)
South Mission Beach (CA-125)	(0)*	0 (see Task 2)	(0-70)*	28 (68)	1.8 (1.1)
Ocean Beach/San Diego FCC (CA-126)	(0)*	0 (see Task 2)	2-57 (10-70)*	44 (108)	2.1 (1.3)
NAS North Island (CA-127)	(2-4)*	20	(2-60)	124 (306)	5.8 (3.6)
NAB Coronado/Silver Strand State Beach/Naval Radio Receiving Facility (CA-128)	(17-45)*	65	(10-100)*	195 (481)	10.0 (6.2)
NAB Delta Beach Bay (CA-129)	(2-8)*	10	(0-30)*	34 (85)	1.8 (1.1)
South San Diego Bay Marine Biological Study Area (CA-130)	(0)*	0 (see Task 2)	(0-80)*	11 (27)	0.0 (0.0)
Western Salt Company (CA-131)	9-31 (1-5)*	10	(0-10)*	743 (1,836)	4.0 (2.5)
Sweetwater National Wildlife Refuge (CA-132)	(7-1l)*	20	(0-150)*	99 (244)	2.4 (1.5)
Tijuana River Beach (CA-133)	4-37 (4-20)*	40	0-91 (10-40)*	52 (129)	3.7 (2.3)

[1] Acreages calculated for San Francisco Bay salt ponds and salt pond levees (Locations CA-25, CA-26, and CA-31 through CA-47) were based on acreage of salt pond (using planimeter) and average levee crown width of 3.7 meters (12 feet).

[2] Although Avila Beach is proposed for excavation of underlying oil contamination and beach restoration, it is anticipated that restoration will replace and enhance existing habitat values for snowy plovers.

APPENDIX C

SUMMARY OF CURRENT AND ADDITIONAL NEEDED MANAGEMENT ACTIVITIES FOR SNOWY PLOVER BREEDING AND WINTERING LOCATIONS

In May 1998, we requested public land managers (i.e. Federal, state, county and city land managers) and private conservation organizations to complete the western snowy plover management and beach use surveys prepared by the recovery team. We sent a total of 178 sets of surveys to land managers in Washington, Oregon and California, and received responses from almost 70 percent of the recipients. The responses showed there is much variability in the extent and duration of population monitoring. Monitoring at breeding locations ranged from no monitoring to monitoring seven days per week. Monitoring at wintering locations ranged from no monitoring to monitoring one to two days per season. However, most breeding locations receive some degree of monitoring. The responses also showed that many land managers conduct general beach patrols to enforce beach rules and regulations; however, they may not employ wardens to specifically enforce protective measures for snowy plovers.

Survey recipients were asked to include the total costs for snowy plover monitoring and management activities, by location. During the 12-month period from approximately June 1997 through June 1998, all respondents spent a total of approximately $806,000 on snowy plover monitoring, management and public education measures. Approximately 42 percent of the respondents expended funds on snowy plovers. Funds for monitoring and management were spent at 47 breeding/wintering locations and 6 wintering locations, representing about 49 percent of the publicly-owned locations for which surveys were completed (53 out of 107 locations). This averages to a management agency expenditure of approximately $37.00 per acre of breeding/wintering habitat and $1.00 per acre of wintering habitat. However, this figure should be considered a very rough estimate. For some locations with broad management programs for sensitive species (e.g., Camp Pendleton), it was difficult to obtain an accurate assessment of costs associated with snowy plover management because it is combined with management costs for the California least tern. Also, costs associated with providing wardens for protection of snowy plovers could not be separated from

enforcement costs for overall enforcement of beach rules and regulations. This figure also does not include costs associated with most monitoring activities, including those provided by the Point Reyes Bird Observatory, U.S. Geological Survey (Biological Resources Division), and several state agencies such as the Washington Department of Fish and Wildlife, Oregon Department of Fish and Wildlife, and California Department of Fish and Game. In general, the least to most expensive costs were associated with the following management measures: (1) public information and education (e.g., brochures and on-site docents); (2) exclusionary measures (e.g., signs, symbolic fencing, and exclosures); (3) monitoring; and (4) predator control. However, each of these costs was also dependent on the extent of area covered and the intensity of the problems addressed. Funding sources included State of Washington general fund, County of Santa Cruz, California Coastal Conservancy grant, U.S. Fish and Wildlife Service, Bayfront Conservancy Trust, Port of San Diego, U.S. Navy, U.S. Marine Corps, U.S. Air Force, National Park Service, California Department of Parks and Recreation "District" funds, Federal Emergency Management Agency, Challenge grant, and Broderbund (private computer software company).

Table C-1 provides location-specific summaries of current management activities based on responses to the surveys and supplemental information from the recovery team and Fish and Wildlife Service field office staff. Current (C) activities are those management measures or activities which are currently in place. Additional (A) activities are those management measures or activities which need to be initiated or improved to achieve the management goals. The C's are shaded and the CA's and A's are not shaded only to visually distinguish between those management measures which are currently in place and those management measures which need to be initiated or improved. For locations where information on current and/or additional management activities by public land managers is not currently available, this information is left blank and referenced as unknown in the comments for those locations.

This table provides preliminary, interim guidance for public land managers, private conservation organizations and private landowners (where known) regarding management measures which should receive emphasis at their locations. In the future, additional management measures for all locations

identified in Table C-1 are to be determined and prioritized on a site-specific basis through coordination and discussions between members of each of the six recovery unit working groups because they have on-the-ground, day-to-day, experience about what is currently being done in those areas. Each of the six working groups should use this recovery plan as a guide, but individual land managers and landowners should implement those actions which are most likely to improve habitat for snowy plovers and meet the management goal target breeding numbers necessary for recovery. This should be done in concert with their working group and through adaptive management.

Detailed knowledge of snowy plover abundance and distribution is needed for adaptive management and to determine the success of this recovery effort. Therefore, the recovery team recommends that all land managers of public lands and private conservation lands monitor snowy plover populations at all breeding and wintering locations annually, in accordance with the monitoring guidelines included in Appendix J. The recovery team also recommends that land managers employ wardens to enforce protective measures for snowy plovers at these locations, as needed. For privately-owned parcels, current and additional management measures are unknown for most locations. Suggested additional measures at these locations include communication and cooperation between public land managers, private conservation organizations, members of the recovery unit working groups, and private landowners. Where needed, development of cooperative agreements with private landowners to conserve snowy plover habitat should be sought. Acquisition of important sites should be sought on a willing-seller basis.

Management Goal Breeding Numbers in Table C-1 represent population targets of breeding adults that, in the view of the snowy plover recovery team's technical subteam, can be achieved under a very intensive management scheme (see also Table B-1). Collectively, these numbers are about 15 percent higher than the recovery criteria subpopulation sizes, but lower than potential carrying capacity. These numbers are not federally mandated and are meant to be flexible, considering variations in habitat conditions and management opportunities from year to year and from location to location. Although they are management targets,

not absolute numbers, landowners/managers should consistently aim to reach these goals annually.

Management Goal Breeding Numbers for individual sites within the San Francisco Bay recovery unit (Sites CA-25 through CA-47) cannot be determined at this time because management goals for the snowy plover must be considered in concert with habitat restoration needs for other listed species. The overall management goal for San Francisco Bay locations is 500 breeding snowy plovers and 2,000 acres of managed salt ponds (see Task 1.7). Locations which show a “0" under Management Goal Breeding Numbers currently support primarily wintering and/or migrating snowy plovers. Task 2 of the Stepdown Narrative provides guidance on monitoring and managing wintering and migration habitats.

KEY TO LANDOWNER AND/OR MANAGER:

ARMY	U.S. Army
BLM	U.S. Bureau of Land Management
Caltrans	California Department of Transportation
CDFG	California Department of Fish and Game
CDPR	California Department of Parks and Recreation
CE	U.S. Army Corps of Engineers
City	Cities identified
County	Counties identified
EBRPD	East Bay Regional Park District
FWS	U.S. Fish and Wildlife Service
HARD	Hayward Area Recreation and Park District
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
NPS	National Park Service
ODFW	Oregon Department of Fish and Wildlife
OPRD	Oregon Parks and Recreation Department
PGH	Port of Grays Harbor
PO	Port of Oakland
Private	Private landowners (except HARD, MPOSD, TNC and TPL)

PSL	Port of San Luis Harbor District
SDRPJPA	San Dieguito River Park Joint Powers Authority
State	State lands
TNC	The Nature Conservancy
TPL	Trust for Public Land
USAF	U.S. Air Force
USFS	U.S. Forest Service
USMC	U.S. Marine Corps
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WSPRC	Washington State Parks and Recreation Commission

NOTE: In the States of Washington, Oregon, and California, the State holds title to the intertidal zone. In addition, the State of Oregon retains jurisdiction over the area between extreme low tide and the vegetation line and refers to this area as the Ocean Shore. To save space on this table, state ownership of the intertidal zone has not been shown for every location. However, the intertidal zone is an extremely important component of western snowy plover habitat, and the Ocean Shore encompasses most currently occupied plover habitat in Oregon. Also in the State of California, there are inholdings and accreted lands under the jurisdiction of the State Lands Commission which have not been shown on this table.

The following key to current and additional management activities contains most of the management categories identified in the surveys of land managers of public lands and private conservation organizations.

KEY TO CURRENT AND ADDITIONAL NEEDED MANAGEMENT ACTIVITIES:

Access	Prohibit/restrict public access
Boats	Prohibit/restrict boats
Contaminant	Contaminant (oil/tarball) removal
Cooperation	Seek landowner cooperation/cooperative agreement
Development	Prohibit/restrict development
Driftwood	Restrict driftwood collection
Enforce	Enforce protective rules/regulations
Enhance	Enhance habitat through creation of ponds/playas for nesting/foraging
Exclosures	Use exclosures
Fence	Symbolically fence or fence nesting area
Horses	Prohibit/restrict horses
Info.& Ed.	Public information and education
Kites	Prohibit/restrict kites
Livestock	Prohibit/restrict livestock
Military	Prohibit/restrict military uses
Monitor	Population monitoring during breeding and/or wintering seasons
OHV's	Prohibit/restrict off-highway vehicles
Pets	Prohibit/restrict pets
Predators	Predator control (other than exclosures)
Signs	Use exclusionary signs
Vegetation	Plant and exotic vegetation control
Unknown	Unknown

Current (C) = management measures or activities which are currently in place.

Additional (A) = management measures or activities which need to be initiated or improved to achieve the management goals.

Table C-1. Summary of Current and Additional Needed Management Activities at U.S. Pacific Coast Snowy Plover Breeding and Wintering Locations

		Mgt. Goal			Current (=C) and Additional (=A) Management																			
No.	Location	Breeding Nos. (adult birds)	Access	Boats	Contaminant	Cooperation	Development	Driftwood	Enforce	Enhance	Exclosures	Fence	Horses	Info. & Ed.	Kites	Livestock	Military	Monitor	OHVs	Pets	Predators	Signs	Vegetation	Owner and/or Manager
WA-1	Copalis Spit	10					C		CA			A		C				C	C	A		C	A	WSPRC
WA-2	Damon Point/Oyhut Wildlife Area	20	C						CA			A		CA				C	C	CA		C	A	WDFW
			C						CA					A					C	A			A	WSPRC
			C				C												C	A			A	WDNR
									A			A		A						A			A	City of Ocean Shores
WA-3	Westport, Units 1-2	8							C					A					C				A	WSPRC
				C			C						C	A			C		C	C			A	PGH
WA-4	Midway Beach	10					C		CA					A					C			A		WSPRC
						A																		Private
														A				CA						WDFW
WA-5	Leadbetter Point/Gunpowder Sands	30					C						C	CA				C	C	C		C		FWS
			C						C															WSPRC
OR-1	Columbia River to Necanicum River	4																C		C				ODPR
																								State/U.S. Army
																								Clapsop County
																								City of Gearhart
						A																		Private
	Comments for OR-1: No current management by State/U.S. Army; current management by County and City unknown.																							
OR-2	Nehalem Spit	4							C											C				OPRD

		Mgt. Goal			Current (=C) and Additional (=A) Management																			
No.	Location	Breeding Nos. (adult birds)	Access	Boats	Contaminant	Cooperation	Development	Driftwood	Enforce	Enhance	Exclosures	Fence	Horses	Info. & Ed.	Kites	Livestock	Military	Monitor	OHV's	Pets	Predators	Signs	Vegetation	Owner and/or Manager
OR-3	Bayocean Spit	16		C													C		C					Tillamook County, OPRD
OR-4	Netarts Spit	4																						OPRD
	Comment: Current management by OPRD unknown.																							
OR-5	Sand Lake Spits	4							C										C					USFS, OPRD and
																								Tillamook County
OR-6	Nestucca Spit	4																						OPRD
	Comment: Current management by OPRD unknown.																							
OR-7	South Beach, Newport	4					C		C										C					OPRD
						A																		Private
	Additional for OR-1, OR-2, OR-4, OR-5, OR-6 and OR-7: Identify and evaluate a core area within each of these locations, and manage it for breeding plovers,																							
	initially focusing on habitat improvement of the core area combined with biweekly monitoring during the breeding season. If plovers are observed during the																							
	breeding season, then more intensive management (access, use exclosures, fence, info. & ed., signs, monitor) should be implemented.																							
OR-8	Heceta Head to Suislaw River	12	C	C			C		CA		C	C	C	C				C	C	C		C	C	USFS, OPRD
																								Lane County
						A																		Private
	Additional for OR-8 (USFS): Increase volunteer interpretation/monitoring. Comment: Current management by County unknown.																							
OR-9	Suislaw River to Siltcoos River	2	C	C					CA		C	C		C			C	C	C	C		C	C	USFS, OPRD
OR-10	Siltcoos River to Threemile Creek	20	C	C			C	C	CA		C	CA		C			C	C	C	CA		C	C	USFS, OPRD
OR-11	Threemile Creek to Umpqua River	4					C		C		C			C			C	C					C	USFS, OPRD
OR-12	Umpqua River to Horsfall Beach	20	C				C	C	CA		C	C						C	C			C	C	USFS, OPRD
			C						CA		C	C						C				C		OPRD
	Additional for OR-12: Increase foredune re-shaping from Umpqua River to Tenmile Creek.																							
OR-13	Horsfall Beach to Coos Bay, Units 1-3	54	C	C			C		CA		C	C		C				C	C	C		C	C	BLM, CE, USFS, ODFW
																								and OPRD

		Mgt. Goal			Current (=C) and Additional (=A) Management																			
No.	Location	Breeding Nos. (adult birds)	Access	Boats	Contaminant	Cooperation	Development	Driftwood	Enforce	Enhance	Exclosures	Fence	Horses	Info. & Ed.	Kites	Livestock	Military	Monitor	OHV's	Pets	Predators	Signs	Vegetation	Owner and/or Manager
OR-14	Whiskey Creek to Coquille River	0 (see Task 2)					C											A	C	C				OPRD
						A																		Private
	Additional for OR-14: Monitor, and if nesting occurs, use exclosures.																							
OR-15	Bandon State Park to Floras Lake	54	CA				C	C	CA		C	C		C				C	CA	C	C	C	CA	OPRD, Curry County
																								BLM
						A																		Private
	Additional for OR-15: Vehicle closure from Bandon Beach access south to current closure one mile north of Twomile Creek.																							
OR-16	Euchre Creek	4																A						OPRD, Curry County
	Comment for OR-16: Current management by County unknown.																							
OR-17	Pistol River	4																CA						OPRD
OR-18	Elk River Mouth	4																A						ODPR
						A																		Private
OR-19	Sixes River Mouth	4																A						ODPR
	Additional for OR-16, OR-17, OR-18 and OR-19: Implement biweekly monitoring during the breeding season, and if plovers are observed, then implement																							
	appropriate intensive management, including but not limited to access, enforce, exclosures, fence, info & ed., signs, monitor, pets and vegetation.																							
CA-1	Smith River Mouth	8					C	A	C				C					C	C				A	CDPR
						A																		Private
	Additional for CA-1: If breeding is observed, increase enforcement, prohibit/restrict pets, and add exclosures, fencing, info. & ed., and signs.																							
CA-2	Lake Earl	10					C	A	C					A				CA	C				A	CDFG
				C			C	A	C				C	A				CA	C				A	CDPR
																								Del Norte County
						A																		Private
	Additional for CA-2: If breeding is observed, increase enforcement, prohibit/restrict pets, and add exclosures, fencing, info. & ed., and signs.																							
	Comment: Current management by County unknown.																							

		Mgt. Goal			Current (=C) and Additional (=A) Management																			
No.	Location	Breeding Nos. (adult birds)	Access	Boats	Contaminant	Cooperation	Development	Driftwood	Enforce	Enhance	Exclosures	Fence	Horses	Info. & Ed.	Kites	Livestock	Military	Monitor	OHV's	Pets	Predators	Signs	Vegetation	Owner and/or Manager
CA-3	Gold Bluffs Beach	0 (see Task 2)					A	A	C			A		C				C	C	C			C	NPS
							A	A	C					A				C	C	C			A	CDPR
	Additional for CA-3: If plovers found (especially breeding) increase enforcement of vehicle restrictions on wave slope. Monitor, and use exclosures if nesting occurs.																							
CA-4	Stone Lagoon	0 (see Task 2)					A	A	C					A				C		C			A	CDPR
	Additional for CA-4: Use exclosures if nesting occurs.																							
CA-5	Big Lagoon	16					A	A	A					A				C	C	CA			A	CDPR
	Additional for CA-5: Use exclosures, prohibit/restrict pets, fence, info. & ed., and signs when nesting occurs.																							
CA-6	Clam Beach/Little River	6					A	A	A		A	A		A	A			CA	C	CA		A	A	CDPR
							CA		A		A	A		A	A			CA	A	A		A	A	Humboldt County
						A																		Private
	Additional for CA-6: Prohibit/restrict fireworks, and use exclosures when breeding is observed.																							
CA-7	Mad River Mouth and Beach	12					C		C		A	C		A				C	CA	A			C	BLM
			C				C		C		A			A				C	C	A	C		C	FWS
							A	A	A		A			A				CA	C	A	A		A	Humboldt County
						A																		Private
	Additional for CA-7: Prohibit/restrict pets and use exclosures when breeding is observed.																							
CA-8	Humboldt Bay, North Spit	8	C				C		C		A	A		A				C	C	A			A	BLM
						A	C																	City of Eureka
						A																		Private
	Additional for CA-8: Prohibit/restrict pets and use exclosures and fencing when breeding is observed.																							
CA-9	Humboldt Bay, South Spit	30				A	A		A		A	A		A				A	A	A			A	Private
CA-10	Eel River, North Spit and Beach	20	A				A	A	C		C	A		A				C	CA	A			A	CDFG
							A	A	A		A	A		A					CA				A	Humboldt County
						A																		Private
	Additional for CA-10: Use exclosures when breeding is observed and prohibit OHV's during breeding season.																							

		Mgt. Goal			Current (=C) and Additional (=A) Management																			
No.	Location	Breeding Nos. (adult birds)	Access	Boats	Contaminant	Cooperation	Development	Driftwood	Enforce	Enhance	Exclosures	Fence	Horses	Info. & Ed.	Kites	Livestock	Military	Monitor	OHV's	Pets	Predators	Signs	Vegetation	Owner and/or Manager
CA-11	Eel River Mouth to Van Duzen River	40	A				A	A	A									C	C	A		C	A	Humboldt County
																								(Worswick Gravel Bar)
	Additional for CA-11: Use exclosures when breeding is observed.																							
CA-12	Eel River, South Spit and Beach	20				A					A	A		A				A	A					Private
CA-13	McNutt Gulch	10				A												A						Private
	Additional for CA-13: Seek cooperative agreement to monitor and use exclosures if nests found.																							
CA-14	MacKerricher Beach, Units 1-2	20					CA		A		A		A	A				C	C	CA		A	C	CDPR (Unit 1)
			A				CA		A		A	C	A	A				C		CA		A	C	CDPR (Unit 2)
	Comment for CA-14: Unit 1 is from Ten Mile Beach to Ward Avenue; Unit 2 is Virgin Creek Beach.																							
	Additional for CA-14: Install informational signs at access points to the two beaches; prohibit development or additional access/parking at Ten Mile beyond what																							
	currently exists; prohibit boardwalk construction north of Ward Avenue; improve trash control; and remove fence with confusing information at Virgin Creek.																							
	Use exclosures when nesting occurs.																							
CA-15	Manchester Beach	0 (See Task 2)	A				C		A		A		A	A				A	C	C		A	A	CDPR
						A																		Private
	Additional for CA-15: Use exclosures if nesting occurs. Implement European beachgrass management plan, especially near southern area at Stonboro Road.																							
CA-16	Salmon Creek	10		C					A		A	A		A				A		A				CDPR
						A																		Private
CA-17	Bodega Harbor	0 (see Task 2)																						State
CA-18	Doran Spit	0 (see Task 2)							A					A				C						Sonoma County
	Additional for CA-18: Use exclosures if nesting occurs. Comment: Monitoring by PRBO.																							
CA-19	Dillon Beach	0 (see Task 2)				A								A				C		A				Private
	Additional for CA-19: Use exclosures if nesting occurs. Comment: Monitoring by PRBO.																							

		Mgt. Goal			Current (=C) and Additional (=A) Management																			
No.	Location	Breeding Nos. (adult birds)	Access	Boats	Contaminant	Cooperation	Development	Driftwood	Enforce	Enhance	Exclosures	Fence	Horses	Info. & Ed.	Kites	Livestock	Military	Monitor	OHV's	Pets	Predators	Signs	Vegetation	Owner and/or Manager
CA-20	Point Reyes Beach	50	C	C	A		C		C		C	C	C	C		C	C	C	C	C	A	C	CA	NPS
	Additional for CA-20: Exclude pinnipeds from plover nesting habitat; docent monitoring and education.																							
CA-21	Drakes Spit	4		C	C		C		C				C	C			C	C	C	C			CA	NPS
	Additional for CA-21: Use exclosures if nesting occurs.																							
CA-22	Limantour Spit	10	C		C				C		C	C		C	C			C	C	C		C	CA	NPS
	Additional for CA-22: Exclude pinnipeds from plover nesting habitat; docent education.																							
CA-23	Bolinas Spit/Stinson Beach	0 (see Task 2)				A												A						Private
	Additional for CA-23: Seek cooperative agreement to monitor and use exclosures if nesting occurs.																							
CA-24	Ocean Beach	0 (see Task 2)							C					C				C	C	C		C	C	NPS
	Additional for CA-24: Use exclosures if nests found.																							
CA-25	Salt Pond 7A Levee	Unknown	C															C						CDFG
CA-26	Little Island	Unknown																C						CDFG
CA-27	Alameda Naval Air Station	Unknown																						Navy
	Comment for CA-27: No current management by Navy.																							
CA-28	Alameda South Shore	Unknown		C			C										C	C		C				EBRPD
						A																		Private
CA-29	Bay Farm Island	Unknown				A																		Private
CA-30	Oakland Airport, Units 1-2	Unknown																						PO
	Comment for CA-30: Current management by PO unknown.																							
CA-31	Oliver Salt Ponds, North of Hwy. 92	50	C	C			C			A	A		C	A			C	CA	C	C	CA	C	C	HARD
	Additional for CA-31: Improve summer water conditions to create foraging habitat for breeding plovers.																							

		Mgt. Goal			Current (=C) and Additional (=A) Management																				
No.	Location	Breeding Nos. (adult birds)	Access	Boats	Contaminant	Cooperation	Development	Driftwood	Enforce	Enhance	Exclosures	Fence	Horses	Info. & Ed.	Kites	Livestock	Military	Monitor	OHV's	Pets	Predators	Signs	Vegetation	Owner and/or Manager
CA-32	Oliver Salt Ponds, South of Hwy. 92	Unknown				A																		Private
CA-33	Baumberg Salt Ponds	50	C						C	A	A	C	C	A				CA	C	C	CA			CDFG
						A																		Private
CA-34	Turk Island Salt Ponds	Unknown				A																		Private
CA-35	Coyote Hills Salt Ponds	Unknown	C				C		C	A	A	C	C	C			C	C	C	C	C	C	A	FWS
			A																					Caltrans
	Additional for CA-35: (1) FWS: conduct banding study, and (2) Caltrans: Develop agreement to prohibit/restrict access during breeding season.																							
CA-36	Dumbarton Salt Ponds	Unknown	C				C		C	A	A	C	C	C				C	C	C	C	C	A	FWS
	Additional for CA-36: Conduct banding study.																							
CA-37	Plummer Creek Salt Pond	Unknown				A																		Private
CA-38	Mowry Salt Ponds	Unknown	C	C			C		C		A		C					CA	C	C	C	C		FWS
						A																		Private
CA-39	Warm Springs Salt Pond	Unknown	C				C		CA	A	A		C	A				CA	C	C	C	C		FWS
						A																		Private
CA-40	Knapp Salt Pond	Unknown	C	C			C		C				C					CA		C	C	C		FWS
	Additional for CA-40: Assess reasons for lack of recent plover use.																							
CA-41	Alviso Salt Ponds	Unknown				A																		Private
CA-42	Moffett Field	Unknown	C				C					C	C							C		C		NASA
CA-43	Crittenden Marsh	Unknown	C				C					C	C							C		C		NASA
				C			C						C				C	C		C				MPOSD
CA-44	Ravenswood Salt Pond Levee	Unknown				A																		Private

		Mgt. Goal			Current (=C) and Additional (=A) Management																			
No.	Location	Breeding Nos. (adult birds)	Access	Boats	Contaminant	Cooperation	Development	Driftwood	Enforce	Enhance	Exclosures	Fence	Horses	Info. & Ed.	Kites	Livestock	Military	Monitor	OHV's	Pets	Predators	Signs	Vegetation	Owner and/or Manager
CA-45	Redwood City Salt Pond	Unknown				A																		Private
CA-46	Redwood Creek	Unknown				A																		Private
CA-47	Middle Bair Island	Unknown				A																		TPL
	Additional for CA-25 through CA-47: See Task 1.7																							
CA-48	Pacifica Beach	0 (see Task 2)							A									C		A		A		CDPR (City of Pacifica)
						A																		Private
	Additional for CA-48: Use exclosures if nesting occurs. Comment: Monitoring by PRBO.																							
CA-49	Pillar Point	0 (see Task 2)		C			C						C				C	A	C	C				San Mateo County
						A																		Private
	Additional for CA-49: Use exclosures if nesting occurs.																							
CA-50	Half Moon Bay Beaches	10	C	C					C		A	C	C					C		C	C		C	CDPR
CA-51	Tunitas Beach	4				A																		Private
CA-52	San Gregorio Beach	0 (see Task 2)		C			C		C				C				C	A	C	C				CDPR
	Additional for CA-52: Use exclosures if nesting occurs.																							
CA-53	Pomponio Beach	0 (see Task 2)		C			C						C				C	A	C	C				CDPR
	Additional for CA-53: Use exclosures if nesting occurs.																							
CA-54	Pescadero Beach	6	C	C			C		C				C				C	C		C				CDPR
	Additional for CA-54: Use exclosures if nesting detected. Comment: Monitoring by PRBO.																							
CA-55	Gazos Creek	4		C			C		C								C	C		C				CDPR
						A																		Private
	Additional for CA-55: Use exclosures when nesting detected. Comment: Monitoring by PRBO.																							

		Mgt. Goal			Current (=C) and Additional (=A) Management																			
No.	Location	Breeding Nos. (adult birds)	Access	Boats	Contaminant	Cooperation	Development	Driftwood	Enforce	Enhance	Exclosures	Fence	Horses	Info. & Ed.	Kites	Livestock	Military	Monitor	OHVs	Pets	Predators	Signs	Vegetation	Owner and/or Manager
CA-56	Ano Nuevo, Units 1-3	10	C	C			C		C				C				C	C		C			C	CDPR
	Additional for CA-56: Use exclosures when nesting detected.																							
CA-57	Waddell Creek	10																C				C		CDPR
	Additional for CA-57: Use exclosures when nesting detected. Comment: Monitoring by PRBO.																							
CA-58	Scott Creek Beach	8	C						C		C	C		C				C	C	C	C			Santa Cruz County
						A																		Private
	Addtional for CA-58: Permanent fence/barrier prohibiting off-road vehicle access. Comment: Monitoring by PRBO.																							
CA-59	Laguna Creek Beach	8	C				C		C		C	C		C				C	C	C	C	C		TPL (Santa Cruz County)
	Additional for CA-59: Remove or prohibit parking on state and county right-of-way. Comment: Monitoring by PRBO.																							
CA-60	Baldwin Creek Beach	0 (see Task 2)																A						CDPR
	Additional for CA-60: Use exclosures if nesting occurs.																							
CA-61	Wilder Ranch Beach	16	C	C			C		C		C	C	C	C			C	C	C	C		C	C	CDPR
	Comment for CA-61: Monitoring by PRBO.																							
CA-62	Seabright Beach	0 (see Task 2)		C			C		C				C				C	C	C	C				CDPR
						A																		Private
	Additional for CA-62: Obtain better information about non-breeding plovers and their habitat needs. Comment: Monitoring by PRBO.																							
CA-63	Jetty Road to Aptos	Total 54																						
	Sunset and Manressa State Beaches	18	C	C			C	C	CA		C	C	C	CA		C	C	C	C	C		C	CA	CDPR-Santa Cruz District
	Pajaro River mouth (Beach Rd. to Zmudowski	26	C	C			C	C	CA	C	C	C	CA	CA	C	C	C	C	C	C	CA	C	CA	CDPR-Monterey District
	State Beach Parking Area 26)																							
	Moss Landing State Beach (Zmudowki State Beach	10	C	C			C	C	CA		C	C	CA	CA		C	C	C	C	C	CA	C	CA	CDPR-Monterey District
	parking lot to mouth of Elkhorn Slough)																							
	Comments for CA-63: Monitoring by PRBO. Seek acquisition of adjacent Foster property on willing-seller basis.																							

		Mgt. Goal			Current (=C) and Additional (=A) Management																			
No.	Location	Breeding Nos. (adult birds)	Access	Boats	Contaminant	Cooperation	Development	Driftwood	Enforce	Enhance	Exclosures	Fence	Horses	Info. & Ed.	Kites	Livestock	Military	Monitor	OHV's	Pets	Predators	Signs	Vegetation	Owner and/or Manager
CA-85	Santa Ynez River Mouth/Ocean Beach	150	CA	C*			C		CA		A		C	CA				C*	CA	CA	CA	C*	A	USAF
	(a/k/a Vandenberg Air Force Base)																							
	Additional for CA-85: Investigate predator ecology and non-lethal control and deterrence; remove non-native vegetation; and work with CA Coastal Commission to																							
	make some beach sectors totally off-limits during the nesting season.																							
CA-86	Jalama Beach	0 (see Task 2)																C*	C*	C*				USAF
							C*						C						C	C*				County
						A																		Private
	Additional for CA-86: Use exclosures if nesting occurs. Comment: Monitoring by PRBO (winter).																							
CA-87	Hollister Ranch	10				A																		Private
CA-88	Devereaux Beach	4				A																		Private
CA-89	Goleta Beach	0 (see Task 2)					C*						C							C*			C	County
						A																		Private
	Additional for CA-89: Use exclosures if nesting occurs.																							
CA-90	Point Castillo/Santa Barbara Harbor	0 (see Task 2)		C*			C						C				C*	C	C	C*				City of Santa Barbara
	Additional for CA-90: Use exclosures if nesting occurs. Comment: Monitoring by PRBO.																							
CA-91	Carpinteria Beach	0 (see Task 2)																C*						CDPR
	Comment for CA-91: Use exclosures if nesting occurs. Comment: Irregular monitoring by PRBO.																							
CA-92	San Miguel Island, Units 1-8	30	C*	C*										C*				C*		C*				NPS
	Additional for CA-92: Fence off areas to prevent marine mammals from using all habitat. *Note: Boats prohibited/restricted, except Cuyler Cove.																							
CA-93	Santa Rosa Island, Units 1-11	130	C*	C*					A		A			C*				C*		C*	CA	A	C	NPS
	Additional for CA-93: Remove ravens; signage at closure boundary; foot patrols of closure. *Note: Access prohibited/restricted at Skunk Point.																							
CA-94	Santa Cruz Island, Units 1-2	20	C*	C*			C		C*				C*				C*	C*	C*	C*				TNC
	Additional for CA-94: Feral pig control.																							

		Mgt. Goal			Current (=C) and Additional (=A) Management																			
No.	Location	Breeding Nos. (adult birds)	Access	Boats	Contaminant	Cooperation	Development	Driftwood	Enforce	Enhance	Exclosures	Fence	Horses	Info. & Ed.	Kites	Livestock	Military	Monitor	OHV's	Pets	Predators	Signs	Vegetation	Owner and/or Manager
CA-78	Villa Creek	Unknown				A																		Private
CA-79	Toro Creek	16				A												A						Private
	Additional for CA-79: Seek cooperative agreement to monitor and use exclosures if nesting occurs. Comment: Monitoring by PRBO.																							
CA-80	Atascadero Beach	40	C				C		C			C		C				C		C	A	C		CDPR
																								City of Morro Bay
	Comment for CA-80: Monitoring by PRBO. Current management by City unknown.																							
CA-81	Morro Bay Beach	110					C		C		A							C	C	C		C	A	CDPR
											A												A	City of Morro Bay
CA-82	Avila Beach	0 (see Task 2)																						PSL
						A																		Private
	Comment for CA-82: Although Avila Beach is proposed for excavation of underlying oil contamination and beach restoration, it is anticipated that restoration will																							
	replace and enhance existing habitat values for snowy plovers.																							
CA-83	Pismo Beach/Nipomo Dunes	350																						
	(Pier Ave. to southern State Vehicular Recreation)								C		C	C						C	C	C		C		CDPR
	Area riding boundary)																							
	(State Vehicular Recreation Area riding boundary)		C						C					C				C		C		C		CDPR
	to Mobil coastal preserve)																							
	(Mobil coastal preserve to Point Sal)								C									A	C					CDPR
																								San Luis Obispo County
																								TNC
						A																		Private
	Comment for CA-83: No current management by County; current management by TNC unknown.																							
CA-84	Vandenberg Air Force Base	250	CA	C			C		CA		A	CA	CA	CA			CA	C	CA	CA	CA	C	A	USAF
	(a/k/a Minuteman Beach)																							

		Mgt. Goal			Current (=C) and Additional (=A) Management																			
No.	Location	Breeding Nos. (adult birds)	Access	Boats	Contaminant	Cooperation	Development	Driftwood	Enforce	Enhance	Exclosures	Fence	Horses	Info. & Ed.	Kites	Livestock	Military	Monitor	OHV's	Pets	Predators	Signs	Vegetation	Owner and/or Manager
CA-66	Asilomar Beach, Units 1-2	0 (see Task 2)		C			C		CA				C	C				C	C	A	C			CDPR
						A																		Private
	Additional for CA-66: Use exclosures if nesting occurs. Comment: Monitoring by PRBO.																							
CA-67	Carmel River Mouth	0 (see Task 2)							C				C					C	C	C	C			CDPR
	Additional for CA-67: Use exclosures if nesting occurs. Comment: Monitoring by PRBO.																							
CA-68	Point Sur	20	C						C									C				C		CDPR
						A										A		A					A	Private
	Comment for CA-68: Monitoring by PRBO. Additional for CA-68: Seek cooperative agreement to allow monitoring on private land, discuss control of European																							
	beachgrass, and prevent disturbance from cattle.																							
CA-69	San Carpoforo Creek	10				A																		Private
CA-70	Arroyo Hondo Creek	0 (see Task 2)				A																		Private
CA-71	Pt. Sierra Nevada	0 (see Task 2)				A																		Private
CA-72	Arroyo de la Cruz	0 (see Task 2)				A																		Private
CA-73	Sidney's Lagoon	0 (see Task 2)				A																		Private
CA-74	Piedras Blancas, Units 1-2	0 (see Task 2)				A																		Private
CA-75	Arroyo Laguna Creek	6				A												A						Private
	Additional for CA-75: Seek cooperative agreement to monitor and use exclosures when nesting occurs.																							
CA-76	Pico Creek	0 (see Task 2)				A																		Private
CA-77	San Simeon Beach	0 (see Task 2)							C									C		CA			C	CDPR
	Additional for CA-77: Use exclosures if nesting occurs. Comment: Monitoring by PRBO.																							

No.	Location	Breeding Nos. (adult birds)	Access	Boats	Contaminant	Cooperation	Development	Driftwood	Enforce	Enhance	Exclosures	Fence	Horses	Info. & Ed.	Kites	Livestock	Military	Monitor	OHV's	Pets	Predators	Signs	Vegetation	Owner and/or Manager
CA-64	Elkhorn Slough Mudflat/Salt Pond	80	C	C			C	C	CA	CA			C	CA	C	C	C	CA	C	C	CA	CA	A	CDFG
	(a/k/a Moss Landing Wildlife Area)																							
	Additional for CA-64: Monitor erosion rate of bank separating Elkhorn Slough from salt ponds. Comment: Monitoring by PRBO.																							
CA-65	Monterey to Moss Landing	Total 162																						
	Salinas River State Beach																							
	Molera/Potrero (Salinas State Beach from the	10	C	C			C	C	CA		C	C	CA	CA		C	C	C	C	C	CA	C	C	CDPR, Private
	mouth of Elkhorn Slough to northern boundary																							
	of Monterey Dunes Colony)																							
	Monterey Dunes (beach in front of Monterey	12		C				C	CA		C	C	CA	CA		C	C	C	C	C	CA	C	C	CDPR
	Dunes property)																							
	North Salinas (beach from south boundary of	20	C	C			C	C	CA	C	C	C	CA	CA		C	C	C	C	C	CA	C	C	CDPR
	Monterey Dunes property to north boundary																							
	of Salinas River National Wildlife Refuge; mouth																							
	of Salinas River)																							
	Salinas River National Wildlife Refuge	40	C	C			C	C	CA	C	C	C	C	CA	C	C	C	C	C	C	CA	C	C	FWS
	Martin property beach	12				C			CA		C	C									CA		C	Private
	Lone Star beach and interior areas	32				C			CA		C	C									CA			Private
	Reservation Road (Reservation Road to Stilwell	16	C	C			C	C	CA		C	C	C	C		C	C	C	C	C	A	C	C	CDPR, Army
	Hall on Fort Ord)																							
	Sand City/Del Monte (southern boundary of Fort Ord	20	C	C		A	C	C	CA	C	C	C	C	CA	CA	C	C	C	C	C	A	C	C	Army, Private, City of
	to City of Monterey)																							Sand City, MPRPD, CDPR
			C	C			CA		CA			CA	C	CA		C			C	CA	A	CA	CA	Navy
			C	C			C		CA				C	CA		C	C		C	CA	A		CA	City of Monterey
	Additional for CA-65: Enhance dunes on Navy property for snowy plover and other sensitive species; monitor if breeding birds detected. On City of Monterey																							
	property, monitor and use signs if breeding birds detected; remove trash manually to avoid mechanical raking. Comments: Monitoring by PRBO. Seek																							
	acquisition of Martin, Lone Star, Sandholt, and Sand City small parcels on willing-seller basis.																							
	Comment for CA-63, CA-64 and CA-65: Predator control performed by U.S. Department of Agriculture, Wildlife Services Branch, for FWS and CDPR.																							

		Mgt. Goal			Current (=C) and Additional (=A) Management																			
No.	Location	Breeding Nos. (adult birds)	Access	Boats	Contaminant	Cooperation	Development	Driftwood	Enforce	Enhance	Exclosures	Fence	Horses	Info. & Ed.	Kites	Livestock	Military	Monitor	OHV's	Pets	Predators	Signs	Vegetation	Owner and/or Manager
CA-95	San Buenaventura Beach	0 (see Task 2)					A											C	CA	C			C	CDPR
																								City of Ventura
	Additional for CA-95: Use exclosures if nesting occurs. Avoid plover areas during maintenance trash pick-up. Comments: Monitoring by PRBO. Current																							
	management by City unknown.																							
CA-96	Mandalay Bay/Santa Clara River Mouth	60					C							C				C	C	C			C	CDPR
																								Ventura County
																								City of Oxnard
	Comment for CA-96: Current management by County and City unknown.																							
CA-97	Hollywood Beach	4																C						Ventura County
						A																		Private
	Comment for CA-97: Irregular monitoring by PRBO.																							
CA-98	Ormond Beach	50							C											C				City of Port Hueneme
																								City of Oxnard
						A																		Private
	Comments for CA-98: Current management by City of Oxnard unknown. Irregular monitoring by PRBO.																							
CA-99	Mugu Lagoon Beach	110	C	C										C			C	C			C			Navy
	Additonal for CA-99: Use exclosures if warranted.																							
CA100	San Nicolas Island, Units 1-15	150	C						C					C			C				C	C		Navy
CA101	Zuma Beach	0 (see Task 2)		C			C						C				C	C	C	C				Los Angeles County
	Addtional for CA-101: Use exclosures if nesting occurs. Comment: Monitoring by PRBO.																							
CA102	Corral Beach	0 (see Task 2)		C			C						C				C	C	C	C				Los Angeles County
						A																		Private
	Additional for CA-102: Use exclosures if nesting occurs. Comment: Monitoring by PRBO.																							

		Mgt. Goal			Current (=C) and Additional (=A) Management																			
No.	Location	Breeding Nos. (adult birds)	Access	Boats	Contaminant	Cooperation	Development	Driftwood	Enforce	Enhance	Exclosures	Fence	Horses	Info. & Ed.	Kites	Livestock	Military	Monitor	OHV's	Pets	Predators	Signs	Vegetation	Owner and/or Manager
CA103	Malibu Lagoon Beach	0 (see Task 2)					C						C				C	C	C	C				CDPR
	Additional for CA-103: Enhance snowy plover habitat by fencing area on ocean side of historic Adamson House. Comment: Monitoring by PRBO.																							
CA104	Santa Monica Beach	0 (see Task 2)		C									C						C	C				City of Santa Monica
	Additional for CA-104: Use exclosures if nesting occurs.																							
CA105	Dockweiler to Hermosa Beach	0 (see Task 2)		C			C						C				C	C	C	C				Los Angeles County
				C			C						C						C	C				City of Hermosa Beach
	Additional for CA-105: Use exclosures if nesting occurs. Comment: Monitoring by PRBO.																							
CA106	San Clemente Island	0 (see Task 2)	C	C			C						C					CA	C	C				Navy
	Additional for CA-106: Use exclosures if nesting occurs. Comment: Irregular monitoring (every other year).																							
CA107	Huntington Beach	0 (see Task 2)	C	C			C		C			C	C	C			C	C	C	C	C		C	CDPR
				C			C						C				C			C				City of Huntington Beach
	Additional for CA-107: Use exclosures if snowy plovers nest outside of California least tern preserve. Comment: Monitoring by PRBO.																							
CA108	Bolsa Chica Wetlands	50	C	C	C	C	C			A		C	C	C	C	C	C	C	C	C	C		A	FWS
CA109	Newport Beach	0 (see Task 2)																						Orange County
																								City of Newport Beach
	Additional for CA-109: Use exclosures if nesting occurs. Comment: Current management by County and City unknown.																							
CA110	Crystal Cove	0 (see Task 2)		C			C		C				C	C			C	C		C				CDPR
																								Orange County
						A																		Private
	Additional for CA-110: Use exclosures if nesting occurs. Comment: Monitoring by PRBO. Current management by County unknown.																							
CA111	Salt Creek Beach	0 (see Task 2)																C						Orange County
						A																		Private
	Additional for CA-111: Use exclosures if nesting occurs. Comment: Irregular monitoring by PRBO.																							

		Mgt. Goal			Current (=C) and Additional (=A) Management																			
No.	Location	Breeding Nos. (adult birds)	Access	Boats	Contaminant	Cooperation	Development	Driftwood	Enforce	Enhance	Exclosures	Fence	Horses	Info. & Ed.	Kites	Livestock	Military	Monitor	OHV's	Pets	Predators	Signs	Vegetation	Owner and/or Manager
CA112	Doheny Beach/Dana Point	0 (see Task 2)		C			C		C				C	C			C	C		C				CDPR
																								Orange County
						A																		Private
	Additional for CA-112: Use exclosures if nesting occurs. Comment: Monitoring by PRBO. Current management by County unknown.																							
CA113	San Onofre Beach	15	A	C			C		C				C				C	C		CA	A		A	USMC (CDPR)
	Comment for CA-113: Monitoring by USGS-BRD (winter).																							
CA114	Aliso/French Creek Mouth	40	CA	C			C		C			C	C	C			C	C	C	C	CA	C	CA	USMC
	Comment for CA-114: Monitoring by USGS-BRD (winter and breeding).																							
CA115	Santa Margarita River Estuary	160	CA	C			C		CA			C	C	C			C	C	C	C	CA	C	CA	USMC
	Comment for CA-115: Monitoring by USGS-BRD (winter and breeding).																							
CA116	San Luis Rey River Mouth	0 (see Task 2)		C									C				C	A	C	C				City of Oceanside
	Additional for CA-116: Monitor, and use exclosures if nesting occurs.																							
CA117	Agua Hedionda Lagoon/Beach	10																C		C				CDPR
																								City of Carlsbad
						A																		Private
	Comments for CA-117: Irregular monitoring by USGS-BRD (winter and breeding). Current management by City unknown.																							
CA118	South Carlsbad Beach	0 (see Task 2)					C											C		C				CDPR
	Additional for CA-118: Use exclosures if nesting occurs. Comment: Monitoring by USGS-BRD (winter).																							
CA119	Batiquitos Lagoon	70	C	C			C		C			C	C	A	C	C	C	CA	C	C	CA	C	A	CDFG
	Comment for CA-119: Monitoring by USGS-BRD (winter and breeding).																							
CA120	San Elijo Lagoon/Beach	10	A									A						CA		C	A		A	CDPR
			A									A						CA			A		A	CDFG
			C	C			C					CA		C				CA	C	C	A	C	CA	San Diego County
						A																		Private
	Comment for CA-120: Irregular monitoring by USGS-BRD (winter and breeding).																							

		Mgt. Goal			Current (=C) and Additional (=A) Management																			
No.	Location	Breeding Nos. (adult birds)	Access	Boats	Contaminant	Cooperation	Development	Driftwood	Enforce	Enhance	Exclosures	Fence	Horses	Info. & Ed.	Kites	Livestock	Military	Monitor	OHV's	Pets	Predators	Signs	Vegetation	Owner and/or Manager
CA121	San Dieguito Lagoon/Beach	10	A				C		A									CA		CA	A		A	City of Del Mar
			A	C		A	C		A	A	C	C	A	A	A	C	C	CA	C	CA	A		A	SDRPJPA
	Comment for CA-121: Irregular monitoring by USGS-BRD (winter and breeding).																							
CA122	Los Penasquitos Lagoon/Beach	10	CA						C									CA		C	A		CA	CDPR
																								City of Del Mar
	Comments for CA-122: Irregular monitoring by USGS-BRD (winter and breeding). Current management by City unknown.																							
CA123	Mission Bay, Bonita Cove	0 (see Task 2)																CA						City of San Diego
						A																		Private
	Additional for CA-123: Monitor, and use exclosures if nesting occurs. Comment: Irregular monitoring by USGS-BRD (winter and breeding).																							
CA124	Mission Bay, Fiesta Island	0 (see Task 2)																CA						City of San Diego
	Comment for CA-124: Monitor, and use exclosures if nesting occurs. Comment: Irregular monitoring by USGS-BRD (winter).																							
CA125	South Mission Beach	0 (see Task 2)																CA						City of San Diego
	Comment for CA-125: Monitor, and use exclosures if nesting occurs. Comment: Irregular monitoring by USGS-BRD (winter).																							
CA126	Ocean Beach/San Diego FCC	0 (see Task 2)																CA						City of San Diego
	Comment for CA-126: Monitor, and use exclosures if nesting occurs. Comment: Irregular monitoring by USGS-BRD (winter).																							
CA127	NAS North Island	20	A				C		A				C					CA	C	CA	A		A	Navy
																								City of Coronado
	Comment for CA-127: Irregular monitoring by USGS-BRD (1997, breeding and winter). Current management by City unknown.																							
CA128	NAB Coronado/Silver Strand State Beach/Naval	65	A						C			A	C	C				C	C			C	A	Navy
	Radio Receiving Facility		C						CA			A		A				C	C	C		C	C	CDPR
CA129	NAB Delta Beach Bay	10	C	C			C					C	C	C			C	C	C	C	C	C	C	Navy
CA130	South San Diego Marine Biological Study Area	0 (see Task 2)	C	C			C						C					C	C	C		C		Navy (San Diego County)
	Additional for CA-130: Use exclosures if nesting occurs. Comment: Monitoring by USGS-BRD (winter).																							

		Mgt. Goal			Current (=C) and Additional (=A) Management																			
No.	Location	Breeding Nos. (adult birds)	Access	Boats	Contaminant	Cooperation	Development	Driftwood	Enforce	Enhance	Exclosures	Fence	Horses	Info. & Ed.	Kites	Livestock	Military	Monitor	OHV's	Pets	Predators	Signs	Vegetation	Owner and/or Manager
CA131	Western Salt Company	10	C	C			C		C	A		A	C	A	C	C	C	C	C	C	CA		A	State (FWS)
CA132	Sweetwater National Wildlife Refuge	20	C	C			C		C			C	C	C			C	C	C	C	C	C	C	FWS
	Comment for CA-132: Monitoring by USGS-BRD (winter and breeding).																							
CA133	Tijuana River Beach	40	C	C			C		CA			C	C	C			C	C	C	C	C	C	C	FWS
			C				C		CA			C						C		C		C		CDPR
	Comment for CA-133: Monitoring by USGS-BRD (winter and breeding).																							

Note: In California, where landowner and land manager differ, land manager is shown parenthetically.

APPENDIX D

POPULATION VIABILITY ANALYSIS FOR PACIFIC COAST SNOWY PLOVERS

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Introduction

In 1993 the Pacific coast population of the snowy plover (*Charadrius alexandrinus nivosus*) was designated as threatened by the U.S. Fish and Wildlife Service under the Endangered Species Act. To aid the Snowy Plover Recovery Team in developing recovery criteria, the authors developed this population viability analysis for Pacific coast snowy plovers.

Population viability analysis is used increasingly as a tool for developing conservation, management or restoration strategies for threatened, endangered, or potentially threatened species. The method is reviewed by Boyce (1992), Burgman *et al*. (1993), Beissinger and Westphal (1998) and Nur and Sydeman (1999). Examples of its use include Haig *et al*. (1993), Maguire *et al*. (1995), Akçakaya *et al*. (1995), and Bustamante (1996). In particular, population viability analyses have been developed for the congener piping plover *Charadrius melodus* (Great Plains population: Ryan 1993; Atlantic coast population: Melvin and Gibbs 1996).

General Features of the Population Viability Analysis Model

The model is stochastic. Stochasticity is one of the defining features of Population Viability Analyses in general (Burgman *et al*. 1993). Two types of random variation are incorporated: unpredictable variation in the environment and "demographic stochasticity." Demographic stochasticity can be thought of as follows: even if all relevant features of the environment (including predators, competitors, abiotic factors, etc.) impinging on snowy plovers are known, and even though, on average, survival or reproductive success can be related to these environmental features, there will still be an element of unpredictability regarding the precise number of young or adults that survive or the number of fledglings produced in any time period.

For the population viability analysis, we have used a metapopulation model with six subpopulations linked by dispersal of individuals. A metapopulation is a set of subpopulations among which there is restricted dispersal (Harrison 1994, Nur and Sydeman *in press*). In this population viability analysis, we have incorporated into the metapopulation model the best available estimates on dispersal. However, using the same model structure, one can easily alter the parameter values of dispersal, and, indeed, we do so. An alternative approach would be to treat Pacific coast birds as a single population, with unrestricted mating among all individuals, regardless of location. The latter model assumes that a bird from, say, Oregon is as likely to mate with a bird from San Diego as with a bird from Oregon. Such an assumption is exceedingly unrealistic; hence, we have adopted a metapopulation model. Another virtue of the metapopulation approach is that survival and/or fecundity can be allowed to vary among subpopulations, rather than being assumed homogeneous throughout the species' range. Note that the Atlantic coast piping plover population viability analysis assumed a single, panmictic population instead of a metapopulation (U.S. Fish and Wildlife Service 1996).

The population viability analysis is carried out using the RAMAS/GIS program which is commercially available (Akçakaya 1997) and has been widely used for population viability

analyses. Use of an off-the-shelf program makes modeling convenient and reproducible, but there are attendant limitations regarding input and output. For example, RAMAS/GIS allows one to specify the degree of stochastic variability in survival and reproductive success, but not dispersal. Other limitations are mentioned in the "Discussion." The Snowy Plover Recovery Team determined that the cost of developing a specially written program to carry out the population viability analysis was not justified.

The type of model that can be generated using RAMAS/GIS does not incorporate the production and elimination of genetic variation brought about by sexual reproduction (Caswell 1989, Beissinger and Westphal 1998). As a simplification, only one sex is modeled. We have used males because their demographic parameters can be estimated with greater certainty than for females. In addition, there is reason 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).

The snowy plover population viability analysis projects into the future up to 100 years. Although, there is considerable uncertainty in projecting 100 years, this time-horizon is commonly used and is recommended by Mace and Lande (1991). This time horizon was also used for the Atlantic coast Piping Plover Recovery Plan. We also depict population trajectories for shorter time-horizons.

The population viability analysis indicates trends and quantifies the risk that the total population goes extinct or falls below a **specified threshold**. We used a specified threshold of 50 individuals, but the population viability analysis could be modified by choosing any other threshold value.

The population viability analysis includes different scenarios pertaining to changes in reproductive success resulting from predator management and could be used to model other changes in management practices or the environment, affecting any of the other demographic parameters.

Subpopulations

The Snowy Plover Recovery Team has identified six subpopulations of snowy plovers, each corresponding to a region of the U S. Pacific coast. The population viability analysis assumes restricted dispersal among subpopulations, but unrestricted access to mates within

subpopulations. The six subpopulations, with their two-letter or three-letter designations, and estimated population sizes are:

1. Oregon and Washington coast (OR) estimated at 134 plovers;
2. Northern California coast (NC; Del Norte, Humboldt and Mendocino counties) with 50 plovers;
3. San Francisco Bay (SFB; primarily South Bay) with 264 plovers;
4. Monterey Bay (MB; coast of Sonoma, Marin, San Mateo, Santa Cruz and Monterey counties) with 300 plovers;
5. coast of San Luis Obispo, Santa Barbara and Ventura counties (SLO) with 886 plovers;
6. San Diego area (SD; Los Angeles, Orange and San Diego counties) with 316 plovers.

For the OR, MB, and SD subpopulations, intensive monitoring of color-banded individuals was carried out in 1997, and population size was estimated on that basis. For the NC, SFB and SLO subpopulations, information is less complete. Instead, we relied on "window surveys" conducted in 1995, 1991, and 1995, respectively. To account for birds missed during the window surveys we applied a correction factor to the survey numbers for the NC, SFB and SLO subpopulations. Where window surveys were conducted at locations with color banded birds, the number of marked birds known to be at the location was underestimated by about 22 percent. This takes into account both birds known to be present but missed and birds that were double counted. The correction factor used is 1/(1-.222) = 1.286. For the NC and SLO subpopulations, the correction factor was applied to the number of birds counted on window surveys in 1995.

However, for the SFB subpopulation, no window survey has been carried out since 1991. Uncertainty about population trends since 1991 compounds uncertainty about current abundance. We therefore considered there to be an upper bound of 310 individuals (219 individuals observed on the window survey in 1991 x 1.286 x 1.1, to account for modest population growth since 1991) and a lower bound of 219 individuals (population decline since 1991, equal in magnitude to the undercounting during the window survey). For modeling, we used the mean of those two estimates (= 264 individuals).

Conceptual Framework of the Model

The key demographic parameters in the model are: (1) adult survival, (2) juvenile survival, (3) reproductive success, and (4) dispersal. All individuals 1 year or older are considered to be adult, and assumed to breed (see below). The demographic parameters are linked in the population

model in the following manner, ignoring dispersal among subpopulations (detailed later) and ignoring any stochastic effects.

The model keeps track of the abundance of each age class (one-year-old, two-year-old, etc., up to twenty-year-old individuals) in each subpopulation. This enumeration by the model is carried out at the onset of the breeding season; this is referred to as a pre-breeding census. In the model, the number of two-year-olds in year t+1, symbolized $N(2)_{t+1}$ is equal to the number of one-year-olds in year t, symbolized $N(1)_t$, times the annual survival rate of one-year-olds, symbolized S_1. Note that S_1 is not constant, but varies stochastically from year to year, and differs among subpopulations. Similar calculations are performed for the number of three-year-olds, i.e., $N(3)_{t+1} = N(2)_t*S_2$, four-year-olds, etc. In the model, adult survival is assumed to be the same for all ages, i.e., $S_1 = S_2 = ... = S_{19}$, but no adult lives beyond 20 years of age, which is considered maximum age for this species.

The number of one-year-olds in a given year is equal to the number of fledged chicks produced the year before times the probability that a fledged chick will survive to reach the age of one year. If the total number of adults the year before is written $N(A)_t = N(1)_t + N(2)_t + ... + N(20)_t$, then the number of one-year-olds in year t+1, symbolized $N(1)_{t+1}$, is equal to the product $N(A)_t*F*S_0$, where F is the number of male fledglings produced per male adult in each year, and S_0 is the probability a fledgling survives to one year (12 months) of age. Since the sex ratio of fledglings is unknown, we assume a 1:1 ratio. Any non-breeding among adults would act to reduce F; however, all adults are assumed to breed (see below). In the model, F and S_0 also vary among subpopulations and vary randomly among years, with a specified mean and standard deviation.

Parameter Estimates

Adult survival - The best estimates for adult survival came from capture/recapture analyses of Monterey Bay color-banded plovers, a major study population (henceforth Monterey Bay) situated within the MB subpopulation. Additional data for analyses came from color-banded study populations on Oregon beaches (Oregon) and San Diego beaches (San Diego). Note that we distinguish between study areas (Monterey Bay, Oregon and San Diego) and their respective, more inclusive subpopulations (MB, OR, SD). Analyses of survival were carried out using the program SURGE (Lebreton *et al*. 1992, Cooch *et al*. 1996) and for Monterey Bay were based on 777 adults (361 males, 416 females) followed over 14 years. Sample sizes for Oregon were 108 males and 70 females, followed over 8 years, and for San Diego 91 males and 137 females, followed over 4 years. Since male survival significantly exceeded female survival at Monterey

Bay and only males were modeled, we present only estimates for male adults, for the Monterey Bay, Oregon and San Diego study populations.

We fit a two-age class model for male adult survival, in which the first age class covers the first year after first capture, and the second age class covers all subsequent years. Estimates of survival for the first age class can be biased due to behavioral responses to trapping and banding, lower site-fidelity among some first-time captures, and other methodological difficulties. These biases do not apply to survival after the first year of banding (Pradel *et al*. 1997). For this reason, several studies have used only survival estimates from the second age class (e.g., Gaston 1992, Johnston *et al*. 1997); we adopted the same practice.

A potential shortcoming of capture/recapture analyses of survival is that they cannot allow for permanent emigration, though they can allow for temporary emigration (Lebreton *et al*. 1992). A bird which moves permanently out of the study area cannot be distinguished from one that has died. The problem of permanent emigration can be overcome somewhat by enlarging the study area. In our analyses we compare survival estimates from three nested data sets, which differ only in the spatial and temporal extent of resightings. The most restricted data set included only resightings from birds seen during the breeding season in the same study area. In the next, more comprehensive data set, resightings of color-banded birds at other study areas were also included. In the most extensive data set, resightings during the entire year were included, as well as resightings at other study areas. The extent to which survival estimates differ among the three data sets provides insight into the magnitude of the problem of dispersal (permanent emigration).

Male survival estimates for Monterey Bay, for 2nd-year and older adults, were 74, 74, and 75 percent for the three data sets (Table D-1A). In other words, survival estimates differed slightly depending on the spatial extent of coverage and whether winter observations were included. Increasing the study area for Monterey Bay birds (either spatially or through observations outside the breeding season), increased the survival estimates by up to 1 percent. This implies that 1 percent of the individuals, inferred to be dead if observations are only from one study area and only during the breeding season, are inferred to be alive using the data from the enlarged study area. These results suggest that amount of dispersal out of the original study area is not negligible but it is also not great. Since not all breeding areas of Pacific coast snowy plovers are adequately surveyed for color-banded birds, we assume that there was additional, **undetected** dispersal out of the study area on the order of 1 percent. If so, then the true adult survival rate is 76 percent.

For the Oregon study population, male survival values were 74 to 75 percent, i.e., nearly identical to those from Monterey Bay (Table D-1A). Estimates for San Diego are somewhat lower, at 71 percent, but the difference between the San Diego estimates and those from Monterey Bay is no greater than the standard error of these estimates (Table D-1A). Among all three sites, survival estimates did not differ to a statistically significant degree. In the population viability analysis, we assume a survival rate of 76 percent for all subpopulations, but also model population trajectories with an adult survival of 75 percent and 77 percent, for all subpopulations. Capture/recapture analyses of Atlantic coast piping plovers resulted in a survival estimate of 74 percent (Melvin and Gibbs 1996). Paton (1994) analyzed survival for Great Salt Lake snowy plovers over a 3-year period. Survival rates were pooled over the two sexes (unlike our analyses), and differed among years, ranging from 58 percent to 88 percent, with median survival = 73 percent. Thus, survival values from other plover studies are consistent with the survival values used here.

Finally, the year to year variation in male survival for Monterey Bay was estimated to be 5.65 percent (standard deviation). We used this parameter value in our simulations, for all six subpopulations. Note that "catastrophic mortality" (see below), represents additional temporal variation.

Juvenile survival - Table D-1B shows survival estimates for first year birds (from fledging to 12 months of age), by study population and data set. Sample sizes were 1069 fledged young at Monterey Bay, 207 at Oregon and 102 at San Diego. Results were very similar at Monterey Bay and San Diego; Oregon values were somewhat higher but not statistically divergent from Monterey Bay. We therefore used juvenile survival estimates for Monterey Bay for all subpopulations. The different estimates for Monterey Bay, depending on the data set, were 39 percent, 44 percent and 45 percent. Note that for Monterey Bay as we expand the data from just 1 study site to a large network of sites, the survival estimate increases by 5 to 6 percent in absolute terms, and by 15 percent in relative terms. Compare this to the increase in adult survival estimates by 1 percent for the same series of nested data sets (see above). Thus, it is clear that there is quite a bit of dispersal among first-year birds. Undoubtedly, we are still underestimating survival because of permanent emigration. Therefore, we increased the survival estimate to 50 percent. This would imply that among 100 fledged young, 50 survive to age 1, but of these only 39 are inferred to survive based on observations at the single study population, with 11 out of 50 surviving juveniles (or 22 percent) dispersing out of the single study population. This estimate of dispersal is consistent with that directly observed and included in the population viability

analysis (see below). Annual variation in juvenile survival (obtained from Monterey Bay) is also shown in Table D-1B.

Reproductive Success - Here we had empirical data for three study areas, corresponding to three subpopulations (Table D-1C). For Monterey Bay, reproductive success was 0.849 fledged young reared per breeding male in years without predator control and without any exclosures, versus 1.105 fledged young per male in years with predator control and with exclosures. Reproductive success was similar but slightly lower (= 1.04 chicks per male) in Oregon, where intensive management has occurred in all years for which we had data; estimates for Oregon and Monterey Bay are not statistically significantly different for years in which predators were managed. Reproductive success at the San Diego study area, where some (indirect) management activities are thought to have some protective effect on breeding snowy plovers, is a little more than that observed at Monterey Bay without any management activity, but substantially, and significantly, lower than that observed at Monterey Bay and Oregon with management activity.

Simulations assuming that protective management continues in MB and OR, used the respective, current reproductive success values of 1.105 and 1.04 fledglings per male. For SD we did not use the observed reproductive success of 0.917 chicks per male, because this would have produced a subpopulation that (in the absence of net immigration) would have declined at 1.8 percent per year. Such a decline would have been inconsistent with observations and window surveys, which indicate a relatively stable or perhaps increasing SD subpopulation since 1995. Therefore, for the SD subpopulation, we assume that with current management practices continuing, reproductive success is 0.988 chicks per male, a value that produces a numerically stable subpopulation in the long-term (given the other demographic parameter estimates and assumptions). Reproductive success estimates for San Diego were based on only three years of data, and the overall mean of 0.917 may have underestimated the long-term, expected reproductive success.

In the scenarios below we use Monterey Bay past reproductive success (in the absence of intervention) for NC and SFB; i.e., we use that as a best estimate for reproductive success in the absence of predator control/exclosures. We also assume that if management activities cease in MB, OR, and SD regions then reproductive success will be at 0.849 fledged young per male, as well.

For the SLO subpopulation there was considerable uncertainty regarding the appropriate reproductive success value to use. Window surveys indicate that snowy plover numbers have fluctuated over time, with no clear trend discernible, except that, whatever the trend, it is not increasing. At best, the SLO subpopulation might be considered stable; at worst the subpopulation is declining. On that basis, we considered there to be an "optimistic" and a "pessimistic" reproductive success value. The optimistic value is that level of reproductive success which would produce a stable, self-sustaining population (given all other assumptions); that value is 0.988 (the same value used for the SD subpopulation). The pessimistic value is 0.849 chicks per male, the same as used for NC and SFB subpopulations. A third possibility is to use an intermediate value (the mean of the optimistic and pessimistic values = 0.919 chicks per male). In our simulations, we consider all three possibilities, to demonstrate the sensitivity of model results to assumptions about SLO reproductive success. However, in all but two series of simulations, we use the intermediate reproductive success value of 0.919 fledged chicks per male, which in the long-term (given other parameter estimates and assumptions) would produce a population decline of 1.8 percent per year.

For annual variation in reproductive success we used a value of 0.157 (standard deviation.), which is the variation observed in reproductive success at Monterey Bay from 1992-1997. We also note that annual variation in reproductive success among the 3 sites showed weak but not significant correlations. In the scenarios below we assume that all demographic parameters show weak positive correlations (r = + 0.10 between pairs of subpopulations).

RAMAS/METAPOP allows one to add "catastrophic mortality" over and above "regular mortality." Catastrophic mortality can include both reproductive failure and changes in survival of juveniles and adults. It is not clear that snowy plovers suffer from catastrophic mortality (none was apparent in the data sets analyzed), yet we should not rule it out. On the basis of recommendations of the Snowy Plover Recovery Team our simulations include additional mortality due to reproductive failure (see below). We also compare simulations with and without this additional catastrophic mortality.

Dispersal - There are qualitative data indicating dispersal, especially of first-year birds, to/from all three intensively studied areas (Monterey Bay, Oregon, and San Diego). The only extensive quantitative data are from Monterey Bay. These data indicated that 21 percent of individuals hatched in Monterey Bay and later observed breeding, were known to breed in areas other than at Monterey Bay. Results from the SURGE analyses of juvenile survival implied a similar

dispersal rate of 22 percent among surviving juveniles (see above). Individuals observed dispersing were seen as far north as Washington and Oregon, and as far south as SLO, but none in the sample were observed going to SD. However, there have been additional observations of Monterey Bay individuals dispersing to SD. Meanwhile, dispersal from SD (43 individuals born at San Diego), indicated a small percentage going to SLO. Using these results, we assumed the following: a general dispersal rate of 25 percent for first-year males; adult males are assumed not to disperse. In other words, we assumed that the total number of birds dispersing exceeded the number known to have dispersed; i.e., some birds dispersed but were undetected. The exception to these assumed dispersal rates was for the most northern subpopulation (OR, which includes Washington) and the most southern, SD. For these, dispersal rates were assumed to be 20 percent, allowing for reduced dispersal from subpopulations, located on the edge of the metapopulation.

We also assumed dispersal was constant, in the absence of information to the contrary. Thus, dispersal did not increase or decrease as subpopulation size increased or decreased. There is little information on dispersal rates in relation to population characteristics for other, similar species (Nur and Sydeman *in press*). For example, a study of Roseate Terns (*Sterna dougallii*; Spendelow *et al*. 1995) found no relationship of dispersal rates to colony size (either colony of origin or colony of destination). RAMAS/GIS does not allow for stochastic variation in dispersal rates among years. Note also, that the metapopulation model does not include dispersal to or from Baja California. This is equivalent to assuming that the number of immigrants from Baja California to the metapopulation equals the number of emigrants dispersing to Baja California. This assumption of balanced dispersal to and from Baja California may be unrealistic, but we had no data on which to develop a metapopulation model which incorporates Baja California.

To demonstrate the impact of a change (or uncertainty) in dispersal rates, we also carry out simulations in which dispersal rates are reduced by 50 percent and by 100 percent.

Additional Assumptions

Density Dependence - Not much is known about this, for any bird species. Following input from Snowy Plover Recovery Team members, we assume a limit on availability of beach habitat, i.e., that there is a region-specific limit on adequate nesting sites. Based on information provided by the recovery team, we estimate the limit, or ceiling, of breeding snowy plovers to be:

Subpopulation	Ceiling size
OR	300
NC	200
SFB	500
MB	500
SLO	1600
SD	550

These ceilings are about 80 percent greater than current numbers, and are similar to, or slightly in excess of, estimates of target population size, obtained by snowy plover Recovery Team biologists, on a site by site basis (see Appendix B). A realistic assumption is that ceilings represent the maximum number of individuals that can successfully breed for each subpopulation. Under such an assumption, individuals in excess of the ceiling are still alive but cannot breed successfully in the current year. However, such an assumption cannot be implemented by RAMAS/GIS 2.0. Therefore, we made a more restrictive (and admittedly less realistic) assumption: individuals in excess of ceiling numbers do not survive the current year. This imposes a hard limit on maximum number of individuals in each subpopulation. Note that the metapopulation only reaches ceiling levels under Scenarios 17-19; in the other Scenarios, the metapopulation declines and/or is well below ceiling levels. Note also that there is no decrement in survival until the breeding population size **exceeds** the ceiling for that subpopulation.

Catastrophic Mortality - There is at present no evidence of catastrophic mortality in snowy plovers, but the 1998 El Niño may prove otherwise[1]. Though it may seem desirable to include catastrophic mortality, the problem is that we have no idea of its magnitude or frequency of occurrence. Thus any quantitative results (when this is included) depend entirely on the assumptions made. On the basis of input from Snowy Plover Recovery Team members we assume catastrophic mortality in the form of "reproductive failure." We assume that catastrophes occur, on average, once every 20 years (i.e., in each year with 5 percent probability), and that in a catastrophe year reproductive success is reduced to 50 percent of what it "normally" would have

[1] It is believed that snowy plovers suffered unusually high winter mortality in the 1998 El Niño and the subsequent La Niña. Point Reyes Bird Observatory plans to examine this issue when appropriate data have been incorporated into the survivorship database (Gary Page, Point Reyes Bird Observatory, pers. comm. 2001).

been. Note that model results are identical whether reproductive success itself is impacted, as part of catastrophic mortality, or whether juvenile survival is impacted. Catastrophes were assumed to occur independently of one another (i.e., the reproductive failure is specific to a subpopulation). We also consider a scenario with no catastrophic mortality and one in which catastrophic mortality includes reduction in adult survival (50 percent reduction compared to "normal" levels of survival, with a 5 percent probability per year) in addition to catastrophic reproductive failure.

All one-year-olds breed - This may be an overestimate but not likely by much; available field data (PRBO, unpubl.) indicate that the actual percent of males breeding is close to 100 percent. If we allow for less than 100 percent breeding among one-year-olds (or even among older adults), then results presented would be more pessimistic.

Weak, positive environmental correlations among subpopulations - This is a compromise between assuming strong correlations (for which there is no evidence) and assuming no correlation (which at least for survival would seem **unlikely**). Empirical data on reproductive success supports the assumption of weak, positive correlation among subpopulations.

Extinction Threshold

The Atlantic coast Piping Plover Recovery Plan had an objective of keeping the probability of extinction below 5 percent for the entire (meta)population in the next 100 years (U.S. Fish and Wildlife Service 1996). A scenario in which Pacific coast snowy plovers fall to a few individuals should not, in our opinion, be considered acceptable. Therefore, we consider the endpoint of "quasi-extinction," defined here as 50 individuals, rather than extinction itself (Burgman *et al*. 1993). This follows recommendations of Beissinger and Westphal (1998) and others. If there were as few as 50 individuals we expect that extreme measures would be undertaken to prevent extinction, such as captive breeding (as was the case for the California Condor). Also, an effective population size (N_e) of 50 individuals is considered close to the threshold number below which genetic and demographic forces combine, in the absence of intervention, to produce an "extinction vortex" (Gilpin and Soule 1986). It is difficult to determine what is the actual population size that corresponds to an effective population size of 50; for simplicity, in the results we present the probability that actual population size decreases below 50 individuals, but we recognize that N_e is always less than actual population size.

Results

Deterministic Results

With 76 percent adult survival, 50 percent juvenile survival, and fecundity = 1.105 (see above), the geometric rate of population growth (lambda) is 1.036, or 3.6 percent increase per year. All results in this section assume no stochastic effects (which are treated below) and in particular no catastrophic mortality. With 75 percent adult survival, and all other values the same, the growth rate decreases to 2.6 percent per year (lambda = 1.026). To produce a population growth rate of 1.0, requires 0.964 fledged young/male assuming 76 percent adult survival and 50 percent juvenile survival; if adult survival is 75 percent, 1.003 fledged young/male are required. Note that increasing fecundity by 0.037 chicks per male has an effect equivalent to increasing adult survival by 0.01 (i.e., decreasing adult mortality by 0.01, or 4 percent in relative terms).

Sensitivity analysis for Deterministic Results

A change in adult survival of 0.01 (0.75 to 0.76), produces a change in lambda of 1.0 percent. A change in fecundity of 8 percent (in relative terms), e.g. from 1.00 to 1.08, changes lambda by 2.24 percent. The same is true for a change in juvenile survival, e.g., increasing juvenile survival from 50 percent to 54 percent, changes lambda by 2.24 percent. Clearly, a small difference in adult survival (e.g., 1 percent) can have a substantial impact on population trajectory, especially over a 100-year time period.

Stochastic Results

We present results from 19 different scenarios for the Pacific coast Snowy Plover metapopulation. Each scenario differs with respect to one or more demographic parameters, or starting population size, or other assumptions (e.g., catastrophic mortality). In all cases, results from 400 replications of each scenario are shown. Scenario 1 is for **"Status Quo"** conditions: current values for reproductive success, etc., are assumed to continue indefinitely, i.e., management activities continue in OR, MB, and SD. Scenario 1 uses our best estimates for the suite of demographic parameters outlined above. This includes 76 percent adult survival and catastrophic reproductive failure, but no other catastrophic mortality. Results for Scenario 1 are summarized in Tables D-2A and D-2B. The overall trajectory for the metapopulation is shown in Fig. D-1A; shown also are the highest and lowest values obtained in the 400 simulations (depicted with diamonds), the mean outcome and also outcomes that are plus or minus one standard deviation. Thus, about 16 percent of outcomes will be above the mean + 1 S.D. level and about 16 percent of outcomes will be below the mean - 1 S.D. level. Furthermore, about 68 percent of outcomes, on average, will be within +/- 1 S.D. of the mean. We also depict two

examples of representative population trajectories, out of the total of 400 simulations (Fig. D-1B).

We see that even with continued levels of ongoing management into the future, the prognosis is for a slowly-decreasing metapopulation, one that, on average, declines at 0.92 percent per year (Table D-2A). After 100 years, the metapopulation can be expected to be 39 percent of its original size. The probability that the metapopulation will increase in 100 years is essentially zero (Fig. D-1A). On the other hand, the probability of quasi-extinction (fewer than 50 individuals) is also zero. Fig. D-1C depicts the probability of the metapopulation declining below specified levels. For example, there is a nearly 100 percent chance of declining below 1800 individuals (compared to the estimated 1950 at present), but only a 1 percent chance of declining below 200 individuals. The probability of at least a 50 percent decline after 100 years is 72 percent (Table D-2B). Results for individual subpopulations after 100 years are shown in Fig. D-1D; these show that, in almost all simulations, all six subpopulations are likely to persist for 100 years, but in some cases at very low levels (close to zero).

Sensitivity Analysis of Stochastic Results

In this section, we carry out a sensitivity analysis with respect to demographic parameters. We examine the effect of a change in one parameter (adult survival, juvenile survival, reproductive success, dispersal, or catastrophic mortality) on the future trajectory of the metapopulation, compared to Scenario 1. Such comparisons provide insight into the sensitivity of model outcomes to the assumptions made regarding each parameter, as well as providing insight into the response of the metapopulation to a change in a demographic parameter, either due to environmental alteration or to an anthropogenic effect.

Change in Adult Survival - In Scenario 2 adult survival is assumed to be 75 percent; all other parameter values and assumptions are as in Scenario 1. Compared to Scenario 1, the metapopulation declines at a faster rate - 1.59 percent per year, on average (Fig. D-2, Table D-2). After 100 years, the metapopulation will have declined on average by 80 percent (Table D-2A). The probability of quasi-extinction is 2.8 percent (Table D-2B), with an approximate 95 percent confidence interval about that estimate of 0 to 7.2 percent. There is nearly 100 percent probability that the metapopulation will decline by at least 32 percent after 100 years. The probability of at least a 50 percent decline after 100 years is 96 percent. These results confirm that a small change in adult survival can have potent effects on the long-term metapopulation trajectory. Scenario 3 demonstrates the sensitivity of results to a 1 percent increase in adult

survival. The metapopulation is still expected to decline, but at an even shallower rate compared to Scenario 1 - on average 0.46 percent per year, and 37 percent after 100 years (Table D-2A). The chance of any decline at all after 100 years is reduced to 96 percent. It would require a greater increase in adult survival (to above 78 percent) to produce a metapopulation whose long-term trajectory is essentially stable (Results not shown).

Change in Juvenile Survival - We consider two alternative scenarios. In Scenario 4, juvenile survival is reduced by 10 percent in relative terms, i.e., a reduction of .05 in absolute terms, from 0.50 to 0.45 probability of surviving. A difference in survival of 0.05 is not unreasonably large; it is less than the standard error of the most precise estimate available for juvenile survival (Table D-1). 0.05 is also the quantity by which we incremented the Monterey Bay juvenile survival estimate to account for permanent emigration. Results (Fig. D-3A, Table D-2) under this scenario depict a metapopulation that is quickly declining (at 2.8 percent per year, on average) and quickly approaches critical levels. Under Scenario 4, there is a 42 percent chance of quasi-extinction. The probability of a 50 percent decline is essentially 100 percent. In fact, in 50 percent of the simulations, the metapopulation declines by 96 percent or more.

Scenario 4 shows the stark effects of a 10 percent relative change in juvenile survival. But what about the impact of more subtle changes in juvenile survival? To answer that question, in Scenario 5, we consider a 4 percent decrease, in relative terms, of juvenile survival, from 0.50 to 0.48. Note that from the point of view of a change in **mortality** (rather than survival), a change in juvenile survival from 0.50 to 0.48 implies a 4 percent relative increase in mortality, just as does a change in adult survival from 0.76 to 0.75. Results (Table D-2, Fig. D-3B) in this scenario demonstrate a metapopulation that declines with 100 percent probability, with an average decline of 1.5 percent per year, and a 78 percent decline after 100 years. Moreover, in 100 percent of simulations metapopulation size decreased by at least 26 percent. However, the probability of quasi-extinction is low, 3.5 percent (Table D-2B). We conclude that relatively small changes in juvenile survival will have sizeable impacts on long-term population trends, but will not have large effects on quasi-extinction probabilities.

Change in Reproductive Success - In the age-structured model used in the population viability analysis, a change in juvenile survival of *k* percent is exactly equivalent to a change in reproductive success (fledglings per male adult) of *k* percent. This is because only the product of juvenile survival x reproductive success is modeled. Hence, Scenarios 4 and 5 (discussed above) demonstrate the effects of a 10 percent and 4 percent change, respectively, *in reproductive*

success, just as they do for a change in juvenile survival. We also consider sensitivity of model results to assumptions about reproductive success of just the SLO subpopulation. In Scenarios 1-5 above, an intermediate value of reproductive success was assumed for the SLO subpopulation (0.919 fledged young per male). Scenario 6, instead, assumes an optimistic value of 0.988 fledged chicks per male; i.e., that value of reproductive success which would produce a stable, self-sustaining population in the absence of immigration and emigration. Scenario 7, instead, assumes a pessimistic value of 0.849 fledged chicks per male; i.e., the same reproductive success as assumed for NC and SFB and as observed in Monterey Bay in the absence of intensive management. Results are summarized in Tables D-2A and D-2B. The effect of a 7.5 percent relative change in SLO reproductive success, either an increase (Scenario 6) or a decrease (Scenario 7), is fairly minor. For example, comparing Scenarios 1 and 6, lambda for the metapopulation increases slightly from 0.9908 to 0.9926, a difference of less than 0.2 percent (Table D-2A). The chance of a 50 percent decline for the metapopulation decreases from 72 percent (Scenario 1) to 59 percent (Scenario 6) (Table D-2B). Similarly, comparisons of Scenarios 7 and 1, indicate only minor differences (Table D-2). We conclude that, though reproductive success for SLO cannot be estimated with great certainty, results of the population viability analysis are not very sensitive to assumptions made regarding this parameter, providing they are within a reasonable range (bounded by the optimistic and pessimistic values considered).

Change in Catastrophe - Scenario 8 assumes no catastrophic reproductive failure at all. Compared to Scenario 1, the effect of eliminating catastrophic reproductive failure is to increase lambda slightly, by 0.3 percent (0.9938 instead of 0.9908; Table D-2A). However, the absence of catastrophic failure results in a substantial reduction in risk of metapopulation decline, from 72 percent chance of a 50 percent decline to a 42 percent probability in Scenario 8 (Table D-2B). An even larger impact on the risk of metapopulation decline is observed in Scenario 9, in which catastrophic mortality of adults is added to catastrophic reproductive failure in years of catastrophe. In Scenario 9, lambda decreases substantially, to 0.9763 (Table D-2A). Under this scenario, we expect, on average, a 91 percent decline in metapopulation size. In addition, the risk of quasi-extinction is 29 percent, with a 99 percent probability that the metapopulation decreases by at least 50 percent after 100 years (Table D-2B). These results demonstrate that a relatively rare catastrophic event (5 percent probability per year) can have a large long-term effect on population growth and risk, if it entails a substantial increase in adult (and possibly juvenile) mortality. If catastrophes are as common as is assumed in Scenario 9, then the risk of metapopulation decline will be severely underestimated by any model which does not incorporate catastrophes.

Change in Dispersal - Here we consider the impact of a 50 percent and a 100 percent decrease in dispersal rates (Scenarios 10 and 11, respectively). That is, in Scenario 10 all dispersal rates were reduced by 1/2, and in Scenario 11, we assumed no dispersal whatsoever among subpopulations. The dynamics of the metapopulation as a whole were not much affected by even large changes in dispersal rates (Tables D-2A and D-2B). With a 50 percent reduction in dispersal (Scenario 10), the population growth rate increased slightly to lambda = 0.9914, that is, the metapopulation declined at an average of 0.86 percent per year instead of 0.92 percent (Scenario 1). The probability of quasi-extinction remained essentially zero, and the probability of a 50 percent decline after 100 years was little changed (71 percent instead of 72 percent for Scenario 1). Even when dispersal was eliminated the dynamics were not altered greatly. In the latter case, lambda decreased to 0.9906, almost identical to that observed in Scenario 1. The probability of a 50 percent decline after 100 years increased somewhat, from 72 percent in Scenario 1 to 79 percent in Scenario 11.

A 50 percent reduction in dispersal rates, also had only minor effects on the expected sizes of the six subpopulations after 100 years (Fig. D-4A; cf. Fig. D-1D). The most notable difference is an increased size of the MB subpopulation with reduced dispersal. With the elimination of dispersal, two subpopulations could be expected to go completely extinct with more than 50 percent probability, NC and SFB (Fig. D-4B). We conclude that within the likely range of dispersal rates, model results are not very sensitive to the exact parameter values used.

Changes in Management

We consider the impact of changes in management practice that may increase or decrease reproductive success. It is possible for changes in management practice to impact other demographic parameters, but we consider that possibility less likely.

Scenario 12 assumes "**No Management**". We assume cessation of management in OR, MB, and SD and that the other subpopulations continue as in the present (i.e., as in Status Quo, Scenario 1). In Scenario 12, reproductive success is assumed to be 0.849 chicks per male for OR, MB, and SD, just as it is for NC and SFB. All other parameter values are as in Scenario 1. The expected outcome under this Scenario is for the metapopulation to show a strongly declining trend (Fig. D-5A, Table D-2A). Likelihood of decrease below specified population levels (for the entire metapopulation) is shown in Fig. D-5B. The probability that the metapopulation will decline by at least 50 percent after 100 years is 100 percent. In fact, there is a 100 percent probability of at least a 77 percent decline (Fig. D-5B). The probability of quasi-extinction is 51

percent (Table D-2B). Clearly, the abandonment of management that protects snowy plovers is an unpalatable alternative.

Scenario 13 is a modification of Scenario 12. In Scenario 13, metapopulation size is assumed to begin with 3500 individuals, close to, and slightly in excess of, the number of individuals for which there is at present available beach habitat. One can imagine that intensive management resulted in an increase in snowy plover numbers until a population size of 3500 was reached, but that once reached, management activities ceased. In other words, Scenario 13 differs from Scenario 12 only with respect to starting population sizes. It is also assumed that with a metapopulation size of 3500, all ceiling values are increased by 10 percent (i.e., to 3850 breeding individuals). As expected, the metapopulation shows the same steep population decline as in Scenario 12 (Table D-2A). In one sense, all Scenario 13 does (compared to Scenario 12) is to buy some time for the metapopulation. After 21 years, the metapopulation has decreased from 3500 individuals to about 1950, the starting level for Scenario 5. After 100 years, the probability that the metapopulation has fallen below 50 individuals is 35 percent (cf. to 51 percent for Scenario 5). There is a 100 percent probability that the population will decline at least 85 percent. These results demonstrate that simply increasing population size is not a viable solution for the snowy plover metapopulation.

We next considered scenarios in which reproductive success is enhanced. In the next four scenarios we assumed that management continues in OR, MB, and SD, as it has, and that, therefore, fecundity and other parameter values continue as at present. In the first of these (Scenario 14), we assume that management activities in SLO (the largest subpopulation) results in an increase in fecundity to that obtained in MB now (i.e., 1.105 chicks fledged per breeding male). Results are shown in Fig. D-6, indicating that, on average, the population declines, albeit at a very slight rate (0.3 percent decline per year; Table D-2A). There is an 85 percent chance of at least some decline, and a 19 percent chance of a 50 percent decline (Table D-2B). The probability of quasi-extinction is zero.

In the next scenario (Scenario 15), it is assumed that management activities at SLO are not quite as effective, and that reproductive success can only be increased to 1.0 fledged chicks per male. In this case, population growth rate declines at, on average, 0.7 percent per year (Table D-2A). As a result, there is a 51 percent probability of at least a 50 percent decline, over 100 years. While, this result is an improvement over the results of the Status Quo scenario (Scenario 1), it would still not be considered a desirable outcome.

An alternative scenario (Scenario 16) is for management action to increase reproductive success in NC and SFB, with SLO remaining as it is now. Results of Scenario 16 are a slight decline, just as in Scenario 14 (0.3 percent decline per year; Table D-2A). However, results from this scenario indicate less variability of outcome (Fig. D-7) compared to Scenario 14, in which SLO reproductive success was enhanced. As a result, the probability of a 50 percent decline is only 6 percent (Table D-2B). The probability of quasi-extinction is zero.

Comparison of results from Scenarios 14 and 16 indicate that increases in reproductive success of either SLO or SFB and NC would be effective in stabilizing snowy plover numbers, and reducing the risk of substantial population decline in the future.

None of the scenarios presented above result in likely population increase. We therefore considered three additional metapopulation scenarios (Scenarios 17-19). In Scenario 17, management at SLO, NC, and SFB are such that all three subpopulations achieve fecundity of 1.105 chicks reared per breeding male (with the other three subpopulations as assumed above). Under this scenario the metapopulation does show an increase, but a surprisingly shallow increase: lambda = 1.0013 (Table D-2A), an annual growth rate of 0.13 percent per year. At the end of 100 years, the metapopulation is expected to grow by a total of 14.4 percent, on average. The relatively flat trajectory is surprising because we expected numbers to show an increase to close to ceiling levels, an 87 percent increase if all ceiling levels were attained. It turns out that some subpopulations achieved ceiling levels while others did not (Fig. D-8). Fig. D-8 demonstrates that (under assumptions of the model), OR, NC, SFB, and MB, were on average close to their ceiling levels, but SLO and SD are not. SLO and SD numbers would increase much further if excess individuals at other subpopulations (above ceiling levels) were to disperse to SLO and SD; however, such selective dispersal was not incorporated into the simulations, nor is it possible to do so using the RAMAS/GIS 2.0 program. Therefore, we consider the results from Scenario 17 to be somewhat unrealistic, since they incorporate unrealistic assumptions about dispersal when subpopulation size is at or near ceiling levels. A more sophisticated modeling program is required to incorporate assumptions about the dependence of dispersal on population size relative to population ceiling size.

Finally, we considered two scenarios in which population increase can be expected to reach 3000 snowy plovers within a 25 year period. In the first of these (Scenario 18), reproductive success is assumed to be 1.3 chicks per male for all subpopulations. This level of reproductive success is high, but attainable; in 1998, snowy plovers in the Monterey Bay study area achieved this level of

reproductive success. This scenario assumes that with sufficiently intensive management, all subpopulations will be able to achieve this level of reproductive success at some time in the future. Under this scenario, there is an 82 percent chance of the population reaching 3000 or more birds at the end of 25 years (see Table D-3). At first the size of the metapopulation increases rapidly, but the rate of growth slows down beyond year 10 (Fig. D-9), and then shows very slow growth beyond year 15.

The last scenario (Scenario 19) assumes that reproductive success of 1.2 chicks fledged per male is achieved for all subpopulations. Under this scenario, there is a 57 percent chance that the metapopulation will contain 3000 or more individuals after 25 years. The median outcome after 25 years is 3110 individuals, which is only 540 less than the overall maximum allowed for the metapopulation. Scenarios 18 and 19 demonstrate that there is a reasonably high probability of achieving at least 3000 birds within 25 years, provided that reproductive success averages 1.2 or more chicks per male over all subpopulations.

Discussion

In all modeling exercises, the results are sensitive to the assumptions. In this case we have tried to make assumptions explicit and we have examined the influence of the assumptions (or assumed values) on model results. The strength of the current analysis is that demographic estimates were based on data gathered from study populations within the Pacific coast metapopulation. An important feature of the population viability analysis is the use of a metapopulation structure that allows estimates for parameters to vary among subpopulations. We consider it highly desirable for population viability analyses to incorporate such flexibility.

Reproductive Parameters

That we could allow for subpopulation-specific parameters is a boon, yet the lack of available estimates for several of the subpopulations constitutes a drawback to the population viability analysis. In particular, no demographic parameter estimates are available for the SLO subpopulation, which is estimated to contain 45 percent of the entire metapopulation. Obtaining fecundity estimates for this subpopulation, as well as for NC and SFB, should be a priority. Even when we assumed that reproductive success in SLO was sufficiently high to produce a self-sustaining population, the metapopulation, on average, showed a decline at 0.74 percent per year, under the Status Quo conditions ("optimistic" scenario, Scenario 6). On the other hand, if reproductive success in SLO is as low as 0.849 chicks per breeding male ("pessimistic" Scenario,

Scenario 7) then the metapopulation would be expected to decline at a faster rate, at 1.1 percent per year. Though it would be desirable to obtain estimates from the SLO subpopulation itself, the sensitivity analyses demonstrated that results were not unduly sensitive to the estimate of reproductive success for this subpopulation, if SLO reproductive success was within the range of values modeled.

Dispersal

Theoretical studies have demonstrated that dispersal among subpopulations will reduce the chance of extinction of the metapopulation (Burgman et al. 1993, Harrison 1994), compared to a set of isolated subpopulations. In this case, we had reasonably good empirical data from the Monterey Bay study population, indicating dispersal rates of 20 percent to 25 percent among first-year birds. An area of uncertainty was whether dispersal rates varied with density (Beissinger and Westphal 1998). Recent observations of snowy plovers indicate that dispersal occurs at high and low densities, and therefore we did not include density-dependent dispersal in the modeling. However, there may be a threshold effect: once a breeding area (e.g., beach) is saturated, dispersal from that area may be enhanced. Future modeling could address this possibility, and its implications. Though our knowledge of dispersal was incomplete, it did not appear that model results were very sensitive to assumed dispersal rates. In particular, a 50 percent relative reduction in dispersal had almost no discernible effect on the metapopulation trajectory, persistence, or on subpopulation composition. This provides us with some confidence in model results despite the acknowledged uncertainty in dispersal rates.

Adult and Juvenile Survival

The sensitivity analysis (Scenarios 2-11) demonstrated a strong effect of inclusion of catastrophic mortality of adults. It is possible that the El Niño of 1998 will demonstrate such catastrophic mortality, but such a phenomenon cannot be demonstrated until completion of the 1999 breeding season, at the earliest. The sensitivity analysis also confirmed the sensitivity of metapopulation trajectory to moderately large changes in reproductive success and/or juvenile survival. We did not examine the sensitivity of results to a moderately large long-term change in adult survival, but even a small change (1 percent change in absolute survival) had a noticeable effect on metapopulation trajectory. Nevertheless, the probability of quasi-extinction was low whether adult survival was 75 percent (Scenario 2), 76 percent (Scenario 1), or 77 percent (Scenario 3). We conclude that, in general, the results shown are applicable, assuming that adult survival was between 75 percent and 77 percent. We consider it unlikely that adult survival was much lower than 75 percent. At the same time, there is no support for assuming that adult survival was

greater than 77 percent. Adult survival would have to be greater than 78 percent (Results not shown) to produce a metapopulation that is likely to grow, and even then it would only be growing slowly.

In most Scenarios, we assumed 50 percent juvenile survival. Though juvenile survival was surely at least 45 percent, it is debatable just how much greater it is than 45 percent. Thus, our results could be considered a bit liberal, or optimistic. If juvenile survival was actually lower than 50 percent (as in Scenarios 4 and 5) population trends would be more pessimistic.

Limitations to the Population Viability Analysis

There are several limitations to the population viability analysis. First, we did not include risk to the metapopulation due to genetic factors. Such a simplification (ignoring genetic factors) is consistent with recommendations of Beissinger and Westphal (1998). Genetics would become much more important to consider if metapopulation size would likely decrease to low levels, that is, 50 or fewer. However, population viability analysis results here indicate decrease to such low levels unlikely.

Second, we did not take into account an "Allee effect," which is a decrease in survival or reproductive success with a decrease in population size, usually due to social factors. For example, Allee effects can arise if individuals have difficulty securing mates when density is low. However, we believe that as long as metapopulation size remains at 50 or more (see above), Allee effects are not likely important.

The use of a packaged program (RAMAS/GIS) had the advantages of convenience, reproducibility, and general availability. Balancing that were limitations of that particular program. As already mentioned, dispersal was modeled at a constant rate and does not vary stochastically. Dispersal cannot vary with the size of the target population. Nor can one specify a constant number of dispersers. Thus, for example, one cannot specify balanced dispersal (dispersal from the population exactly equals dispersal to that population). Furthermore, with RAMAS/GIS dispersal cannot be modeled as a threshold phenomenon (e.g., dispersal only for those in excess of carrying capacity). Even if dispersal could be modeled in very sophisticated ways, we are limited by the lack of information regarding dispersal. Other limitations of RAMAS/GIS included the requirement that temporal covariation of population parameters is 100 percent. If it is a very good year for survival, the program assumes it is a very good year for reproductive success. There are many limitations on modeling density dependence with RAMAS/GIS. For example, we could not model a "ceiling effect" on reproductive success (i.e.,

individuals in excess of the ceiling do not reproduce), and had to assume that excess individuals were dead.

Tentative Conclusions

Results from this population viability analysis highlight the need for increased management of Pacific coast western snowy plovers and their habitats. Under status quo scenarios, even with intensive management in some areas, the population is almost certain to decline. Without question, ceasing current management efforts (area closures, predator exclosures, and predator control) would be disastrous for the Pacific coast population. The Snowy Plover Recovery Team, however, has identified population growth as a prerequisite to recovery. The most direct means to increase population size will be to enhance reproductive success throughout the western snowy plover range. The model suggests that productivity of **at least** 1.0 chicks fledged per breeding male per year should result in a stable population, if our estimates of adult and juvenile survivorship are accurate. Productivity of 1.2 or more chicks fledged per breeding male should increase population size at a moderate pace before growth slows as the metapopulation approaches its ceiling. Population growth would be hastened, of course, if survival of adults or juveniles can also be improved. Under this population growth scenario, the metapopulation could increase to 3000 individuals within the relatively short time span of 25 years. Recovery is plausible. It will require, however, short-term intensive management and long-term commitments to maintaining gains.

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Table D-1. Snowy plover demographic parameter estimates.

A) Percent adult male survival, for males, excluding first-year after banding.

	All Observations (including Winter)	Expanded Area (Breeding Season only)	Single Study Area (Breeding Season only)
Monterey Bay	74.7 ± 1.9	74.3 ± 1.9	73.7 ± 3.6
Oregon	74.5 ± 13	74.3 ± 8.5	73.6 ± 18
San Diego	71.3 ± 9.0	71.3 ± 9.0	71.3 ± 16

Notes: Observed between-year standard deviation in Monterey Bay = 5.65 percent; mean adult male survival used in the population viability analysis is 76 percent (also 75 percent and 77 percent, see text).

B) Percent Juvenile (1st Year) survival, post-fledging.

	All Observations (including Winter)	Expanded Area (Breeding Season only)	Single Study Area (Breeding Season only)
Monterey Bay	45 ± 15	44 ± 6.7	39 ± 12
Oregon	51 ± 40	49 ± 53	44 ± 65
San Diego	45 ± 22	43 ± 15	42 ± 16

Notes: Between-year standard deviation = 6.8 percent for Monterey Bay. Juvenile survival used in population viability analysis = 50 percent (also 48 percent and 45 percent, see text).

C) Fecundity (chicks reared to fledging, per adult male).

Study Population	Years	Mean	Between-year standard deviation
Monterey Bay w/o predator control	1984-1991	0.849	0.173
Monterey Bay w/ predator control	1992-1997	1.105	0.157
Oregon	1993-1997	1.040	---
San Diego	1995-1997	0.917	---

Table D-2. Summary of stochastic results, after 100 years (400 simulations each scenario).

A. Summary of long-term population trajectories.

Sce-nario No.	Description	Mini-mum	X - S.D.	Mean	X + S.D.	Lamb-da	Percent Change
1	Status Quo (SQ)	61	410	771	1131	0.9908	-61
2	SQ but 75 percent adult survival	0	127	391	654	0.9841	-80
3	SQ but 77 percent adult survival	182	817	1232	1647	0.9954	-37
4	Juvenile survival or reproductive success reduced 10 percent	0	5	118	231	0.9723	-94
5	Juvenile survival or reproductive success reduced 4 percent	3	134	437	740	0.9851	-78
6	SQ but optimistic SLO reproductive success estimate	28	511	930	1348	0.9926	-52
7	SQ but pessimistic SLO reproductive success estimate	28	306	639	972	0.9889	-67
8	SQ, no catastrophic mortality	147	669	1044	1419	0.9938	-46
9	Catastrophic mortality includes survival and reproductive failure	0	0	177	362	0.9763	-91
10	Dispersal reduced by 1/2	85	453	825	1196	0.9914	-58
11	No dispersal	7	448	757	1066	0.9906	-62
12	No management	0	5	86	166	0.9692	-96
13	Start with 3500 total; no management	0	16	116	215	0.9722	-94
14	Improve SLO reproductive success to 1.105 chicks	198	934	1445	1957	0.9970	-26
15	Improve SLO reproductive success to 1.0 chicks	80	560	975	1389	0.9931	-50
16	Improve NC and SFB reproductive success to 1.105 chicks	601	1138	1440	1742	0.9970	-26
17	Improve reproductive success at SLO, NC and SFB to 1.105 chicks	1018	1741	2230	2718	1.0013	14.4

Note: The last column shows mean total percent decline after 100 years, except for Scenario 17, for which percent increase is shown.

Table D-2. Summary of Stochastic Results, continued

B. Probability of Quasi-extinction and Probability of Specified Declines during 100 years.

Sce-nario No.	Description	Probability of Quasi-Extinction, percent[1]	Probability of any decline, as percent	Probability of 50 percent decline, as percent	Median percent decline[2]
1	Status Quo (SQ)	0	100	72	61
2	SQ w/ 75 percent Adult Survival	2.8	100	96	83
3	SQ w/ 77 percent Adult Survival	0	96	27	36
4	Juvenile Survival/reproductive success reduced 10 percent	42	100	100	96
5	Juvenile Survival or reproductive success reduced 4 percent	3.5	100	92	81
6	SQ + optimistic SLO reproductive success estimate	0.3	100	59	54
7	SQ + pessimistic SLO reproductive success estimate	0.3	100	83	69
8	SQ, no catastrophic reproductive failure	0	100	42	46
9	Catastrophic mortality includes survival and reproductive failure	29	100	99	94
10	Dispersal reduced by 1/2	0	100	71	59
11	No dispersal	0.3	100	79	64
12	No management	51	100	100	97
13	Start with 3500; no management	35	100	100	97
14	Improve SLO reproductive success to 1.105 chicks	0	85	19	26
15	Improve SLO reproductive success to 1.0 chicks	0.3	99	51	50
16	Improve NC and SFB reproductive success to 1.105 chicks	0	97	6	25
17	Improve reproductive success at SLO, NC and SFB to 1.105 chicks	0	30	0	12[2]

[1] - Standard error of the estimate of Probability of Quasi-extinction is $\pm$ 2.2 percent in all cases.

[2] - Median percent increase in total population size.

Table D-3. Summary of results for growth scenarios, at the end of 25 years.

Sce-nario No.	Description	Median outcome after 25 years, N	Probabi-lity of 3000+ after 25 years, percent	Population size reached after 25 years with 80 percent probability, N	Percent annual growth rate in first 15 years[1]
18	Improve reproductive success to 1.3 chicks per male in all subpopulations	3341	82	3018	3.35
19	Improve reproductive success to 1.2 chicks per male in all subpopulations	3110	57	2740	2.95

[1] - Annualized growth rate, calculated for first 15 years.

A

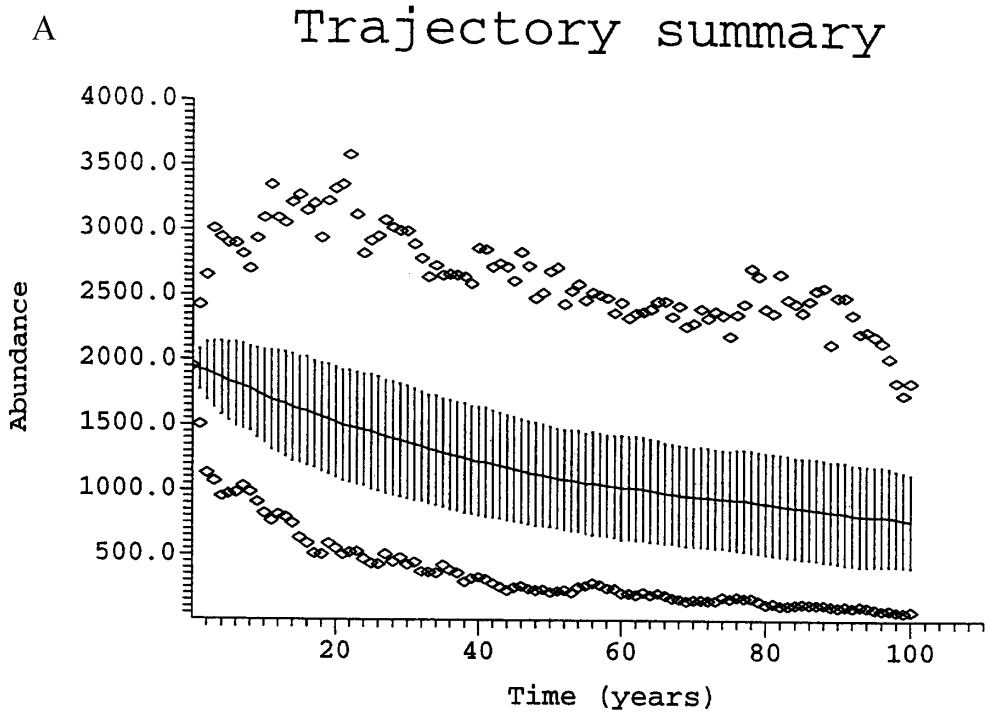
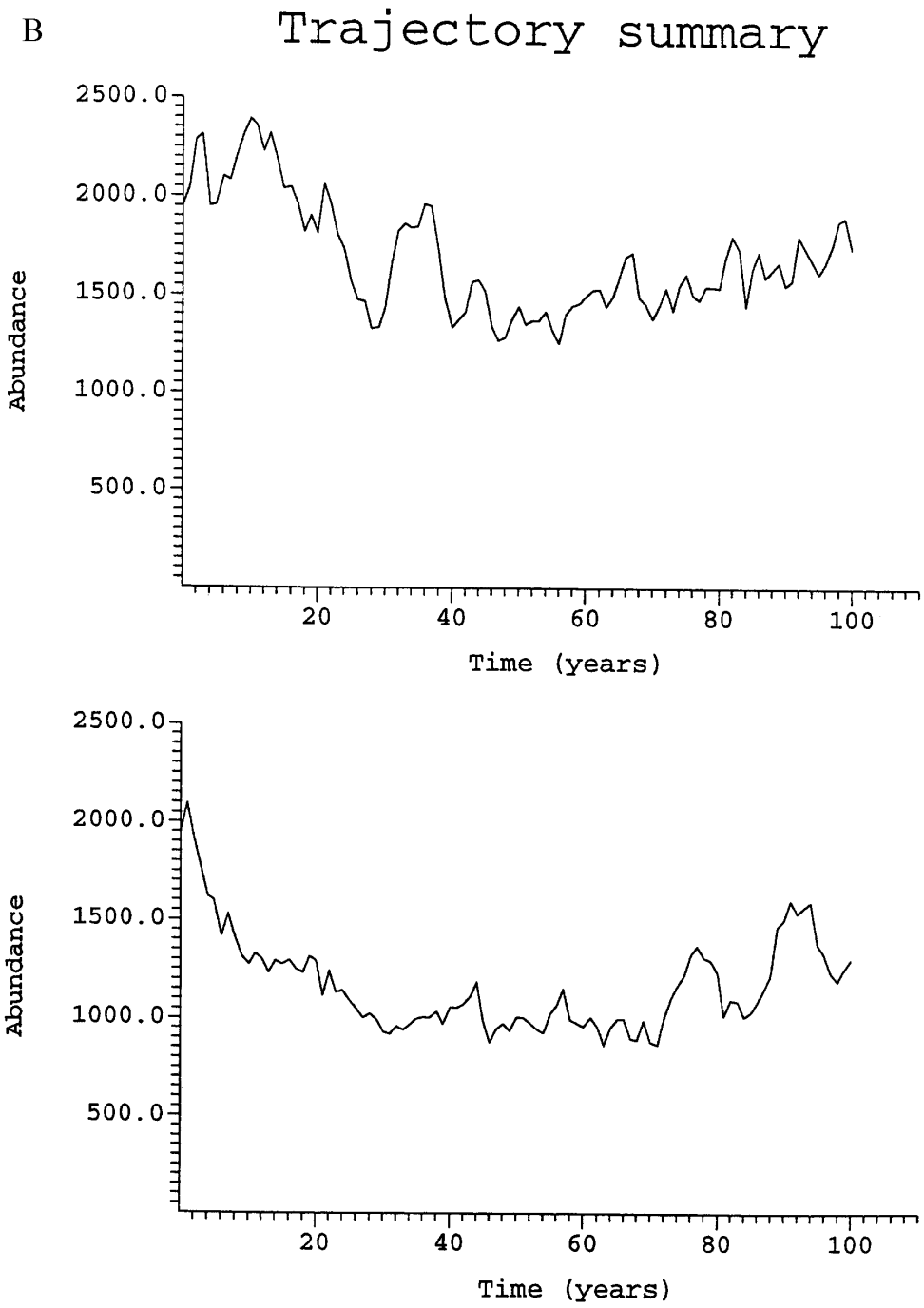
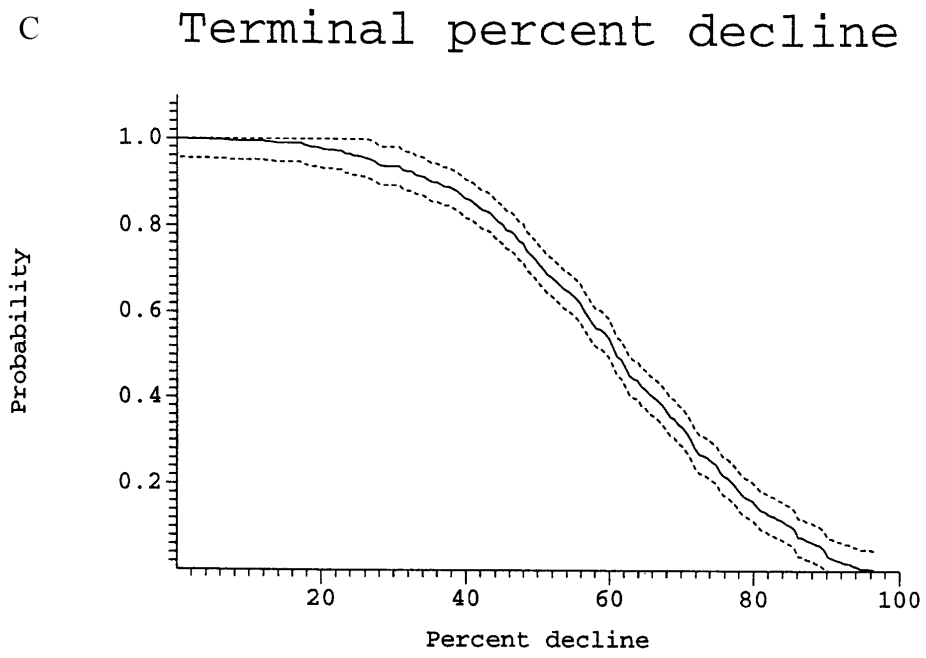


Figure D-1. Scenario 1: Status Quo (see text). A) Population trajectory for the metapopulation. Diamonds indicate maximum and minimum (400 simulations, total). Horizontal line indicates mean trajectory. Vertical lines connect mean +/- 1 standard deviation of outcome. B) Population trajectories for two sample simulations (among 400), under Scenario 1. C) Probability that after 100 years the metapopulation will have declined below specified level. Dotted lines indicate approximate 95 percent confidence interval. D) Abundance for each subpopulation (abbreviated as in text) at the end of 100 years. Bars indicate means, vertical lines with bars indicate + 1 standard deviation. Diamonds show maximum (among 400 simulations).

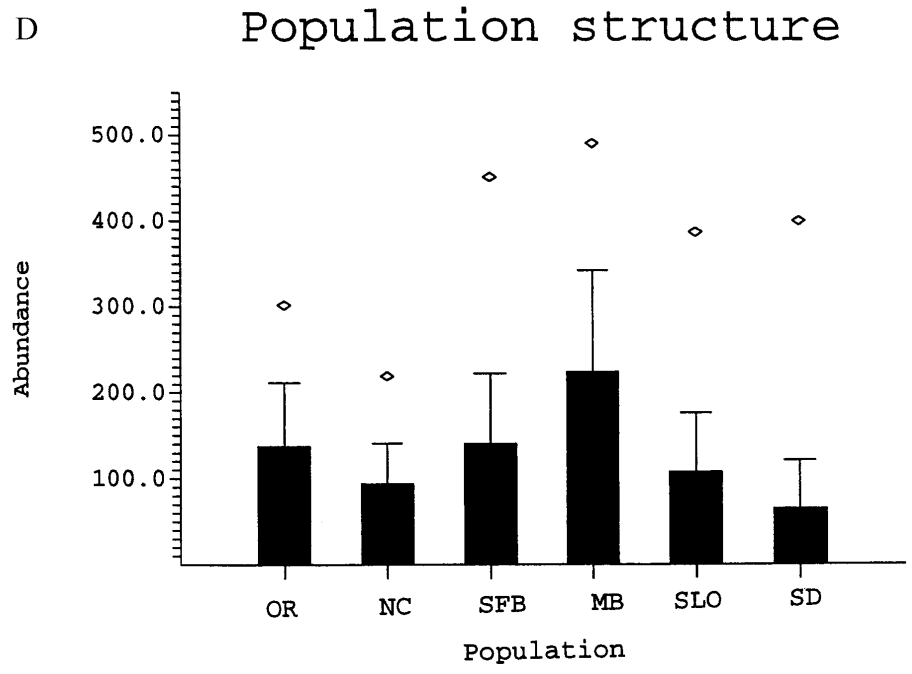
B


Trajectory summary
2500.0
2000.0
1500.0
1000.0
500.0
Abundance
20
40
60
80
100
Time (years)
2500.0
2000.0
1500.0
1000.0
500.0
Abundance
20
40
60
80
100
Time (years)

C


Terminal percent decline
Probability
1.0
0.8
0.6
0.4
0.2
20
40
60
80
100
Percent decline

D


Population structure
Abundance
500.0
400.0
300.0
200.0
100.0
OR
NC
SFB
MB
SLO
SD
Population

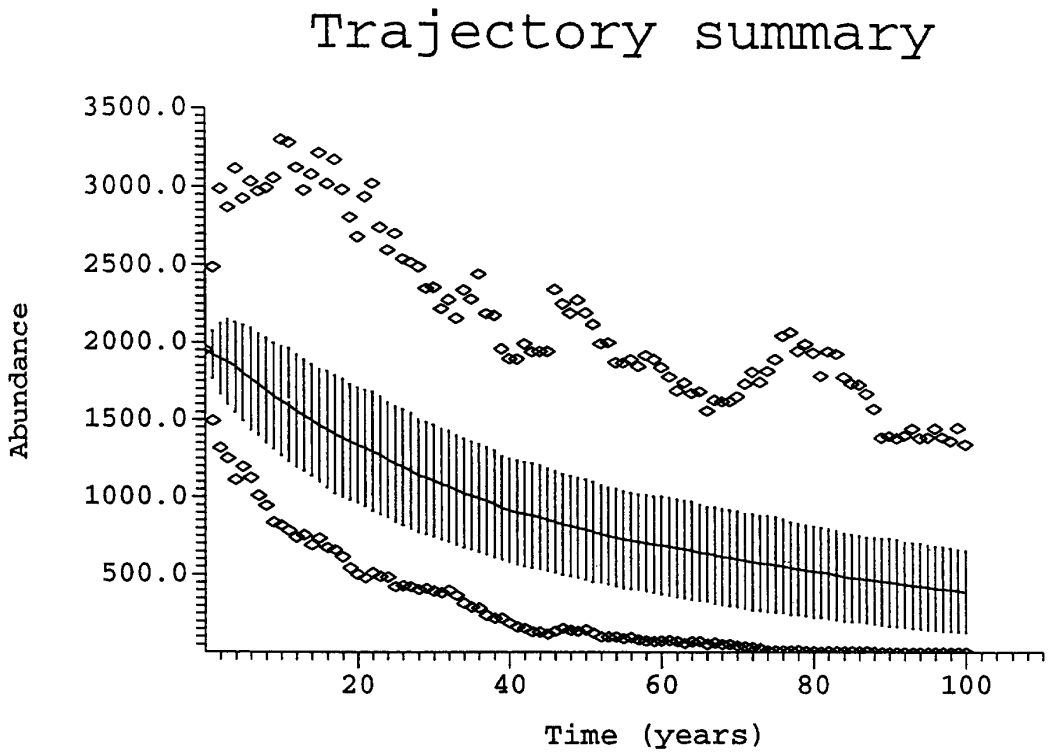


Figure D-2. Scenario 2: Status Quo with 75 percent adult survival instead of 76 percent. Population trajectory for the metapopulation. Diamonds indicate maximum and minimum (400 simulations, total). Horizontal line indicates mean trajectory. Vertical lines connect mean +/- 1 standard deviation of outcome.

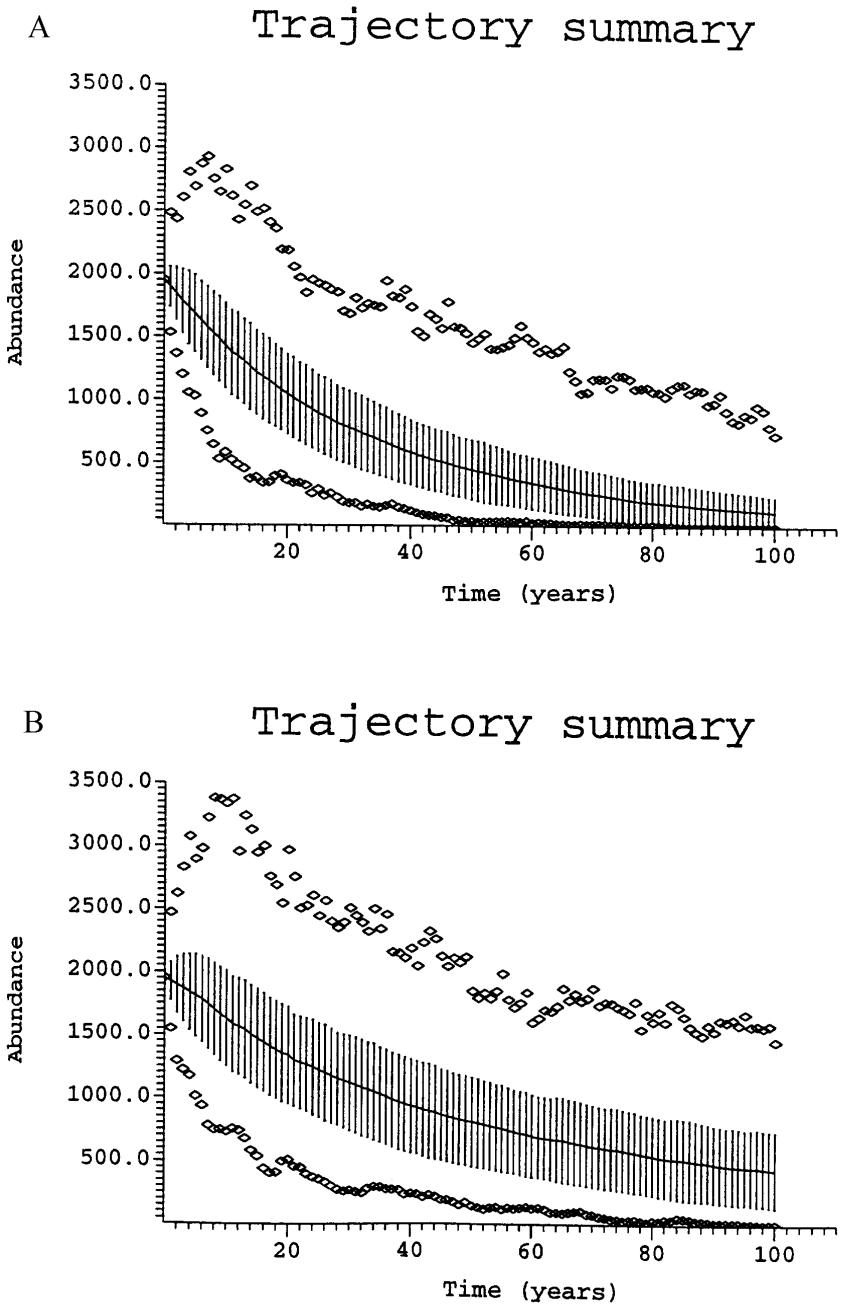


Figure D-3. Scenarios 4 and 5: Status Quo with reduction in juvenile survival (equivalently, reproductive success) by 10 percent (A) and by 4 percent (B). In each Figure panel: Population trajectory for the metapopulation. Diamonds indicate maximum and minimum (400 simulations, total). Horizontal line indicates mean trajectory. Vertical lines connect mean +/- 1 standard deviation of outcome.

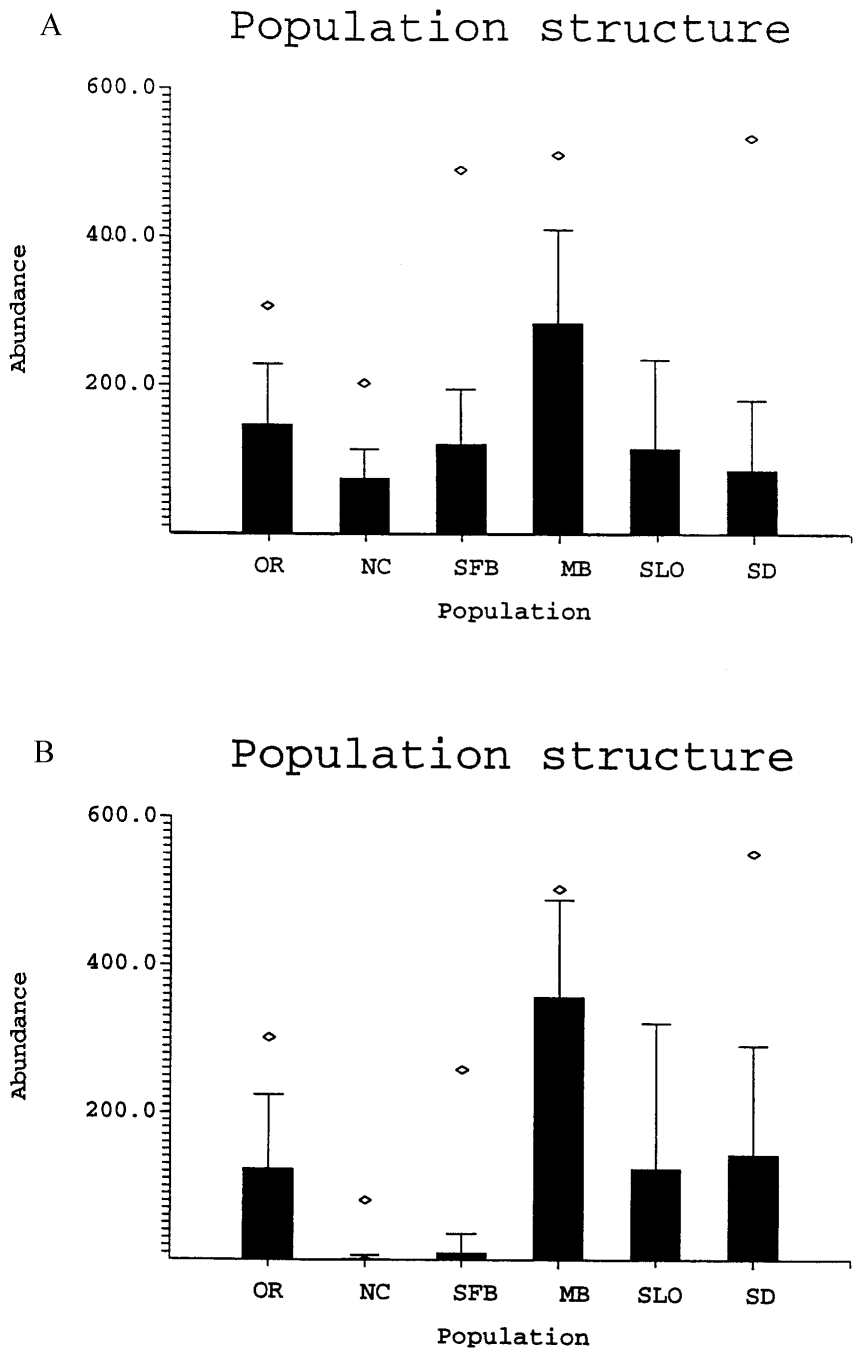


Figure D-4. Scenarios 8 and 9: Status Quo with reduction in dispersal. A) Dispersal reduced by 1/2 (Scenario 8). B) No dispersal (Scenario 9). For each Figure panel: Abundance for each subpopulation at the end of 100 years. Bars indicate means; vertical lines with bar indicate +1 standard deviation. Diamonds show maximum (among 400 simulations).

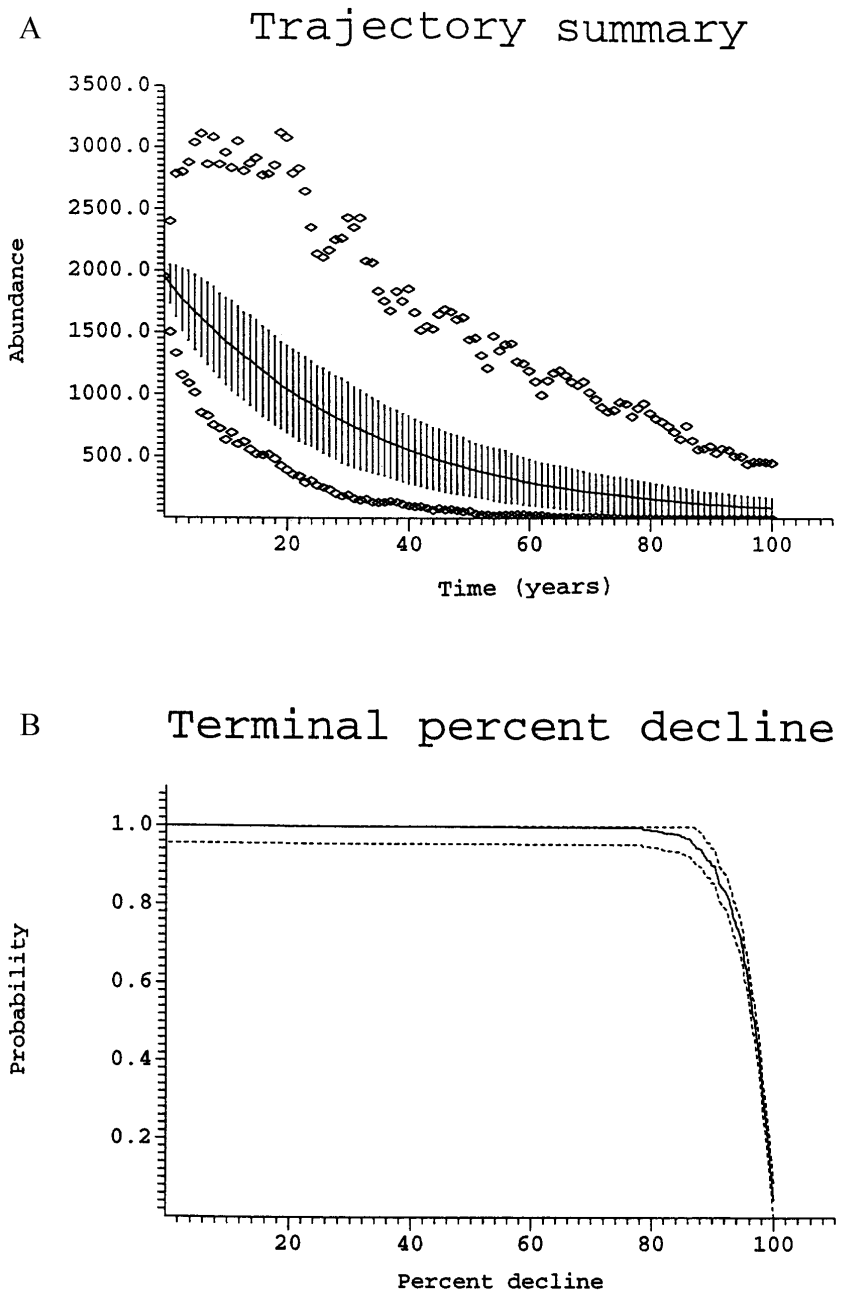


Figure D-5. Scenario 12: No Management. A) Population trajectory for the metapopulation. Diamonds indicate maximum and minimum (400 simulations, total). Horizontal line indicates mean trajectory. Vertical lines connect mean +/- 1 standard deviation of outcome. B) Probability that at the end of 100 years the metapopulation will have declined below specified level. Dotted lines indicate approximate 95 percent confidence interval.

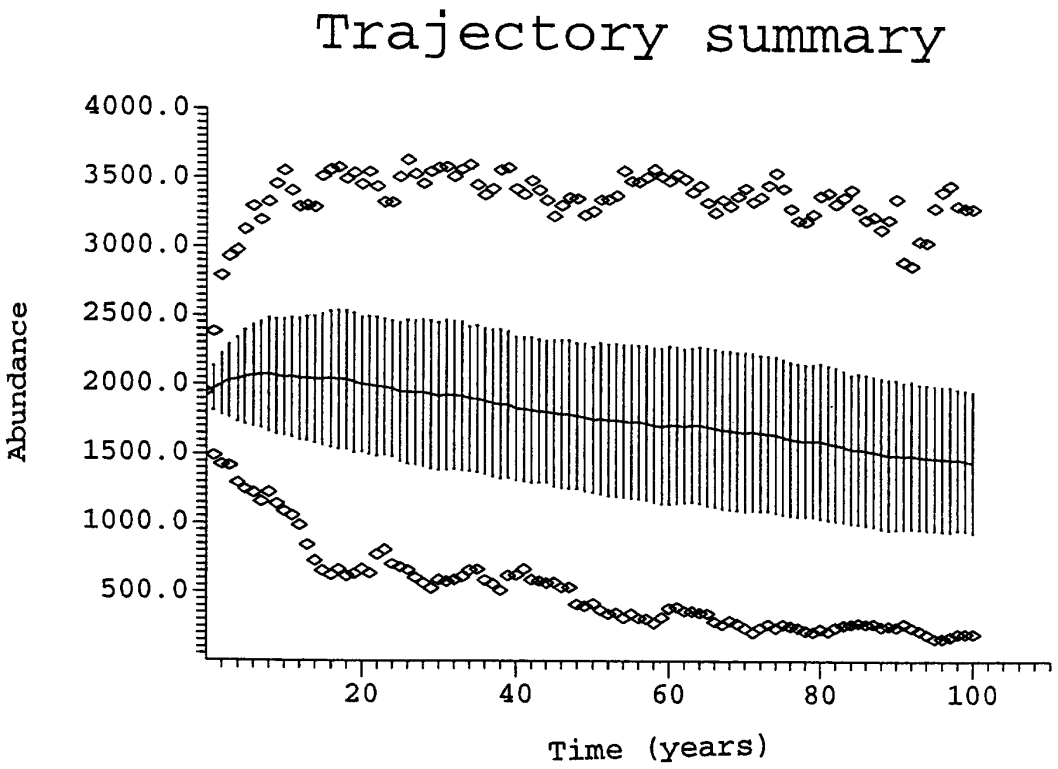


Figure D-6. Scenario 14: Improve reproductive success in San Luis Obispo/Santa Barbara/Ventura subpopulation and Status Quo elsewhere; see text. Population trajectory for the metapopulation. Diamonds indicate maximum and minimum (400 simulations, total). Horizontal line indicates mean trajectory. Vertical lines connect mean +/- 1 standard deviation of outcome.

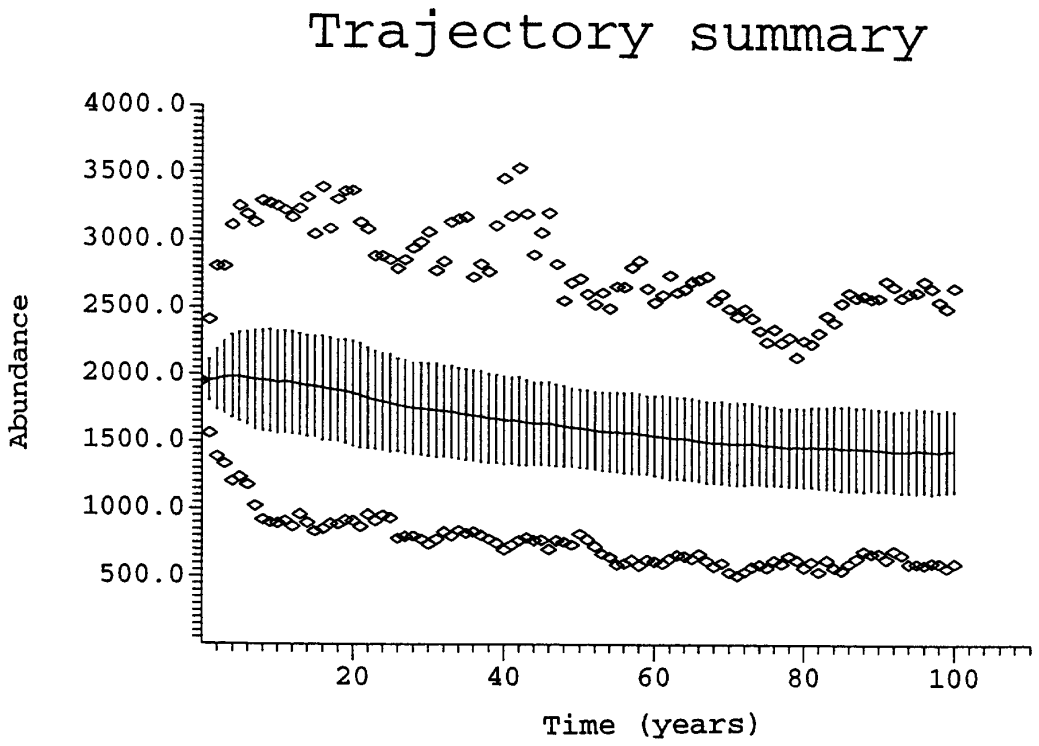


Figure D-7. Scenario 16: Improve reproductive success in San Francisco Bay and Northern California Coast subpopulations, Status Quo elsewhere; see text. Population trajectory for the metapopulation. Diamonds indicate maximum and minimum (400 simulations, total). Horizontal line indicates mean trajectory. Vertical lines connect mean +/- 1 standard deviation of outcome.

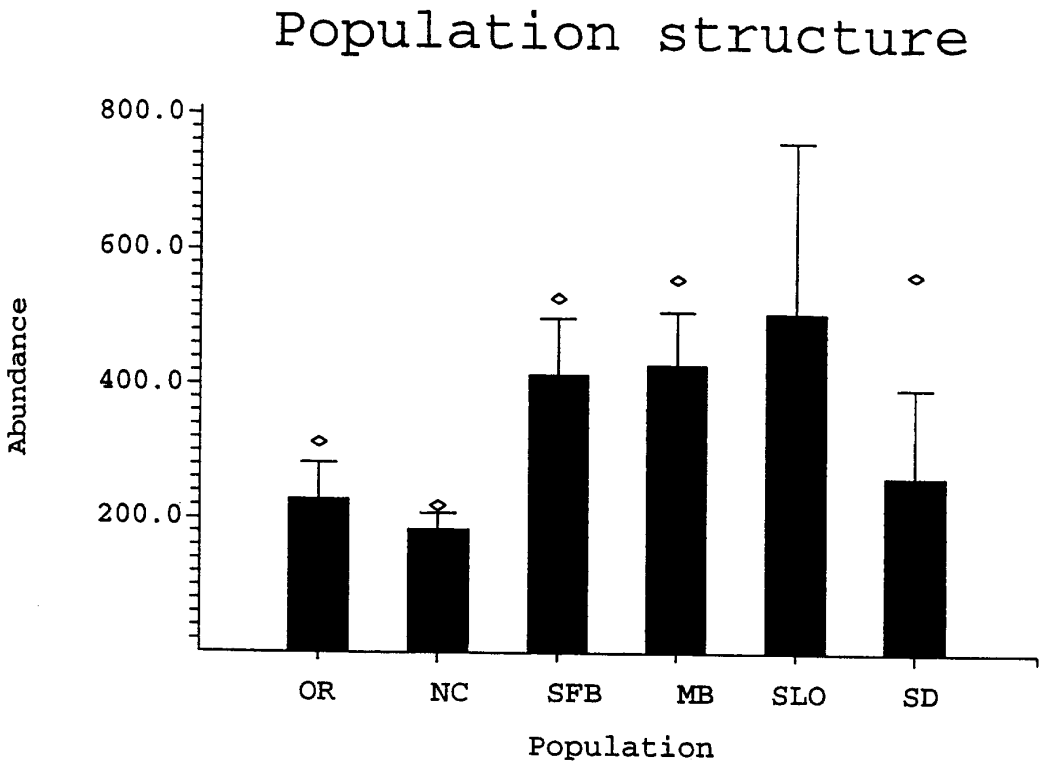


Figure D-8. Scenario 17: Management at all areas (see text). Abundance for each subpopulation at the end of 100 years. Bars indicate means; vertical lines with bars indicate + 1 standard deviation. Diamonds show maximum (among 400 simulations).

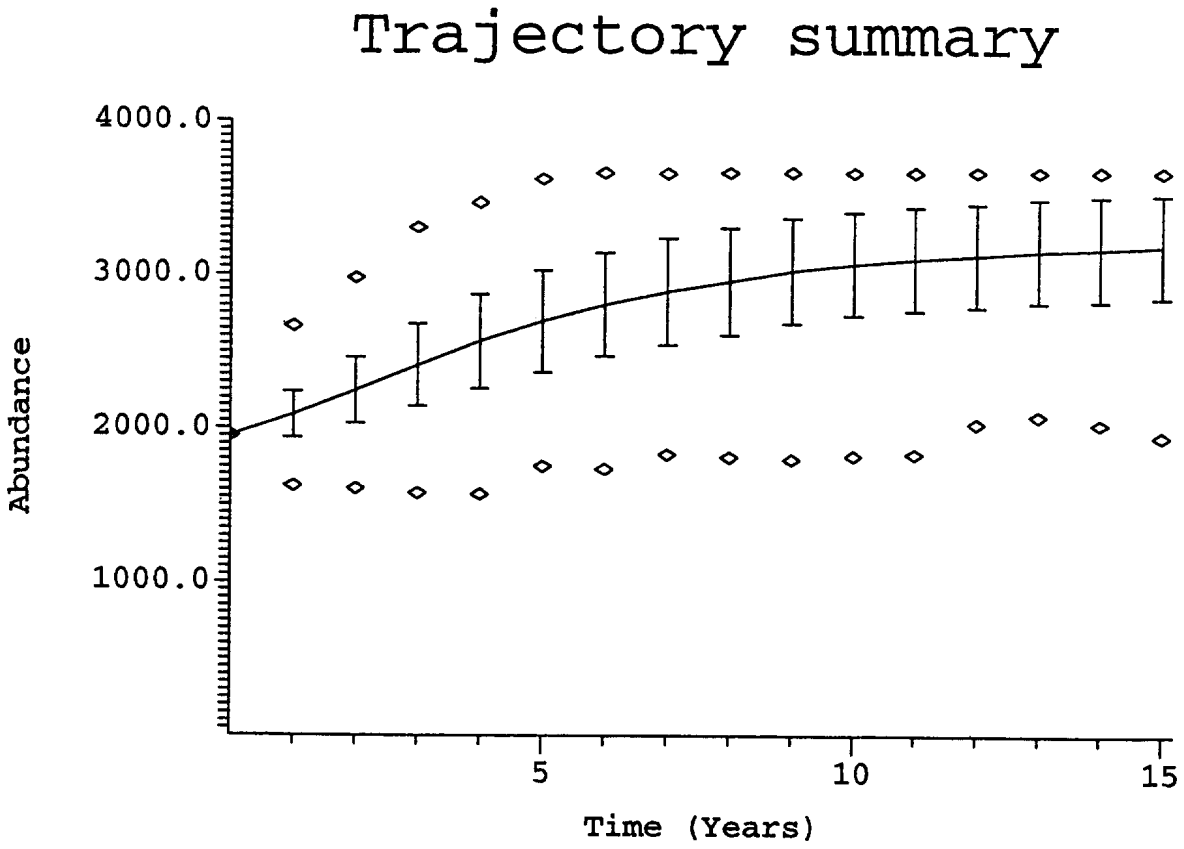


Figure D-9. Scenario 18: Recovery of snowy plovers assuming 1.3 chicks fledged per male in all subpopulations. Population trajectory for the metapopulation is shown for first 15 years of the scenario. Diamonds indicate maximum and minimum (400 simulations, total). Horizontal line indicates mean trajectory. Vertical lines connect mean +/- 1 standard deviation of outcome.

APPENDIX E

ASSOCIATED SENSITIVE SPECIES OF THE COASTAL BEACH-DUNE ECOSYSTEM AND ADJACENT HABITATS

We, the U.S. Fish and Wildlife Service, are committed to applying an ecosystem approach to conservation to allow for efficient and effective conservation of our nation's biological diversity (U.S. Fish and Wildlife Service 1994*a*). In terms of recovery plans, it is our policy to incorporate ecosystem considerations in the following manner:

(1) Develop and implement recovery plans for communities or ecosystems where multiple listed species, candidates and species of concern occur.

(2) Develop and implement recovery plans for threatened and endangered species in a manner that restores, reconstructs, or rehabilitates the structure, distribution, connectivity, and function upon which those listed species depend. In particular, these recovery plans shall be developed and implemented in a manner that conserves the biotic diversity of the ecosystems upon which the listed species depend.

(3) Expand the scope of recovery plans to address ecosystem conservation by enlisting local jurisdictions, private organizations, and affected individuals in recovery plan development and implementation.

(4) Develop and implement agreements among multiple agencies that allow for sharing of resources and decision making on recovery actions for wide-ranging species (U.S. Fish and Wildlife Service 1994*a*).

Improved habitat conditions for co-occurring species within the coastal beach-dune ecosystem will undoubtedly occur through attainment of snowy plover recovery objectives. Many listed, proposed, or candidate fish and wildlife species, and federally recognized species of concern occur in habitats within or adjacent to this ecosystem (Table E-1). Some of these species are included in existing or developing recovery plans, and actions to recover the snowy plover will also

contribute to implementation of those recovery plans (e.g., beach layia, Howell's spineflower, Menzies' wallflower, Monterey gilia, Monterey spineflower, Sonoma spineflower, Tidestrom's lupine, Myrtle's silverspot butterfly, Smith's blue butterfly, California least tern, American bald eagle, American peregrine falcon, California brown pelican, Pacific pocket mouse, tidewater goby, coho salmon, and steelhead trout). Other sensitive species which are not covered by regulatory processes or existing recovery planning efforts should also benefit from implementation of the snowy plover recovery plan through improvements in coastal beach, dune, and adjacent habitats where their ranges coincide with the snowy plover (i.e., beach invertebrates and other rare plants included in Table E-1). Marine mammals, which use the coastal beach-dune ecosystem and are protected under the Marine Mammal Protection Act of 1972, also would benefit from conservation of snowy plover habitat. However, marine mammals are addressed primarily because of the potential need to manage these species when they usurp snowy plover nesting habitat (e.g., pinnipeds) or become stranded in snowy plover breeding areas (e.g., cetaceans). This appendix contains brief species accounts for the sensitive species listed in Table E-1.

Federal Status

Endangered: Any species which is in danger of extinction throughout all or a significant portion of it's range.

Threatened: Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Species of concern: Federally-recognized sensitive species for which further biological research and field study are needed to resolve its conservation status.

Table E-1. Associated sensitive fish, wildlife, and plants.

Taxon (Scientific Name)	Federal Status/State Status
Federally-listed plants	
Beach layia (*Layia carnosa*)	Endangered/Endangered (CA)
Coastal dunes milk vetch (*Astragalus tener* var. *titi*)	Endangered/Endangered (CA)
Hoffman's slender-flowered gilia (*Gilia tenuiflora* var. *hoffmanii*)	Endangered
Howell's spineflower (*Chorizanthe howellii*)	Endangered/Threatened (CA)
Island malacothrix (*Malacothrix squalida*)	Endangered
Menzies' wallflower (*Erysimum menziesii*)	Endangered/Endangered (CA)
Monterey gilia (*Gilia tenuiflora* ssp. *arenaria*)	Endangered/Threatened (CA)
Monterey spineflower (*Chorizanthe pungens* var. *pungens*)	Threatened
Soft-leaved Indian paintbrush (*Castilleja mollis*)	Endangered
Sonoma spineflower (*Chorizanthe valida*)	Endangered/Endangered (CA)
Tidestrom's lupine (*Lupinus tidestromii*)	Endangered/Endangered (CA)
Federally-listed animals	
El Segundo blue butterfly (*Euphilotes battoides allyni*)	Endangered

Taxon (Scientific Name)	Federal Status/State Status
Morro shoulderband snail (*Helminthoglypta walkeriana*)	Endangered
Myrtle's silverspot butterfly (*Speyeria zerene myrtleae*)	Endangered
Smith's blue butterfly (*Euphilotes enoptes smithi*)	Endangered
California brown pelican (*Pelecanus occidentalis californicus*)	Endangered/Endangered (CA)
California least tern (*Sterna antillarum browni*)	Endangered/Endangered (CA)
Pacific pocket mouse *(Perognathus longimembris pacificus*)	Endangered
Tidewater goby (*Eucyclogobius newberryi*)	Endangered
Coho salmon (*Oncorhynchus kisutch*)	Varies by geographic area
Steelhead trout (*Oncorhynchus mykiss*)	Varies by geographic area
Federally-proposed plants	
La Graciosa thistle (*Cirsium loncholepis*)	Proposed Endangered/Threatened (CA)
Nipomo mesa lupine (*Lupinus nipomensis*)	Proposed Endangered/Endangered (CA)
Animals delisted or proposed for delisting	
American bald eagle (*Haliaeetus leucocephalus*)	Endangered (1978); Threatened (1995); Proposed for delisting (1999)/ Threatened (WA);Endangered (CA)

Taxon (Scientific Name)	Federal Status/State Status
American peregrine falcon (*Falco peregrinis anatum*)	Delisted (1999)/Endangered (WA, CA)
Plant species of concern	
Northcoast phacelia (*Phacelia insularis* var. *continentis*)	Species of concern
Beach spectacle pod (*Dithyrea maritima*)	Species of concern/Threatened (CA)
Pink sand-verbena (*Abronia umbellata* ssp. *breviflora*)	Species of concern/Endangered (OR)
San Francisco spineflower (*Chorizanthe cuspidata* var. *cuspidata*)	Species of concern
Surf thistle (*Cirsium rhothophilum*)	Species of concern/Threatened (CA)
Animal species of concern	
Barrier beach tiger beetle (*Cicindela latesignata latesignata*)	Species of concern
Belkin's dune fly (*Brennania belkini*)	Species of concern
Gabb's tiger beetle (*Cicindela gabbi*	Species of concern
Globose dune beetle (*Coelus globosus*)	Species of concern
Little bear scarab beetle (*Lichnanthe ursina*)	Species of concern
Mimic tryonia snail (*Tyronia imitator*)	Species of concern

Taxon (Scientific Name)	Federal Status/State Status
Morro blue butterfly (*Icaricia icarioides morroensis*)	Species of concern
Mudflat tiger beetle (*Cicindela trifasciata sigmoidea*)	Species of concern
Oblivious tiger beetle (*Cicindela latesignata obliviosa*)	Species of concern
Oso Flaco flightless moth (*Areniscythris brachypteris*)	Species of concern
Oso Flaco patch butterfly (*Chlosyne leanira*)	Species of concern
Oso Flaco robber fly (*Ablautus schlingeri*)	Species of concern
Point Conception Jerusalum cricket (*Ammopelmatus muwu*)	Species of concern
Point Reyes blue butterfly (*Icaricia icarioides* ssp.)	Species of concern
Rude's longhorn beetle (*Necydalis rudei*)	Species of concern
Salt marsh skipper (*Panoquina erans*)	Species of concern
Sandy beach tiger beetle (*Cicindela hirticollis gravida*)	Species of concern
White sand bear scarab (*Lichnanthe albopilosa*)	Species of concern

Marine Mammals (all protected under the Marine Mammal Protection Act and some protected under the Endangered Species Act)

Pinnipeds:

California sea lion (*Zalophus californianus*)
Guadalupe fur seal (*Arctocephalus townsendi*)
Harbor seal (*Phoca vitulina richardsi*)
Northern elephant seal (*Mirounga angustirostris*)
Northern fur seal (*Callorhinus ursinus*)
Steller sea lion (*Eumetopias jubatus*)

Cetaceans:

Gray whale (*Eschrichtius robustus*)
Sperm whale (*Physeter macrocephalus*)
Blue whale (*Balaenoptera musculus*)
Humpback whale (*Megaptera novaeangliae*)
Minke whale (*Balaenoptera acutorostrata*)
Killer whale (*Orcinus oraca*)

Federally-listed plants

Beach layia. *Layia carnosa* is a small succulent plant in the sunflower family (Asteraceae). Until recent surveys, 17 California occurrences of *Layia carnosa* located in 8 dune systems from Santa Barbara County to Humboldt County had been found. Currently, 21 populations are known. Although the species range is relatively unchanged, at least five historical occurrences are thought to be extirpated. The species is restricted to coastal sand dunes. In northern California, it occurs in the northern dune scrub community; in Monterey County, the species occurs in the central dune scrub community. It generally occurs behind the northern foredune community, occupying sparsely vegetated open areas on semi-stabilized dunes. The species will also occur in open areas, such as along trails and roads. The largest populations are in Humboldt County. Three of the historic Humboldt County occurrences were on the Samoa Peninsula in the Humboldt dune system, and two have been extirpated (U.S. Fish and Wildlife Service 1998*a*). In 1995, a small population was rediscovered on Vandenberg Air Force Base (D. Keil

pers. comm. 1995 *in* U.S. Fish and Wildlife Service 1998*a*). The threats to *Layia carnosa* include displacement by invasive, non-native vegetation, recreational uses such as off-road vehicles and pedestrians, and development.

Beach spectacle pod. *Dithyrea maritima* is a low-growing dune perennial in the mustard family (Brassicaceae or Cruciferae). *Dithyrea maritima* grows in the active foredune habitat of coastal sand dune systems, mainly at the base of the small transverse dunes. The range of the species has been greatly reduced from its historic distribution (Morey 1989). Historically, *Dithyrea maritima* was found just north of the Palos Verdes Peninsula along the coastal dune strip including Hermosa and Redondo Beaches, Los Angeles County. The current mainland distribution is patchy, occurring from Surf, in western Santa Barbara County, north to the Morro Bay sand spit, San Luis Obispo County. Approximately 14 populations are known to still exist. A small Channel Islands population is known from San Miguel Island and scattered locations of the plant occur on the west end of San Nicolas Island. A single location in Baja California, Mexico, just south of San Quintin was documented for this species in 1886. The Los Angeles populations have been extirpated since the early 1930's, and the species has not been seen in Mexico for over 100 years (Rollins 1979). The largest known extant population is on Vandenberg Air Force Base in Santa Barbara County. It occurs intermittently along the coast from Shuman Creek to Purisima Point. *Dithyrea maritima* is extremely vulnerable to physical damage and habitat deterioration caused by foot traffic and off-road vehicle activities. Foot traffic is a continuing threat at Surf Beach on Vandenberg Air Force Base, and occasional errant off-road vehicles from the Nipomo Dunes State Vehicular Recreation Area continue to degrade habitat of the species as does the continued operation of oil fields. Within the Nipomo Dunes State Vehicular Recreation Area all but one small population of *Dithyrea maritima* has been eliminated by off-road vehicle activity. This remaining population is in an unrestricted area subjected to off-road vehicle use and is consequently threatened by habitat degradation (Morey 1989).

Coastal dunes milk vetch. *Astragalus tener* var. *titi* is a diminutive annual herb of the pea family (Fabaceae). Colonies of the milk-vetch occur on a relatively flat coastal terrace within 30 meters (100 feet) of the ocean beach and 8 meters (25 feet) above sea level. Two historical locations from Los Angeles County (Hyde

Park in Inglewood and Santa Monica) and two from San Diego County (Silver Strand and Soledad) were annotated by Barneby as *Astragalus tener* var. *titi* (Barneby 1950). The only known extant population of this species occurs along 17-Mile Drive on the western edge of the Monterey Peninsula on land owned by the Pebble Beach Company and the Monterey Peninsula Country Club. It is unlikely that suitable habitat remains at the Los Angeles locations, since they have been heavily urbanized. In San Diego County, the Silver Strand area is owned by the Department of Defense (Miramar Naval Weapons Center), and a portion has been subjected to amphibious vehicle training exercises. Another portion of Silver Strand has been leased by the Navy to the California Department of Parks and Recreation for development of a campground and recreational facilities. Numerous unsuccessful searches for the plant have been made in these locations since 1980 (Ferreira 1995, California Natural Diversity Data Base 1997). This species is currently threatened with alteration of habitat from trampling associated with recreational activities, such as hiking, picnicking, ocean viewing, wildlife photography, equestrian use, and golfing. Due to the fragmented nature of the plants habitat and the human uses that surround it, the species is vulnerable to extinction from random events. The species is also threatened by competition from two non-native plants, fig-marigold (*Carpobrotus edulis*) and cut-leaf plantain (*Plantago coronopus*) (U.S. Fish and Wildlife Service 1998*b*).

Hoffman's slender-flowered gilia. *Gilia tenuiflora* ssp. *hoffmannii* is a small, erect annual herb in the phlox (Polemoniaceae) family. It has been collected from three extant populations on Santa Rosa Island (C. Rutherford and T. Thomas *in litt.* 1994). One population occurs at the type locality near East Point on Santa Rosa Island, California, where it occurs as a component of dune scrub vegetation (Thomas 1993). A partially-fenced population was found in 1994 on stabilized dunes at Skunk Point, Santa Rosa Island. The third population corresponds reasonably well with a 1941 specimen of Reid Moran which was collected between Ranch and Carrington Point. Threats to *Gilia tenuiflora* ssp. *hoffmannii* are soil loss, habitat alteration, competition from non-native grasses, cattle grazing, and elk and deer browsing (U.S. Fish and Wildlife Service 1999*a*). It is also vulnerable to random extinction by such events as storms, drought, or fire. The small number of populations and limited number of individuals make the species vulnerable to randomly, naturally occurring events.

Howell's spineflower. *Chorizanthe howellii* is an herbaceous annual in the buckwheat family (Polygonaceae). It occurs in coastal dunes and adjacent sandy soils of coastal prairies at elevations ranging from sea level to 37 meters (120 feet). In coastal dunes, it is associated with yellow sand verbena (*Abronia latifolia*) and Menzies' wallflower (*Erysimum menziesii*) (California Department of Fish and Game 1985). The species occurs in areas of relatively mild maritime climate, characterized by fog and winter rains. *Chorizanthe howellii* is known, both historically and currently, from only one area north of Fort Bragg in Mendocino County, California. Three populations are known in the dune system south of Ten Mile River in that county. One extended population is located in MacKerricher State Park, with a portion of one occurrence extending beyond State park land to include adjacent private property (California Department of Fish and Game, California Natural Diversity Data Base). The other populations occur on private lands. The majority of this species occurs within MacKerricher State Park, where recreational and maintenance activities were described as the main threats to the continued existence of this species (U.S. Fish and Wildlife Service1998*a*). Recreational activities historically included off-road vehicle use and hiker and equestrian traffic that caused habitat degradation. In addition, dune habitat is being invaded by non-native plants such as iceplant (*Carpobrotus edulis*), European beachgrass (*Ammophila arenaria*), and burclover (*Medicago polymorpha*), which can outcompete and displace native species and can be a serious threat to *Chorizanthe howellii*. Conservation measures undertaken for this species have included the elimination of off-road vehicle use, management of invasive, non-native plants including iceplant, European beachgrass, and burclover, and the revegetation of this species and *Erysimum menziesii* in MacKerricher State Park. The Park has redirected an equestrian trail away from occupied habitat. The Park has also developed the MacKerricher State Park Ten Mile Dunes Restoration Plan that describes measures to protect and enhance the habitat for this species within the Park.

Island malacothrix. *Malacothrix squalida* is an annual herb in the sunflower family (Asteraceae). It has been collected from two locations along the north shore of Santa Cruz Island. Green collected it near Prisoner's Harbor in 1886, but the species was not seen on the island again until Philbrick and Benedict collected it in 1968 near Potato Harbor (Rutherford and Thomas *in litt.* 1994). Two populations

are also known from Middle Anacapa Island. Threats to *Malacothrix squalida* are soil loss, habitat alteration resulting from sheep grazing, feral pig rooting, and seabird nesting. The species is also vulnerable to random extinction by such events as storms, drought, or fire. The small numbers of isolated populations and restricted number of individuals also make the species vulnerable to reduced reproductive vigor (U.S. Fish and Wildlife Service 1999*a*).

Menzies' wallflower. A member of the mustard family (Brassicaceae or Cruciferae), *Erysimum menziesii* may be a biennial or a short-lived perennial depending on the particular population. It is restricted to coastal dunes in Humboldt, Mendocino, and Monterey Counties. The species is recognized to have three subspecies which are geographically distinct, *E. menziesii* ssp. *menziesii*, *E. menziesii* ssp. *eurekense*, and *E. menziesii* ssp. *yadonii*. This species occurs on coastal sand dunes in Monterey County from Point Pinos south to Cypress Point and in the Marina Dunes; in Mendocino County from Fort Bragg north to Ten Mile River; and in Humboldt County on the Samoa Peninsula (North Spit) of Humboldt Bay from the southern tip of the North Spit to the Lanphere-Christensen Dunes Preserve, and on the South Spit of Humboldt Bay. In Monterey, the species occurs on coastal strand, close to the high tide line, but protected from wave action. The species has high exposure to strong wind, salt spray, and occasional wave action from storms and high tides. Habitat also occurs in recent bluff scrub, and open, sparsely-vegetated dunes. Subspecies *menziesii* is located in Monterey and Mendocino Counties. It occurs in 10 isolated populations along the Monterey Peninsula from Point Pinos to Cypress Point. The Mendocino County populations range from Ten Mile River south to Fort Bragg. Many of the populations are associated with MacKerricher State Park, except for the Pudding Creek population which is near Fort Bragg. Subpecies *eurekense* occurs in Humboldt County from the coastal dunes of the South Spit to the Lanphere-Christensen Dunes Preserve. Extant Humboldt County populations of the subspecies *eurekense* have five recorded occurrences (California Natural Diversity Data Base 1996) in the Lanphere-Christensen Dunes Preserve, northwest of Mad River Slough, north of Manila (Samoa Peninsula), U.S. Coast Guard Station (Samoa Peninsula), and the South Spit (Humboldt Bay). *Erysimum menziesii* ssp. *yadonii* is restricted to six populations in the vicinity of the Marina Dunes, two at Marina State Beach, and the others at the RMC Lonestar Cement Company property approximately 0.8

kilometer (0.5 mile) south of the Salinas River Lagoon, Monterey County, California. California Natural Diversity Data Base occurrences for subspecies *yadonii* are found in the following habitats: coastal dunes, foredunes, and coastal strand; for subspecies *eurekense*, occurrences are in coastal dunes and foredunes; and for subspecies *menziesii*, occurrences are in coastal strand, coastal dunes, central dune scrub, and northern dune scrub. The species is threatened by invasion by non-native plant species, industrial and residential development, and trampling by recreational users such as pedestrians, equestrians, and hang-gliders. Off-road vehicle recreation, which historically degraded habitat for the species, is again threatening the species (U.S. Fish and Wildlife Service 1998*a*). The displacement of subspecies *menziesii* by the invasive non-native iceplant (*Carpobrotus* sp.) is a threat to Monterey County populations and the populations north of Fort Bragg. In Monterey County, additional threats include browsing by deer (attempts to plant seedlings are successful only with caging of the plants), recreational land uses, coastal erosion, sand mining activities, and the deposition of dredged material from adjacent wetlands (U.S. Fish and Wildlife Service 1998*a*).

Monterey gilia. *Gilia tenuiflora* ssp. *arenaria* is a member of the phlox family (Polemoniaceae). This species grows in sandy soils of dune scrub and maritime chaparral habitat in the coastal dunes of Monterey County. The species occurs most commonly in sites with limited exposure to strong winds, salt spray, and waves. It grows in open areas and wind-sheltered openings in the low-growing dune scrub vegetation or in areas where the sand has experienced some disturbance, such as along trails and roads. The species is usually tolerant of small amounts of drifting sand. Monterey Bay dune populations occur from Moss Landing to Monterey, along coastal and inland dunes. Monterey Peninsula populations occur in the vicinity of Spanish Bay and Asilomar State Beach. One of the largest populations known of this species was recently discovered at Fort Ord in 1993; preliminary estimates indicate that as much as 60 percent of the species may occur at Fort Ord (U.S. Fish and Wildlife Service 1998*a*). The species is threatened by encroachment of invasive, non-native plant species, sand mining trampling by equestrians and pedestrians, and habitat removal for commercial and residential development. Off-road vehicle activities and golf course development have historically degraded habitat for this species (U.S. Fish and Wildlife Service 1998*a*).

Monterey spineflower. *Chorizanthe pungens* var. *pungens* is an herbaceous annual in the buckwheat family (Polygonaceae). It occurs in areas of relatively mild maritime climate, characterized by fog and winter rains. This species occurs in coastal dunes, coastal scrub, and further inland on sandy soils derived from ancient stabilized dunes, dating to the Ice Age (Pleistocene); it tends to occur on bare sandy patches where there is little vegetative cover (Zoger and Pavlik 1987). Sites on Fort Ord where this species was found included firebreaks, along roadsides, in sandy openings between shrubs, the central portion of the firing range, and areas where military activities resulted in frequent habitat disturbances. It occurs from the Monterey Peninsula (Monterey County) northward along the coast to southern Santa Cruz County, and inland to the Salinas Valley (Reveal and Hardham 1989; Ertter 1990). Early collections by Gambel in 1842 indicated that this species historically occurred as far south as San Simeon near the northern boundary of San Luis Obispo County; however, in recent times this species has not been found south of the Monterey Peninsula (Reveal and Hardham 1989). The species is currently known from seven populations with the largest number of plants occurring at Fort Ord. In 1992, Jones & Stokes Associates found this species in almost all the undeveloped areas on the western half of Fort Ord (U.S. Army Corps of Engineers 1992). Populations of the species are also found on California Department of Parks and Recreation lands at Manressa, Sunset, Salinas River, and Asilomar State Beaches and Fort Ord Dunes State Park (C. Roye *in litt.* 1996). In 1987, a survey of 6 properties in the Marina Dunes found a total of 43 individuals of *Chorizanthe pungens* var. *pungens* occurring on 5 of the 6 properties surveyed: Marina State Beach, Granite Rock Company, Gullwing, RMC Lonestar Cement Company, and Martin properties (Zoger and Pavlik 1987). Habitat loss, conversion from agricultural use, residential development, activities at military institutions, and invasion by non-native plants were identified as the primary threats to this species. Hikers and equestrians may trample these plants at various locations throughout its range. The conversion of the Fort Ord military base to other uses, including educational and scientific research facilities, may pose threats to this species if new buildings are constructed; however, large portions of this plant's habitat on Fort Ord are to be reserved for open space. Populations of this species at Sunset State Beach are threatened by recreational activities and are subject to trampling. Invasive non-native species which were introduced as part of dune stabilization programs (i.e., European beachgrass (*Ammophila arenaria*) and

iceplant (*Carpobrotus edulis*)) are also a threat to these populations. This plant at Sunset State Beach may be enhanced by a restoration program established for the removal of non-native species (Ferreira 1989). Restoration of dunes at the Naval Post Graduate School in Monterey where it occurs may also be beneficial. Personnel from Marina State Beach and Asilomar State Park have implemented an aggressive eradication program for invasive, non-native plants, have conducted dune revegetation, and protected dune habitat from recreational uses (i.e., use of raised wooden walkways). The State has installed interpretive signs that educate park visitors on the sensitivity of dune habitat and endangered plant species. Designating large portions of Fort Ord as open space will provide conservation opportunities for this species (U.S. Fish and Wildlife Service 1998*a*).

Soft-leaved Indian paintbrush. *Castilleja mollis* is a presumably partially parasitic perennial herb in the figwort family (Scrophulariaceae). Two collections of this species were made by F. H. Elmore from Point Bennett on San Miguel Island in 1938 (Heckard *et al.* 1991); despite recent searches, this plant has not been seen on the island since then (S. Junak pers. comm. 1994). *Castilleja mollis* is known from two areas on Santa Rosa Island, Carrington Point in the northeast corner of the island, and west of Jaw Gulch and Orr's Camp (this location also referred to as Pocket Field) along the north shore of the island. At Carrington Point, the plant is associated with stabilized dune scrub vegetation that is dominated by goldenbush (*Isocoma menziesii* var. *sedoides*), lupine (*Lupinus albifrons*), and Pacific ryegrass (*Leymus pacificus*). Goldenbush is likely a host plant to the soft-leaved Indian paintbrush, providing water and nutrients (U.S. Fish and Wildlife Service 1998*a*). At the Pocket Field location, the paintbrush is associated with non-native iceplant (*Carpobrotus* sp. and *Mesembryanthemum* sp.), native milkvetch (*Astragalus miguelensis*), and alien grasses. Threats to *Castilleja mollis* are soil loss, habitat alteration, cattle grazing, deer and elk browsing, deer bedding, and competition with alien plant taxa (S. Chaney pers. comm. 1994). Because of the small numbers of isolated populations and individuals, this species is also vulnerable to random extinction by such events as storms, drought, or fire. Small numbers of populations and individuals also make the species vulnerable to random naturally occurring events (U.S. Fish and Wildlife Service 1998*a*).

Sonoma spineflower. *Chorizanthe valida* is an herbaceous annual in the buckwheat family (Polygonaceae). The species is found in areas of relatively mild maritime climate, characterized by fog and winter rains. It occurs exclusively in the sandy soil of a coastal prairie near Abbott's Lagoon, at an elevation of approximately 12 meters (40 feet). This site is adjacent to the dune system which stretches about 19 kilometers (12 miles) from Tomales Point to Reyes (Cooper 1967). The only known extant population of *Chorizanthe valida* (California Natural Diversity Data Base) is located in the Lunny pasture adjacent to Abbott's Lagoon in Point Reyes National Seashore (Davis and Sherman 1990). Historically, the plant was more widespread on the peninsula. The population is located in a pasture that has been grazed for over a century. Changes in grazing or trampling could alter the vegetation structure that has allowed the plant to persist. Increased grazing or trampling may increase seedling mortality, and reduced grazing and trampling may allow surrounding vegetation to outcompete *Chorizanthe valida* (U.S. Fish and Wildlife Service 1998*a*).

Tidestrom's lupine. *Lupinus tidestromii* is a low, creeping perennial member of the pea family (Fabaceae). This species grows in active dune ecosystems and on partially stabilized coastal dunes. With its prostrate habit, it can survive partial burial, providing local dune stabilization. It occurs from sea level to 7.6 meters (25 feet). Several of the occurrences on the Monterey Peninsula are on remnant dunes in the yards of private residences. It occurs in the mild maritime climate of the central California coast, growing in coastal scrub communities in association with Menzies' wallflower (*Erysimum menziesii*) and sand gilia (*Gilia tenuiflora* ssp. *arenaria*). This species occurs from the Monterey Peninsula in Monterey County northward to the south bank of the Russian River near its mouth in Sonoma County. Clark and Fellers (1986) identified three populations of this species in Point Reyes National Seashore, extending from Abbott's Lagoon to Point Reyes Station. The major threats to *Lupinus tidestromii* include loss of habitat due to development, trampling by hikers and equestrians, and livestock grazing. Two populations on the Monterey Peninsula were eliminated by construction of a golf course; mitigation plantings were implemented. Other populations on privately-owned sites in Monterey are potentially threatened by residential and recreational development. At the time of listing, the populations in Asilomar State Park and Point Reyes National Seashore were subject to trampling by hikers, a problem that

is now corrected by controlled pedestrian routes. Additionally, cattle grazing on the dune system near Dillon Beach presents a potential threat of trampling to this species. Many sites are also threatened by the invasion of non-native species, such as iceplant *(Carpobrotus* sp.) and European beachgrass (*Ammophila arenaria*) (U.S. Fish and Wildlife Service 1998*c*). Asilomar State Beach has developed a management plan for dune enhancement. This plan proposes restoration of native dune vegetation, control of invasive, non-native species, monitoring and mitigation of human-use impacts, and changing visitor use patterns. Boardwalks have been constructed to direct visitors away from sensitive dune areas and allow beach access while minimizing trampling of dune vegetation (C. Roye *in litt.* 1996).

Federally-listed animals

El Segundo blue butterfly. The El Segundo blue butterfly (*Euphilotes battoides allyni*) is a member of the Order Lepidoptera and Family Lycaenidae. It is endemic to the formerly expansive El Segundo sand dunes near Los Angeles, California. The El Segundo blue butterfly is currently found at only two sites, on about 32 hectares (80 acres) at the west end of the Los Angeles Airport runways, and on an approximately 0.8-hectare (2-acre) lot at the Chevron oil refinery in El Segundo. Adult butterflies can be found from mid-July to early September at both sites. The emergence of adult butterflies occurs with the peak flowering period of its primary food plant, the seacliff buckwheat (*Eriogonum parvifolium* Sm. in Rees (Polygonaceae)). The coastal buckwheat *(Eriogonum cinereum)* is a secondary food plant at the Los Angeles Airport. Both buckwheats are used as larval and adult food plants. Historically, the coastal dunes inhabited by this butterfly were altered by urbanization, industrialization, highway construction, sand mining, and planting of non-native ground covers, especially iceplant. Invasion of non-native plants and insufficient suitable habitat are the primary limiting factors affecting its survival (U.S. Fish and Wildlife Service 1985).

Morro shoulderband snail. The Morro shoulderband snail (*Helminthoglypta walkeriana*), also commonly known as the banded dune snail, belongs to the Class Gastropoda and Family Helminthoglyptidae. It occurs in coastal dune and sage scrub communities. Throughout most of its range, the dominant shrub associated with the snail's habitat is mock heather (*Ericameria ericoides*). This species is

found only in western San Luis Obispo County. At the time of listing, the Morro shoulderband snail was known to be distributed near Morro Bay. Its currently known range now includes areas south of Morro Bay, west of Los Osos Creek, and north of Hazard Canyon. This species has also been reported near San Luis Obispo City and south of Cayucos (Roth 1985). The survival of the Morro shoulderband snail is threatened by the destruction of its habitat (due to increasing development) and degradation of its habitat due to invasion of non-native plant species (i.e., veldt grass), structural senescense of dune vegetation, and unauthorized recreational use (i.e., off-road vehicle activity).

Myrtle's silverspot butterfly. The Myrtle's silverspot butterfly (*Speyeria zerene myrtleae*) is a member of the Order Lepidoptera and Family Nymphalidae. The current distribution of the butterfly is Sonoma and Marin Counties (Launer *et al.* 1992). This butterfly inhabits coastal dunes, coastal prairie, and coastal scrub at elevations ranging from sea level to 300 meters (1,000 feet) (Launer *et al.* 1992). Populations of the Myrtle's silverspot butterfly are seriously threatened by several factors. Urban development has extirpated and is currently threatening populations of Myrtle's silverspot. The spread of non-native iceplant, grasses, and forbs is a competitive threat to the several plant species which either provide nectar sources for the adults or a food source for the larvae. Two populations are currently protected at Point Reyes National Seashore; however, there is no management plan for the conservation of these two populations (U.S. Fish and Wildlife Service 1998*a*).

Smith's blue butterfly. The Smith's blue butterfly (*Euphilotes enoptes smithi*) is a member of the Order Lepidoptera and Family Lycaenidae. It occupies coastal sand dunes, inland sand dunes, serpentine grasslands, and coastal cliffside chaparral communities. The Smith's blue butterfly is currently found in San Mateo, Santa Cruz, and Monterey Counties (Arnold 1991; U.S. Fish and Wildlife Service 1984). At the time of listing, the Smith's blue butterfly was known primarily from the mouth of the Salinas River to Del Rey Creek in California (U.S. Fish and Wildlife Service 1984). Its current range is from southern Santa Cruz County to the Monterey-San Luis Obispo County line and inland to the Salinas Valley (Arnold 1991). It typically occurs in foredunes and rear sand dunes in the Monterey Bay region (U.S. Fish and Wildlife Service 1998*a*). South of the Carmel River, the

species also occurs in grassland and coastal scrub and the interface between these two habitat types (U.S. Fish and Wildlife Service 1998*a*). The Smith's blue butterfly's distribution is limited to the occurrence of its host plants (buckwheat). Non-native plants (e.g., iceplants, Kikuyu grass, genista) are known to invade the habitats where the host plants occur (Norman 1994). The Smith's blue butterfly's habitat is also threatened by heavy foot and off-road vehicle traffic. Landslides, sand mining, and urbanization are also reasons for the decline and threats to the butterfly's survival.

California brown pelican. The California brown pelican (*Pelecanus occidentalis californicus*) is a conspicuous bird along the coasts of California and Baja California, Mexico. It typically has a bright red gular pouch (basal portion) during the breeding season. The breeding distribution of the California brown pelican ranges from the Channel Islands of southern California southward to Islas Isabela and Tres Marias off Nayarit, Mexico. Nesting habitat includes islands with steep, rocky slopes. Between breeding seasons, pelicans migrate along the Pacific Coast, ranging as far north as Vancouver Island. Brown pelicans inhabit Oregon part of the year. They roost on the North Spit of Coos Bay, Oregon, and on estuaries along the Oregon Coast (E.Y. Zielinski and R.W. Williams *in litt.* 1999). Brown pelicans prefer salt water habitats year-round, where an adequate and consistent food supply is available. Brown pelicans are colonial nesters and require nesting grounds that are free from both mammalian predators and human disturbance. They also depend on estuarine habitat, including roost sites. This habitat has been extremely reduced along the California coast (U.S. Fish and Wildlife Service 1983).

California least tern. The California least tern (*Sterna antillarum browni*) is the smallest tern in the United States. The birds are about 23 centimeters (9 inches) in length and have a wingspan of about 51 centimeters (20 inches). The least tern historically nested along sandy beaches close to estuaries and embayments along the coast of California from San Francisco Bay to Baja California, Mexico. Human encroachment along California beaches for recreation, residential, and industrial development has severely diminished the availability of suitable nesting habitat. The majority of the least tern population currently is concentrated in southern California within Los Angeles, Orange, and San Diego Counties. The

loss of nesting habitat range-wide in conjunction with increased loss of foraging areas, human disturbance, and predation at remaining breeding colonies resulted in a Federal designation of endangered status in 1970 (U.S. Fish and Wildlife Service 1970).

Pacific pocket mouse. The Pacific pocket mouse *(Perognathus longimembris pacificus*) is a small rodent species that is endemic to the immediate coast of southern California from Marina del Rey and El Segundo in Los Angeles County, south to the vicinity of the border of Mexico in San Diego County (Hall 1981, Williams 1986, Erickson 1993). The species inhabits, or was known to inhabit, coastal strand habitats, coastal dunes, river alluvium, and coastal sage scrub growing on marine terraces (Grinnell 1933, Meserve 1972, Erickson 1993). Available data indicate that the historical distribution of the Pacific pocket mouse was much more extensive prior to the large-scale development of the coastal lowlands of southern California. Between 1894 and 1972, the Pacific pocket mouse was recorded from 8 general locales and 29 specific localities from Los Angeles County south to the border of Mexico in San Diego County. Approximately 80 percent of all Pacific pocket mouse records were from 1931 or 1932 (Erickson 1993). Prior to the rediscovery of the Pacific pocket mouse on the Dana Point headlands in Orange County, California (Brylski 1993), the species had not been observed in over 20 years. In 1995, Pacific pocket mice subsequently were discovered near two historically occupied locales on Camp Pendleton Marine Corps Base in San Diego County, California. Current occupied habitat for the Pacific pocket mouse is estimated to be less than 400 hectares (988 acres). None of the eight historic locales are protected and all have been damaged by or are threatened by habitat destruction or fragmentation, fire, or other disturbances.

Tidewater goby. The tidewater goby (*Eucyclogobius newberryi*) is a small fish characterized by large pectoral fins and a ventral sucker-like disk formed by the complete fusion of the pelvic fins. Gobies are mainly tropical and tend to be bottom dwelling, shallow bay and marine intertidal animals. The tidewater goby ranges from Agua Hedionda Creek, Carlsbad, San Diego County, north to Lake Earl, Del Norte County (Irwin and Soltz 1984). They are common in San Luis Obispo County streams and uncommon from San Francisco Bay to Humboldt Bay (Moyle 1976). Threats include coastal development, dredging of coastal

waterways, coastal road construction, and upstream diversions (U.S. Fish and Wildlife Service 1994*b*).

Coho salmon. The general biology of coho salmon (*Oncorhynchus kisutch*) is described in detail in McMahon (1983), Hassler (1987), and Sandercock (1991). The coho salmon is an anadromous species; coho salmon generally return to their natal streams to spawn after spending 2 years in the ocean. The spawning migrations begin after heavy late-fall or winter rains breach the sandbars at the mouth of coastal streams, allowing the fish to move into them (Moyle *et al.* 1989). Spawning occurs in small to medium-sized gravel at well-aerated sites, typically near the head of a riffle (Moyle 1976). These streams have summer temperatures seldom exceeding 21 degrees Centigrade (70 degrees Fahrenheit). Emergent fry utilize shallow near-shore areas, whereas optimal habitat conditions for juveniles and sub-adults seem to be deep pools created by rootwads and boulders in heavily shaded stream sections. Because of dramatic declines in population numbers, the National Marine Fisheries Service was petitioned to list this species coast wide. As a result, the species is listed as threatened in southern Oregon, northern California, and along the central California coast. It is listed as endangered in the upper Columbia River, Washington, and as threatened in Puget Sound, Washington, and the lower Columbia River (in Washington and Oregon). Causes of coho salmon declines in California and other states include incompatible land-use practices such as logging and urbanization, loss of wild stocks, introduced diseases, over harvesting, and climatic changes.

Steelhead trout. Steelhead trout (*Oncorhynchus mykiss*) are also anadromous fish. Adult steelhead typically spawn in the spring, from February to June (Moyle 1976), in gravel riffles. Optimum temperatures for growth range from 13 to 21 degrees Centigrade (55 to 70 degrees Fahrenheit) (Moyle 1976). Steelhead typically spend 2 to 3 years in freshwater (Moyle 1976). Like coho fry, steelhead fry reside in near-shore areas. In the presence of coho juveniles, steelhead juveniles tend to utilize riffles. The National Marine Fisheries Service was petitioned to list this species coastwide. Steelhead trout are listed as threatened along the northern, central, and south-central California Coast, and endangered in southern California and the Central Valley.

Federally-proposed plants

La Graciosa thistle. *Cirsium loncholepis* is a short-lived, spreading, mound-like or erect and often fleshy, spiny member of the sunflower family (Asteraceae). This plant is endemic to the coastal wetlands of southern San Luis Obispo County and northern Santa Barbara County from the Pismo Dunes lake area and south historically to the mouth of the Santa Ynez River. The historic distribution of the species included areas that have been converted from wetland habitat to agriculture and development. Currently, the species is restricted to marshes and the edges of willow thickets in damp swales in the Guadalupe dune system (Hendrickson 1990). Groundwater pumping, off-road vehicle use, and coastal development are continuing threats to this species (California Department of Fish and Game 1992).

Nipomo mesa lupine. *Lupinus nipomensis* is an annual member of the pea family (Fabaceae). This plant grows in stabilized, back dune habitat in the southwestern corner of San Luis Obispo County. The plant occurs as 1 extended population in 5 occurrences with fewer than 700 plants. The high quality occurrences are situated in dune swales and contain a higher diversity of native annuals. This plant requires pockets of bare sand, probably indicating a low tolerance for competition (Walters and Walters 1988). Impacts from off-road vehicles continue to degrade habitat, and the species is threatened by further habitat degradation resulting from expansion of introduced weedy plants. This plant is also threatened by coastal development (U.S. Fish and Wildlife Service 1998*c*).

Animals delisted or proposed for delisting

American bald eagle. The bald eagle (*Haliaeetus leucocephalus*) is a large eagle, weighing up to 7 kilograms (15.5 pounds) and measuring 84 to 95 centimeters (33 to 37 inches) in length in the northern race (Stalmaster 1987). Bald eagles are found in coastal areas throughout the year, but are present in greatest numbers around seabird and marine mammal colonies, waterbird concentrations, and estuaries where food abundance is highest and easily available. Marine mammals and seabirds are available primarily as carrion in the beach/dune ecosystem on a temporary or localized basis. Use of this ecosystem by bald eagles is therefore likely to be opportunistic, occur most frequently during the migration and

wintering periods, and be greatest where reliable food sources occur nearby. The bald eagle historically ranged throughout North America except extreme northern Alaska and Canada, and central and southern Mexico. The population was estimated at 250,000 to 500,000 eagles. However, populations began to decline significantly in the mid- to late-1800's as eagles were killed, prey numbers were reduced, and nesting habitat was destroyed. In the 1940's, the use of DDT and other organochlorine pesticides became widespread, causing further declines in numbers. In 1963, only 417 active nests were reported in the lower 48 states (U.S. Fish and Wildlife Service 1995). The number of occupied territories has greatly increased since the banning of DDT and other organochlorines and habitat protection and other recovery measures have been instituted. The bald eagle was proposed for delisting (removal from the list of endangered and threatened species) in the lower 48 states on July 6, 1999 (U.S. Fish and Wildlife Service 1999*b*).

American peregrine falcon. The American peregrine falcon is a medium-sized raptor. Three subspecies of the peregrine falcon (*Falco peregrinus*) are recognized in North America (Brown and Amadon 1968). The Peale's falcon (*Falco peregrinus pealei*) is a year-round resident of the northwest Pacific Coast, from northern Washington through British Columbia to the Aleutian Islands. The arctic peregrine falcon (*Falco peregrinus tundrius*) nests in the tundra of Alaska, Canada, and Greenland and is typically a long-distance migrant, wintering as far south as South America. The American peregrine falcon (*Falco peregrinus anatum*) occurs throughout much of the remainder of North America, from the subarctic boreal forest south to Mexico. American peregrine falcons that nest in subarctic areas generally winter in South America, and those that nest in lower latitudes exhibit variation in migration behavior or are nonmigratory (Yates *et al.* 1988). The most common habitat characteristic of this species is the presence of tall cliffs which serve both as nesting and perching sites for roosting and hunting. Also required is a source of nearby water (river, coast, lake, wetland, etc.) which supports populations of small- to medium-sized resident or migratory birds upon which the American peregrine falcon preys. Organochlorine pesticides were the primary cause of a rapid and significant decline in the number of American peregrine falcons in many areas of North America between the 1940's and early 1970's. The American peregrine falcon was removed from the list of endangered and threatened wildlife on August 25, 1999 (U.S. Fish and Wildlife Service 1999*c*).

Plant species of concern

Northcoast phacelia. *Phacelia insularis* var. *continentis* is a delicate, annual plant in the borage family (Boraginaceae). The California Natural Diversity Data Base lists occurrences for variety *continentis* in the following habitats: coastal terrace, coastal bluff, coastal scrub, and some stabilized dunes. Clark and Fellers (1986) found that var. *continentis* is restricted to sandy or rocky soils; at Point Reyes, it is found with annual grasses, annual lupines (*Lupinus* spp.), goldfields (*Lasthenia macrantha*), bedstraw (*Galium* sp.), and thistle (*Cirsium* sp.). They also found it only occurs in Marin and Mendocino Counties, California. There are four localities where the plant has been found at Point Reyes, Marin County, in either 1983 or 1984. Two of the populations were found near the tip of the Point Reyes Peninsula (lighthouse and Chimney Rock areas); the other two populations were found along the north and south side of Abbott's Lagoon. *Phacelia insularis* var. *continentis* has also been found at dunes along the coast at Fort Bragg, Mendocino County, including Gold Beach and along Ten Mile Beach, MacKerricher State Park (S. Smith *in litt.* 1994). Dr. Gregory Lee (*in litt.* 1984) reported his suspicion that construction near the Point Reyes lighthouse in the early 1980's may have adversely impacted this population. Both Mendocino County populations are threatened by invasive weeds, trampling by people and horses, and cattle grazing; the Gold Beach population is also threatened by development (S. Smith *in litt.* 1994).

Pink sand-verbena. *Abronia umbellata* ssp. *breviflora* is a succulent, prostrate herb in the four o'clock family (Nyctaginaceae). It blooms in delicate pink flowers arranged in umbellate heads. *Abronia umbellata* ssp. *breviflora* is confined to sand dunes and disturbed sandy areas along the Pacific Coast (Meyers 1990). Historically, populations of this species were known from beaches along the Pacific Coast from Vancouver Island, British Columbia, south to northern California (Kaye 1997). The species is now believed to be extinct in British Columbia and Washington, and is known from only a few populations in Oregon and California (Kaye 1997). The pink sand-verbena is frequently found in association with yellow sand verbena (*Abronia latifolia*). In northern California, this plant has been found at Gold Bluffs Beach in Prairie Creek State Park, Redwood National Park, and the southern end of the Samoa Peninsula in

Humboldt County (Meyers 1990, Arguello 1994). It also has been found at MacKerricher State Park in Mendocino County and Point Reyes National Seashore in Marin County (Duebendorfer 1987). In Oregon, pink sand verbena has been reestablished as part of snowy plover habitat restoration projects at the North Spit of Coos Bay, Tenmile and Tahkenitch Creeks, and Siltcoos River mouths. The U.S. Bureau of Land Management, U.S. Forest Service, and Oregon Department of Agriculture have been experimenting with broadcast seeding and out-planting of greenhouse stock as part of Challenge Cost Share Programs. Reestablishment appears successful. However, it is too early to state whether the populations are self-sustaining (E.Y. Zielinski and R.W. Williams *in litt.* 1999). Threats to *Abronia umbellata* ssp. *breviflora* include habitat encroachment by European beachgrass (*Ammophila arenaria*), destruction by vehicular traffic, human recreational use, and driftwood collection where the *Abronia* is locally abundant (Meyers 1990, Arguello 1994).

San Francisco spineflower. *Chorizanthe cuspidata* var. *cuspidata* is an annual herb in the buckwheat family (Polygonaceae). Most populations occur on coastal sand dunes; a few occur on weakly consolidated sandstone. Usually found in the rear sand dunes on more stabilized, consolidated soils, this plant occurs along the California coast from San Mateo County to southern Sonoma County. It has been found at Dillon Beach and Point Reyes National Seashore in Marin County (Howell 1970), and southwestern portions of the Presidio, San Francisco (Howell *et al.* 1958).

Surf thistle. *Cirsium rhothophilum* is a fleshy, gray tomentose, bush-like or low-mounded biennial to short-lived perennial member of the sunflower family (Asteraceae). This species is known from Pismo Beach, Oso Flaco Lake, Nipomo Mesa, and the Guadalupe dunes in San Luis Obispo County, and from the coastal dunes from Point Sal to Point Conception, Santa Barbara County. This plant typically occurs only in the strip of habitat between the wind-blown beach and the stabilized dunes, a zone that for the majority of its distribution is only a few meters (several feet) wide. Vegetative reproduction is uncommon for this plant in habitats dominated by species that have vigorous vegetative reproduction (Zedler 1979, Zedler and Frazier 1991). Vandenberg Air Force Base contains 57 percent of the recorded locations, with 80 percent of the total number of plants of *Cirsium*

rhothophilum. Foot access to the Vandenberg dune system via Surf, California, allows some recreational trampling to occur and aggressive competition and displacement by non-native species continue to threaten the species. Nine locations occurring just to the south and north of the base are subject to threats from facility development at Point Conception by the U.S. Coast Guard, cattle grazing and trampling impacts, habitat disturbance from oil production on private lands, and trampling by beach users at a small county park. The populations in the Pismo Dunes State Vehicular Recreation Area continue to be threatened by destruction from recreational vehicle activity.

Animal species of concern

Barrier beach tiger beetle. See Tiger beetles section.

Belkin's dune fly. The Belkin's dune fly (*Brennania belkini*) is a member of the Order Diptera and Family Tabanidae. The adult resembles a bee. The range of this fly includes coastal sand dunes from Playa del Rey, Los Angeles, County, south to Ensenada, Baja California Norte, Mexico (Middlekauff and Lane 1980). The Belkin's dune fly breeds only on coastal sand dunes. Threats to this fly include destruction of coastal dunes by off-road vehicles, urban development, and dune stabilization with non-native plants.

Gabb's tiger beetle. See Tiger beetles section.

Globose dune beetle. The globose dune beetle (*Coelus globosus*) belongs in the Order Coleoptera and Family Tenebrionidae. It is a dark, flightless beetle, about 6 to 8 millimeters (0.3 inch) long. The globose dune beetle inhabits foredunes and sand hummocks immediately bordering the coast. This flightless beetle spends most of its life buried under the sand, beneath native dune vegetation. The beetle often lives around the bases of beach bursage (*Ambrosia chamissonis*), saltbush (*Atriplex leucophylla*), sea-rocket (*Cakile edentula*), and yellow sand-verbena (*Abronia latifolia*) (Doyen 1985). The globose dune beetle's range was formally from coastal Mendocino County south to Baja California Norte, Mexico. Its current patchy distribution occurs in Mendocino County (Ten Mile River), Sonoma County (Bodega Head), Marin County (Point Reyes), San Mateo County (Butano

Creek), Santa Cruz County (north of the mouth of the Pajaro River), Monterey County (Salinas River and Point Sur), Santa Barbara County (Dos Pueblos Canyon), Ventura County (Punta Gorda), Los Angeles County (Venice and Topanga), San Diego County (Tijuana River), and the California Channel Islands (except for San Clemente). The globose dune beetle's habitat is threatened by development, heavy foot or vehicle traffic, and the invasion of non-native beach grass (*Ammophila*) or iceplants (*Carpobrotus* and *Mesembryanthemum*).

Little bear scarab beetle. The little bear scarab beetle (*Lichnanthe ursina*) is a member of the Order Coleoptera and Family Scarabaeidae. This beetle varies in color from light brown to nearly black. Its flight behavior is characterized by males flying close to the sand surface in search of females (Carlson 1980). The little bear scarab beetle occurs on coastal dunes at Point Reyes and likely in Sonoma, Marin, San Francisco, and San Mateo Counties (U.S. Fish and Wildlife Service 1998*a*). This species has been found at Dillon Beach and Point Reyes Beach, Marin County and Ocean Beach, San Francisco County (Carlson 1980).

Mimic tryonia snail. The mimic tryonia snail (*Tyronia imitator*) is also commonly known as the California brackish water snail. It belongs in the Class Gastropoda and Family Hydrobiidae. The shell of the mimic tryonia snail is 3 to 5 millimeters (0.1 to 0.2 inch) long; the fine spiral shell has four to five whorls (Taylor 1978). The mimic tryonia snail inhabits coastal brackish water sloughs, lagoons, and estuaries. Historically, this snail was distributed from Salmon Creek Lagoon, Sonoma County (California) to Ensenada, Baja California (northern Mexico). Its current patchy distribution is now found in the counties of Alameda, Santa Clara, San Mateo, San Luis Obispo, Monterey, Santa Barbara, San Diego, Ventura, Los Angeles, and Orange. The dredging and filling of lagoons and estuaries for flood control and other purposes (e.g., creation of small boat harbors and construction of roads) have destroyed mimic tryonia snail habitats, and closed the lagoons' and estuaries' mouths. This action has created an unsuitable freshwater environment for this snail.

Morro blue butterfly. The Morro blue butterfly (*Icaricia icarioides morroensis*) belongs to the Order Lepidoptera and Family Lycaenidae. This butterfly has a wingspan of 27 millimeters (1 inch) and can be distinguished from other

subspecies of *icarioides* by its true blue coloration (Sternitzky 1930). The Morro blue butterfly inhabits sand dune areas. It feeds on *Lupinus chamissonis*, a large blue-flowered beach lupine (Murphy 1988). The Morro blue butterfly is distributed along the coast in San Luis Obispo County and at two localities outside of its Morro dune area, Nipomo Mesa (9.7 kilometers (6 miles) south of Arroyo Grande) and south of Oso Flaco Lake (Murphy 1988). Historically, its range probably extended south to coastal Los Angeles County (Emmel and Emmel 1973) and on the San Antonio Terrace, Vandenberg Air Force Base (Sheridan 1994). The Morro blue butterfly's population decline is mainly due to the destruction of its habitat. Heavy use of off-road vehicles and urbanization (e.g., housing development and nuclear power plant construction) have destroyed many of the Morro blue butterfly's habitat localities.

Mudflat tiger beetle. See Tiger beetles section.

Oblivious tiger beetle. See Tiger beetles section.

Oso Flaco patch butterfly, Oso Flaco robber fly, and Oso Flaco flightless moth. The Oso Flaco patch butterfly (*Chlosyne leanira*) is a member of the Order Lepidoptera and Family Nymphalidae. This butterfly is highly restricted in distribution and little is known of its biology. The Oso Flaco patch butterfly inhabits the Oso Flaco sand dunes of San Luis Obispo County. Adults have been found in late April and early May. This general dune area is threatened by development and off-road vehicle traffic. The Oso Flaco robber fly (*Ablautus schlingeri*) is a member of the Order Diptera and Family Asilidae. Robber flies have the top of the head hollowed out between the eyes. Adults are predaceous and attack a variety of insects, such as wasps, bees, dragonflies, grasshoppers, tiger beetles, and other flies. The larvae feed chiefly on the larvae of other insects. The Oso Flaco flightless moth (*Areniscythris brachypteris*) is a member of the Order Lepidoptera and Family Scythridae. The historic range of the Oso Flaco robber fly and Oso Flaco flightless moth is in California.

Point Conception Jerusalem cricket. The Point Conception Jerusalem cricket (*Ammopelmatus muwu*) is a member of the Order Orthoptera and Family

Stenopelmatidae. Habitat for this species is coastal dunes. The historic range of this cricket is in Santa Barbara County, California.

Point Reyes blue butterfly. The Point Reyes blue butterfly (*Icaricia icarioides* ssp.) is a member of the Order Lepidoptera and Family Lycaenidae. The species pupate in the ground and their larval food is *Lupinus chamissonis.* The Point Reyes blue butterfly occurs in foredunes and rear dunes in the Point Reyes area (U.S. Fish and Wildlife Service 1998*a*). This butterfly is believed to be extinct in San Francisco, California (Powell 1981).

Rude's longhorn beetle. The Rude's longhorn beetle (*Necydalis rudei*) is a member of the Order Coleoptera and Family Cerambycidae. This reddish-brown beetle has a robust form. Its pubescense is moderately dense and golden. Distinguishing features are the barely, longitudinally impressed, and shining pronotal disk, dilated antennal segments, and shining, coarsely punctate elytra[1] (Linsley and Chemsak 1972). The Rude's longhorn beetle inhabits the coastal sand dunes of San Luis Obispo County. The larvae are found on the root crown and lower stem of mock heather (*Ericameria ericoides*) (Linsley and Chemsak 1972). Oviposition occurs on the stem or root crown at ground level, and the larvae feed upon these areas. The larva forms a pupal chamber in the stem.

Salt marsh skipper (a/k/a wandering skipper). The salt marsh skipper (*Panoquina erans*) is a member of the Order Lepidoptera and the Family Hespariidae. This butterfly is olive brown, with light spots on the upper portion and undersides of the forewings (Donahue 1975). Although restricted to tidelands and estuarine habitats, the salt marsh skipper is widely distributed along the narrow coastal strand from Santa Barbara and Ventura Counties, California, to the southern tip of Baja California, Mexico (Murphy 1988). Historical records include occurrences of this species at Huntington Beach and Doheny Beach in Orange County, California; and Imperial Beach in San Diego County, California (Murphy 1988). At the Tijuana Slough National Wildlife Refuge, San Diego County, California, adult butterflies have been observed at the barrier beach, tidal channel, and tidal creek near tidal flats (Nagano 1982*a*). They have also been found at the Bolsa Chica wetlands (MITECH 1990). The threats to habitat for the salt marsh skipper include development and habitat conversion.

Sandy beach tiger beetle. See Tiger beetles section.

Tiger beetles (including Barrier beach tiger beetle, Gabb's tiger beetle, Mudflat tiger beetle, Oblivious tiger beetle, and Sandy beach tiger beetle). Tiger beetles are members of the Order Coleoptera and Family Cicindelidae. They are highly active terrestrial predators, eating any arthropod they can overpower. They are fast runners and agile fliers, making them hard to approach. They are most active on warm sunny days from spring to fall, on mud or sand, near permanent bodies of water. Tiger beetle larva build vertical burrows in the sand in the same area as adults. They are commonly found along the southern California coastline (Nagano 1982*b*). Threats to tiger beetles include oil spills, urban expansion, and increased recreational beach use, especially off-road vehicles, which can crush the burrows of the larva.

The range of the barrier beach tiger beetle (*Cicendela latesignata latesignata*) is from San Pedro, Los Angeles County, south to the Orange/San Diego County line and from Mission Bay, San Diego County, to the Cape region of Baja California, Mexico (Nagano 1982*b*). Habitats of this subspecies include mudflats and sandy areas in coastal estuaries. It has been found at the Tijuana Estuary National Wildlife Refuge (Nagano 1982*a*), the Border Field State Park in San Diego County (Nagano 1982*b*), and Silver Strand in San Diego County (Rumpp 1979).

The range of the Gabb's tiger beetle (*Cicendela gabbi*) is from San Pedro, California, south along the coastline to the Cape region of Baja California, Mexico. Gabb's tiger beetles inhabit mudflats and salt flats in estuarine areas. This subspecies has been found at the Tijuana Estuary National Wildlife Refuge (Nagano 1982*b*).

The range of the mudflat tiger beetle (*Cicendela trifasciata sigmoidea*) is from Morro Bay, San Luis Obispo County, south to the Cape region of Baja California, Mexico. The habitats of this subspecies are mudflats and dark-colored moist to wet sand in coastal estuarine areas. This subspecies has been found at the Tijuana Estuary National Wildlife Refuge (Nagano 1982*b*).

The oblivious tiger beetle (*Cicendela latesignata obliviosa*) inhabits the seashore from La Jolla north to the Orange County line, including Mission Beach and the mouth of the Santa Margarita River at Camp Pendleton, San Diego County (Nagano 1982*b*); it has also been found at the estuary of Los Penasquitos Creek in San Diego County (Rumpp 1979).

The range of the sandy beach tiger beetle (*Cicendela hirticolis gravida*) is from the San Francisco Bay region south along the coast to Baja California Norte, Mexico. This subspecies is generally found on sand in estuarine areas, and has been found at Point Mugu Naval Air Station, Ventura, California, and the Tijuana Estuary National Wildlife Refuge, San Diego County, California (Nagano 1982*b*).

White sand bear scarab beetle. The white sand bear scarab beetle (*Lichnanthe albopilosa*) is a member of the Order Coleoptera and Family Scarabaeidae. A distinguishing characteristic of the white sand bear scarab beetle is the presence of white setae[1]along the elytra[2]and dorsum[3] (Carlson 1980). The elytra are light brown and the clypeus is rectangular. Males range in length from 13.5 to 15 millimeters (0.5 to 0.6 inch); whereas the females are slightly larger, ranging in length from 15 to 17.5 millimeters (0.6 to 0.7 inch) (Carlson 1980). The white sand bear scarab beetle is found in the coastal sand dunes of San Luis Obispo and Santa Barbara Counties. The activity period of the adults is probably from mid-morning to mid-afternoon on sunny days. Little is known regarding this beetle's life history. The white sand bear scarab beetle's habitat is threatened by development and off-road vehicle use.

Marine mammals

California sea lion**.** *Zalophus californianus* are an eared seal (Family Otariidae) that display strong sexual dimorphism. Females are smaller than males, measuring 1.8 meters (6 feet) long and weighing around 113 kilograms (250 pounds). Males measure 2.3 meters (7.5 feet) and weigh around 338 kilograms (750 pounds). The fur coloration is brown to tan. California sea lions were hunted commercially in the mid to late 1800's for their hides and for glue stock. By the 1930's, only 7,000

1. setae- slender, typically rigid or bristly, and springy parts/organs of animals or plants.
2 elytra- thickened, sclerotized anterior wing in beetles and other insects, serving to protect the posterior wings.
3. dorsum-entire dorsal surface of an animal or upper surface of an appendage or part.

California sea lions were seen in California. They were given special protection by the California Department of Fish and Game and the Marine Mammal Protection Act of 1972. The population recovered rapidly, and Bonnell *et al*. (1983) estimated the world population to be 156,000, 50 percent of which resides in California. Currently, the non-breeding range of California sea lions extends from British Columbia, Canada, south to Tres Marias Islands in Mexico, and the breeding range extends from the Farallon Islands south to the tip of Baja California, Mexico. Archaeological data, though, indicate that California sea lion rookeries were in existence prior to 100 years ago in Oregon. All pinnipeds require birthing on land. The breeding season occurs in May through July but most pups are born in June. Pupping and breeding sites are primarily on sandy beach and rocky flat areas on islands. The largest breeding colony occurs on San Miguel Island, California. After the breeding season, seals migrate away from their breeding grounds but still come onshore to rest at traditional haul out sites. In recent years, immature sea lions are increasingly present on northern California haul-out sites such as Ano Nuevo, Point Reyes, and the Farallon Islands during the summer. Sea lions will stampede into the water when resting onshore and disturbed by people on foot, low flying aircraft, or vessel traffic. Chronic human disturbance causes California sea lions to abandon rookeries.

Guadalupe fur seal. *Arctocephalus townsendi* is distinguished from other fur seals by its large head and long, pointed snout. Currently, the species breeds only on Isla de Guadalupe, off Baja California, Mexico (Fleischer 1978). Like the northern fur seal, they have a thick layer of underfur that prevents heat loss and gives buoyancy by trapping air. Males are much larger than females, measuring 1.8 meters (6 feet) in length and weighing about 158 kilograms (350 pounds), compared to the average weight of 45 kilograms (100 pounds) for females (Orr and Helm 1989). Historically, the Guadalupe fur seal ranged from the Farallon Islands south to Revillagigedo Islands off of Mexico; however, the species was nearly exterminated by commercial seal hunters (Fleischer 1978). Currently, their range is from Guadalupe Island, Mexico, north to the California Channel Islands. The estimated population at Guadalupe Island in 1977 was less than 2,000 seals (Bonnell *et al*. 1983). The Guadalupe fur seal is currently rare. Guadalupe fur seals prefer to haul

1. setae- slender, typically rigid or bristly, and springy parts/organs of animals or plants.
2 elytra- thickened, sclerotized anterior wing in beetles and other insects, serving to protect the posterior wings.
3. dorsum-entire dorsal surface of an animal or upper surface of an appendage or part.

out on solid rocky shores at the base of cliffs; however, they also occur on sandy beaches on San Miguel Island, California. The breeding season extends from late spring to summer and most pups are born in June.

Harbor seal. Harbor seals, also known as the common or spotted seal, are the smallest and the most widespread of all pinnipeds in the eastern Pacific (Bigg 1981). Males are only slightly larger than females and both measure around 1.5 to 1.8 meters (5 to 6 feet) in length and weigh 58.5 to 90 kilograms (130 to 200 pounds). Harbor seals are the only pinniped species found throughout the northern latitudes of the world and are separated into five subspecies based on morphology and geography. The subspecies found in California ranges from the Bering Sea, Alaska, south to Isla San Martin, Baja California, Mexico (Bigg 1981). Rough estimates of the total population of harbor seals of the subspecies, *Phoca vitulina richardsi*, range from 300,000 to 350,000 (Boveng 1988). However, there is not a free exchange of seals throughout this range, and instead, the population is comprised of regional stocks. For example, seals on the southern Channel Islands, and in central and northern California are thought to form separate stocks (Boveng 1988). Sixty percent of seals counted in 1987 occurred north of San Francisco. Point Reyes and the southern Channel Islands were the areas of highest concentration accounting for 15 and 22 percent, respectively. Bonnell *et al*. (1983) considered Point Reyes to be the most important harbor seal hauling ground in central and northern California. Harbor seals characteristically congregate onshore in groups to rest and rear their young at traditional sites that are generally used year round. The abundance onshore at any particular location varies with season, time of day, state of sea, tide, age and sex class, and human disturbance (Brown and Mate 1983, Allen *et al*. 1985, Yochem *et al*. 1987). The substrates upon which they prefer to haul out range from rocky intertidal areas to tidal mudflats and sandy beaches. They are a nearshore seal and are found primarily in protected bays and estuaries. Harbor seals are the least pelagic (ocean-going) of the pinnipeds and haul-out on an almost daily basis (Yochem *et al*. 1987). Daily activity pattern studies indicate that seals spend between 30 to 44 percent of the time per day resting, and 56 to 70 percent either traveling to feeding areas or engaged in foraging activities. Seals, though, are seasonally abundant onshore with more seals hauled out during the breeding (March through June) and molt (June through August) periods than during the winter (Yochem *et al*. 1987). Harbor seals breed

throughout their geographic range; however, there is a latitudinal birthing cline. Seals are born progressively later in the season as one moves north from Baja California, Mexico, where pups are born in February, to Alaska, where they are born in June. Harbor seals generally feed alone or in small groups in nearshore waters and at night on primarily small benthic and schooling fish (Bigg 1981).

Northern elephant seal. Northern elephant seals (*Mirounga angustirostris*) are the largest in size of all pinnipeds, weighing up to 2,300 kilograms (5,083 pounds). Adult males physically mature at 9 years with secondary sexual characteristics such as a large proboscis (long flexible snout). Females lack these features and are much smaller in size. The current world population is estimated at around 150,000. The population is expanding rapidly, doubling every 5 years with growth rates averaging around 14 percent per year (LeBoeuf and Laws 1992). Associated with this rapid increase has been the colonization of many areas along the mainland California coast. At Point Reyes Headland, for example, the colony has grown at an average rate of 16 percent per year and is expanding onto adjacent beaches (Allen *et al.* 1989). Northern elephant seals prefer to congregate onshore in large groups on sandy or cobblestone beaches with a gradual slope. There is a pronounced annual pattern in seal abundance onshore with seals most abundant during the molt (April through July) and breeding season (December through March). The breeding range extends from southern Oregon to Baja California, Mexico. Currently in California, elephant seals breed on the southern Channel Islands (Santa Barbara County), Ano Nuevo Island and mainland (San Mateo County), the Farallon Islands (San Francisco County), Diablo Cove (San Luis Obispo County), Cape San Martin (Monterey County), Point Reyes (Marin County), and Point Saint George (Del Norte County). There is also a new colony in southern Oregon near Cape Blanco. The protracted molt period is due to seals of different age and sex classes molting in sequence; however, peak numbers occur in April and May when immatures and adult females are onshore. When onshore, seals remain hauled out continuously, fasting.

Northern fur seal. Fur seals are members of the family of eared seals (Family Otariidae) and are unique among seals because of a thick layer of underfur that insulates them from their environment. Northern fur seal (*Callorhinus ursinus*) males weigh about four times more than females, measuring up to 2 meters (6.6

feet) and weighing 270 kilograms (600 pounds). Fur seals were hunted for their fur but were given special protection by the North Pacific Fur Seal Convention in 1911. The population recovered until 1974 when it began to decline at an average annual rate of 5 to 8 percent. In 1985, the United States ceased annually harvesting fur seals, and the Marine Mammal Commission has designated northern fur seals a depleted species (Marine Mammal Commission 1988). The current world population of northern fur seals is around 1 million. The breeding population on San Miguel Island is around 11,000. The first documentation of northern fur seals breeding on San Miguel Island was in 1961, and between 1969 and 1978, the rate of increase in pups grew 46 percent annually from a total of 28 to 635 pups. Northern fur seals lead a mostly pelagic life (9.5 months) and come onshore only during the breeding season, from May to August. San Miguel Island is the southernmost breeding location of the northern fur seal. The breeding colonies occur in the north Pacific extending from Robben Island in the Okhotsk Sea, the Pribilof Islands, and Commander Islands of Alaska, south to San Miguel Island, California, and more recently the Farallon Islands of California. Fur seals have a polygynous reproductive system whereby males hold territories with females. Females give birth to a single pup, and a few days after giving birth, females go on feeding cycles at sea, returning to nurse pups on land. Unattended pups form pods on the beach until females return. The pups remain at rookeries until November and then go to sea (Orr and Helm 1989).

Steller sea lion. Steller sea lions (*Eumetopias jubatus*) are the largest member of the family of eared seals, Otariidae, and are sexually dimorphic in size and appearance. Males weigh 1 metric ton (2,204 pounds) and are about 2.9 meters (9.5 feet) long, whereas females weigh about 0.2722 metric ton (600 pounds). The mane and roar of the adult males gives the impression of an African lion, and accounts for their name (Orr and Helm 1989). Steller sea lions are widely distributed around the Pacific from Hokkaido, Japan, north to the Bering Sea and south to the Southern California Bight. The breeding range of Steller sea lions, however, has been shrinking steadily in California since the 1930's and more sharply throughout the range since the 1960's (King 1983, National Marine Fisheries Service 1992). The number of animals in the central Gulf of Alaska has declined about 52 percent (down 2.7 percent per year) from 140,000 in 1956 to 1960 to 68,000 in 1985. The species was listed as threatened under the

Endangered Species Act in 1991. In Oregon, the estimated population is around 3,000 animals concentrated at only a few coastal rocky locations (Bonnell *et al*. 1983). In California up until the 1970's, Steller sea lions bred regularly in small groups on San Miguel Island, the Farallon Islands, and at Point Reyes Headland, but no pups have been born at San Miguel Island or Point Reyes Headland since then. The population of Steller sea lions in California is currently estimated to be around 2,000 animals (Bonnell *et al*. 1983). Steller sea lions are present on haul-out sites year round, but the highest numbers occur between June and August during the breeding season. Steller sea lions give birth and breed on sloping, flat rocky areas and cobblestone or coarse sand beaches that are protected from high waves. A female may nurse a yearling and newborn at the same time but nursing usually lasts from 32 to 44 weeks. Steller sea lions eat primarily fish and squid but also will prey on crustaceans and mammals. They are believed to feed on what is seasonally abundant. They also feed on harbor seals, northern fur seal pups, and sea otters (Antonelis and Fiscus 1980).

Cetaceans. There are several federally-listed species of large whale that occur in the inshore waters of California, Oregon, Washington, and Baja California, Mexico. Blue, sperm, and humpback whales are still listed as endangered under the Endangered Species Act, and good population estimates are lacking. On occasion, whales are known to strand onshore when alive or dead. Examples of stranded cetaceans in California include gray whale (*Eschrichtius robustus*), sperm whale (*Physeter macrocephalus*), blue whale (*Balaenoptera musculus*), and humpback whale (*Megaptera novaeangliae*). Other species occur regularly nearshore, are not listed, but are protected by the Marine Mammal Protection Act. Examples of these species include minke whale (*Balaenoptera acutorostrata*) and killer whale (*Orcinus orca*). Most species have recovered in number substantially during the past two decades. The current population estimate of eastern Pacific gray whales is 24,000, and in 1993 the species was removed from the endangered species list (Marine Mammal Commission 1996).

Humpback and gray whales regularly occur in coastal areas. Both species engage in long migration from northern latitudes south during the winter months, and both forage in the Bering Sea. Much is known of the migratory habits of the gray whale which travels close to shore and calves in lagoons of Baja California, Mexico, and

in southern California; however, less is known of where humpback, blue, or sperm whales calf. Given the species' ability to travel great distances, calving could occur anywhere in the Pacific Ocean. Despite their recovery, whales remain vulnerable to the effects of various human activities including coastal development, commercial whale watching, oil and gas development, and salt recovery operations in breeding lagoons of Baja California, Mexico. Development in breeding lagoons is of particular concern because whales have departed from lagoons temporarily when underwater noise levels were excessive. Every year whales are entangled and drowned in fishing nets or hit by ships (Marine Mammal Commission 1996).

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APPENDIX F

U.S. FISH AND WILDLIFE SERVICE
EXCLOSURE PROTOCOLS FOR SNOWY PLOVER NESTS

July, 1999

The purpose of these protocols is to provide standard guidelines for permittees who have been approved to use exclosures to protect nests of the coastal population of the western snowy plover (*Charadrius alexandrinus nivosus*). Information presented here is based on work conducted in California and Oregon, scientific literature describing use of exclosures to protect Atlantic coast piping plovers, and personal communications with biologists protecting plovers with exclosures.

These protocols are periodically revised. Therefore, prior to using them, please contact us (the U.S. Fish and Wildlife Service) to make sure they are the most up-to-date version. Permittees who want to make modifications to these protocols should confer with us and obtain permission prior to making changes to the exclosure designs described in these protocols.

I. Determine Whether Exclosures Are Appropriate

Exclosures should be used only if nest success of plovers is low because of predation or human impacts (i.e., off-road vehicles, horses, high public use areas). Exclosures should be used only when other less intrusive alternatives to protect nests are not appropriate, effective, or practical.

Alternatives include closing breeding areas to public use during the breeding season (March 1 through September 30) or portions thereof, if human disturbance is a limiting factor in nest success. Barriers (e.g., fences) may be used in some breeding areas (i.e., peninsulas, levees, etc.) to prevent people and/or predators from disturbing or destroying nests. These alternatives can effectively protect nests (and possibly chicks) without disclosing individual nest locations or causing disturbance to the adults.

II. Goals of Exclosure Use

Rimmer and Deblinger (1990) described their goals in designing an exclosure to protect Atlantic coast piping plovers. These goals shall be met when designing and implementing any predator exclosure program for the western snowy plover:

A. predators should be unable to penetrate an exclosure;
B. exclosures should allow unimpeded movements of plover adults and chicks between the nest, foraging, and roosting areas, etc.;
C. plover breeding behavior should not be significantly disrupted.

Exclosures shall <u>not</u> be erected:

A. when a nest is close to high tideline and will be flooded;
B. if there is a potential conflict with other endangered species.

Exclosures shall be removed approximately three days prior to hatching if exclosures are used as perches by kestrels (*Falco sparverius*) or loggerhead shrikes (*Lanius ludovicianus*). Exclosures should be removed immediately if they are being used as perches by predators of adult snowy plovers, such as merlins (*Falco columbarius*) and peregrine falcons (*Falco peregrinus*).

III. Exclosure Design and Construction

Presented in this section are protocols for two exclosure designs which the Service has determined to effectively deter ground and aerial predation on snowy plover nests. Both 5 x 5 centimeter (2 x 2 inch) and 5 x 10 centimeter (2 x 4 inch) mesh has been used effectively for both triangular and circular exclosures. The selected mesh size should be monitored closely and may need to vary by location or situation, depending on threats and problems that snowy plovers face. For example, small mammals (e.g., skunks) potentially may be able to get through 5 x 10 centimeter (2 x 4 inch) mesh, and 5 x 5 centimeter (2 x 2 inch) mesh could potentially slow down the speed with which adult snowy plovers can move through the mesh, thereby jeopardizing their survival. If evidence shows that snowy plover adults are being lost during the breeding season, efforts should be made to determine the cause and if exclosure mesh size is a factor, appropriate modifications to mesh size should be made. The design and construction of the triangular and circular exclosures are as follows:

A. The Triangular Exclosure

In central coastal California, 254 triangular exclosures were erected from 1991 to 1993 (Parker *et al.* 1992; U.S. Fish and Wildlife Service unpubl. data; Point Reyes Bird Observatory unpubl. data).

A total of 3 protected nests were preyed upon by mammals (1 non-native red fox, 2 skunks) (Point Reyes Bird Observatory unpubl. data). Although Deblinger et al. (1992) made no recommendation for the style of exclosures to use, it should be noted that triangular exclosures experienced no predation during their study. Tops should only be used on the triangular exclosure when avian predation has been documented and is a potential problem. Figure 1 shows the design of a triangular exclosure.

Exclosures shall be:

1. triangular in shape with a minimum perimeter of 22.8 meters (75 feet);
2. made of metal mesh fence (5x5 or 5x10 centimeters - 5 centimeters (2 inches) wide, 5 centimeters (2 inches) high or 5 centimeters (2 inches) wide, 10 centimeters (4 inches) high), 3 pre-cut sides each 7.6 m (25 feet) in length (5x10 centimeters (2 x 4 inches)) is the minimum in red fox areas);
3. supported by at least 6 sturdy metal 154-centimeter (5-foot) fence posts;
4. have a fence height of at least 122 centimeters (4 feet) above the sand (with another 4 inches of overhang), and buried 20 cm (8 inches) in soft earth or sand;
5. erected in under 30 minutes without tops, 45 minutes with tops;
6. erected around complete clutches (usually 3 eggs) unless accelerated predation rates warrant construction prior to the clutch completion;
7. erected by a minimum of 2 persons, 1 person must have been trained by an experienced exclosure builder;
8. colored nylon webbing along the top edge may be used to alert birds to presence of the structure and therefore avoid “bird strikes.”

Methods for construction of triangular exclosures:

1. prior to construction, assign tasks to individuals to avoid confusion during set-up;

2. upon arrival at the nest site, cover the nest with a bright object (hat, rag, etc.) to shade the eggs from the sun and prevent the nest from accidentally being stepped on;
3. use a rope as a guide to simulate the perimeter of the exclosure with the nest centered within the rope outline;
4. pound six 1 centimeter (0.4 inch) x 244 centimeter (8 foot) steel reinforcement bars (rebar), three corners and three supports, approximately 122 centimeters (4 feet) into the ground;
5. dig a trench, at least 20 centimeters (8 inches) deep, around the perimeter (follow the guide rope);
6. carefully place the three 7.60 meter (25 foot) long walls, made of mesh wire, into the trenches,
7. fasten the wire to the rebar posts using standard, brass hog rings (or wire), removing all slack from the wire and insuring the wire will be buried at least 20 centimeters (8 inches);
8. bend the top 10-15 centimeters (4-6 inches) of wire outward at a 45 degree angle to discourage mammalian predators from climbing over the exclosure;
9. refill the trenches, insuring that the wire lies flush with the sand surface, allowing plovers to move freely through the exclosure;
10. rake the area to remove footprints and level the sand;
11. upon completion, leave the area immediately.

If a top is included, tops should be:

1. made of black seiners twine (or comparable material), avoid using clear monofilament line or fish netting;
2. twine should be set in parallel rows 15 centimeters (6 inches) apart.

Methods for construction of tops:

1. prior to exclosure set-up, ready enough wood strapping (2.5 x 5 centimeters) (1 x 2 inches) to be attached to two sides of the exclosure;
2. on the wood strapping, place small hooks, used to hold the twine, at 15 centimeter (6 inch) intervals;
3. after completion of exclosure perimeter, attach wood strapping (2.5 centimeters x 5 centimeters) (1 x 2 inches) along 2 sides of the exclosure with bailing wire;

4. attach twine to hooks creating parallel rows as you move along the exclosure, ensuring the twine is taut;
5. if twine loosens, tighten it by wrapping it around the hooks.

B. The Circular Exclosure

In Oregon, a circular exclosure design with a top has proven an effective means of deterring ground and aerial predation on snowy plover nests. In one study at sites along the Oregon Coast in 1990 to 1993, 85 percent (n=66) of plover nest with exclosures hatched compared to only 15 percent (n=67) of unprotected nests (Stern 1994). The circular exclosure maximizes the distance between the edge of the exclosure and the nest. Figure 2 shows the design of a circular exclosure.

Exclosures shall be:

1. generally circular in shape with a 20.3 meter (66 foot, 7 inch) perimeter;
2. made of 122 centimeter tall mesh fence with 5 x 5 or 5 x 10 centimeter (2 x 2 inch or 2 x 4 inch) mesh size;
3. supported by eight 154 centimeter (5 foot) tall steel posts;
4. achieve a fence height of 106.7 centimeters (3 feet, 6 inches) above ground with 20 centimeters (8 inches) buried;
5. erected in under 60 minutes, including top;
6. erected by a minimum of 2 persons, with one person previously trained by an experienced exclosure builder;
7. erected around complete clutches unless accelerated predation rates warrant construction prior to the clutch completion;
8. colored nylon webbing along the top edge may be used to alert birds to presence of the structure and therefore avoid “bird strikes.”

Methods for construction of exclosures:

1. prior to arrival at the nest site wipe oil off of the 20.3 meter (66 foot, 7 inch) length of metal mesh fence, connect ends to each other, making sure that no sharp points protrude at the place of joining, then role up the fence;
2. prior to arrival at the nest site, assign tasks to individuals, and provide training and explanation to new exclosure builders;
3. upon arrival at the nest site, place a cap over the eggs to protect the eggs from the sun, and to mark the location of the nest. If permit allows handling of eggs, float the eggs to determine incubation stage;

4. unroll fencing material so that the middle of the fence is about 10 meters (33 feet) from the nest, and the fence ends are equidistant from the nests;
5. have each person take a fence post in hand or place it nearby;
6. have one person pick up the top half of fence, and at once lift and pull the fence to extend over and beyond the nest, then gently stand up the exclosure;
7. place the two fence posts inside the exclosure and have both persons stretch the fence slightly;
8 have one person pound in the first fence post, then assist the second person to pound in the second fence post;
9. pound in remaining fence posts at equal distances, gently stretching fencing to attain desired configuration;
10. dig a 20 centimeter (8 inch) trench underneath the bottom of the fence, pull the fence down into the trench, then refill with sand;
11. level the sand around the exclosure with horizontal stretches of mesh;
12. pound all fence posts in further so that the tops are about 5 centimeters (2 inches) below the top of the wire;
13. upon completion, leave the area immediately.

If a top is included, it should be:

1. made of black seiners twine (or comparable material), avoid using clear monofilament line or fish netting;
2 twine should be set in parallel rows 15 centimeters (6 inches) apart.

Methods for construction of tops:

1. extend the twine across the exclosure, tying ends off on each parallel row;
2. each row should have the same degree of tightness;
3. Run one row of twine in perpendicular direction, bisecting each row at midpoint, thus providing support to the rows of twine.

III. **Timing of Exclosure Set-up**

Exclosures may not be erected under the following conditions:

A. on windy (> 20 mph) or rainy days
B. 2 hours or less before sunset

C. less than 1.5 hours after sunrise
D. when the air temperature exceeds 80 degrees Fahrenheit
E. during constant or steady rain.

IV. Monitoring Exclosures

Exclosures must be monitored at least twice per week. Information gathered should include:

1. fate of the eggs
2. presence or absence of incubating bird and mate
3. status of exclosure
4. presence of predators
5. other disturbances.

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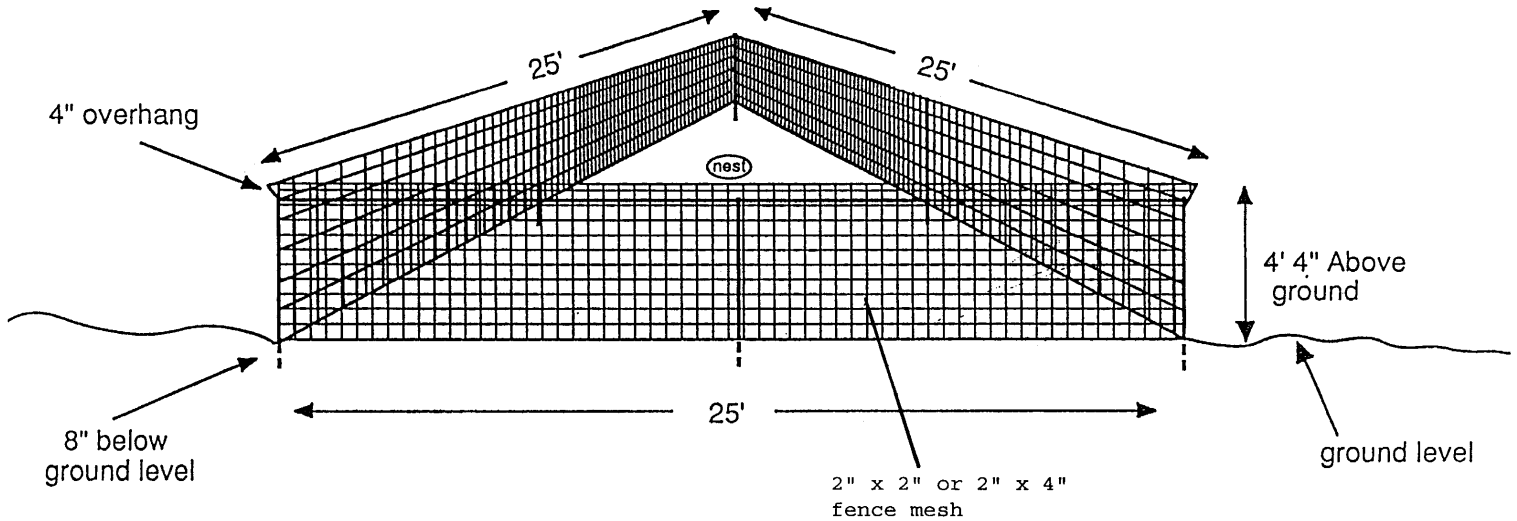
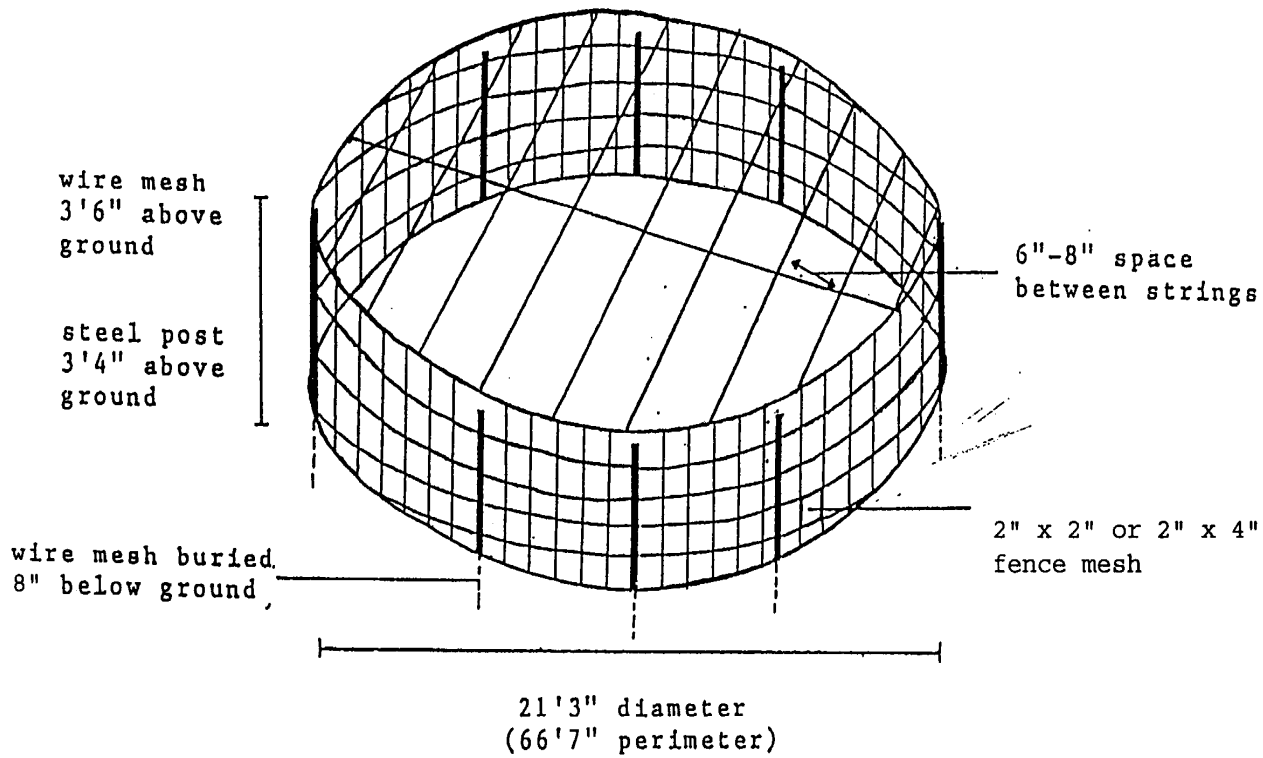


SOURCE: M. PARKER, SAN FRANCISCO BAY NATIONAL WILDLIFE REFUGE

Figure F-1. Triangular Exclosure Design



SOURCE: M. STERN, THE NATURE CONSERVANCY

Figure F-2. Circular Exclosure Design

APPENDIX G. PRIORITIES FOR RECOVERY OF THREATENED AND ENDANGERED SPECIES

(Priority System Developed and Used by the U.S. Fish and Wildlife Service)

Degree of Threat	Recovery Potential	Taxonomy	Priority	Conflict
High	High	Monotypic Genus	1	1C
	High	Species	2	2C
	High	Subspecies	3	3C
	Low	Monotypic Genus	4	4C
	Low	Species	5	5C
	Low	Subspecies	6	6C
Moderate	High	Monotypic Genus	7	7C
	High	Species	8	8C
	High	Subspecies	9	9C
	Low	Monotypic Genus	10	10C
	Low	Species	11	11C
	Low	Subspecies	12	12C
Low	High	Monotypic Genus	13	13C
	High	Species	14	14C
	High	Subspecies	15	15C
	Low	Monotypic Genus	16	16C
	Low	Species	17	17C
	Low	Subspecies	18	18C

C: Indicates some conflict between the species' conservation and construction of development projects or other forms of economic activity.

The national recovery priority assigned to the Pacific coast population of the western snowy plover is 3C, indicating a subspecies with high threat and high recovery potential.

APPENDIX H

CONSERVATION TOOLS AND STRATEGIES

Rights and Interests in Land that Can be Acquired

Right or Interest	Explanation	Advantages	Disadvantages
Fee simple ownership	Full title to land and all rights associated with land.	Owner has full control of land. Allows for permanent protection and public access.	Most costly. Ownership responsibility includes liability and maintenance.
Conservation easement / development rights (If used for snowy plover habitat, access to monitor snowy plover populations should be added to conservation easement)	A partial interest in property transferred to an appropriate non-profit or governmental entity either by gift or purchase. As ownership changes, the land remains subject to the easement restrictions.	Less expensive than fee simple. Landowner retains ownership and property is taxed at a lower rate. Easement may allow for some development. Potential income and estate tax benefits from donation.	Public access may not be guaranteed. Easement must be enforced. Restricted use may lower resale value. If the easement has a "sunset" then permanent protection is not guaranteed.
Fee simple / leaseback	Purchase of full title and leaseback to previous owner or other lessee. May impose land use restrictions.	Allows for comprehensive preservation program of land banking. Income through leaseback. Liability and management responsibilities assigned to lessee.	Public access is not guaranteed. Land must be appropriate for leaseback (e.g., agricultural).
Lease	Short or long-term rental of land.	Low cost for use of land. Landowner receives income and retains control of property.	Does not provide equity and affords only limited control of property. Temporary.

Right or Interest	Explanation	Advantages	Disadvantages
Undivided Interest	Ownership is split between different owners, with each fractional interest extending over the whole parcel. Each owner has equal rights to entire property.	Prevents one owner from acting without the consent of the others.	Several landowners can complicate property management issues, especially payment of taxes, future sale, land uses, and access.
Deed Restriction	Voluntary or imposed restriction on land use placed on title by landowner.	Can prevent impacts to or protect habitat and/or open space values as long as landowner retains the restriction.	Is easily removed from property title by property owner without government. knowledge. Does not guarantee even short-term protection.

Ways that Title Can Be Acquired

Technique	Explanation	Advantages	Disadvantages
Fair market value sale*	Land is sold at its highest and best use value.	Highest income (cash inflow) to seller.	Most expensive. Greatest capital gains.
Bargain Sale*	Part donation/part sale - property is sold at less than fair market value.*	Tax benefits to seller since difference between fair market value and sale price is considered a charitable contribution. Smaller capital gains tax.	Seller must be willing to sell at less than fair market value.
Charitable Gift	A donation by landowner of all interest in property.*	Allows for permanent protection without direct public expenditure. Tax benefits to seller since property's fair market value is considered a charitable contribution.	Seller must be willing to donate.

Technique	Explanation	Advantages	Disadvantages
Bequest	Landowner retains ownership until death.*	Management respon-sibility usually deferred until donor's death.	Date of acquisition is uncertain. Donor does not benefit from income tax deductions. Landowner can change will, will may contain land use conditions unfavorable to open space/ habitat use.
Donation with reserved life estate	Landowner donates during lifetime but has lifetime use.	Landowner retains use but receives tax benefits from donation.	Date of acquisition is uncertain.
Land exchange	Exchange of developable high habitat/open space land for land with equal development potential but less habitat/open space value.	Low-cost technique if trade parcel is donated. Reduces capital gains tax for original owner of protected land.	Properties must be of comparable value. Complicated and time consuming.
Eminent domain (government)	The constitutional police power of government to take private property for public purpose upon payment of just compensation.	Provides government with a tool to acquire desired properties if other acquisition techniques are not workable.	Can be expensive. Can have negative political consequences. Can result in expensive and time consuming litigation.
Tax foreclosure (government)	Government acquires land by tax payment default.	Limited expenditure. If land is not appropriate for public open space, it can be sold or exchanged.	Competitive sealed bidding risk.
Purchase of a Deed of Trust (1st)	Government acquires land by defaulted loan (private institution) payment and subsequent foreclosure.	Land can be acquired at a distressed sale price.	Can be complicated and result in conflict with local Tax Collector/Assessor

Technique	Explanation	Advantages	Disadvantages
Agency transfer (government)	Certain government agencies may have surplus property inappropriate for their needs that could be transferred to a parks agency for park use.	Limited expenditure.	Time consuming with possible conflicts with local government.
Restricted auction (nonprofit)	Government restricts the future use of property to open space, then sells.	Property sold to highest bidder but restriction lowers price and competition.	It may be difficult for a nonprofit to convince government that a restriction will serve to benefit the general public. Can be expensive.

* There are different ways of financing, i.e.: cash, mortaged, owner financed, lease/option, etc. with some means having greater tax benefits than others for the seller and some means more easily financed by government than others. Conservation easements also can be acquired by these means.

Management and Ownership Options Following Purchase by Non-profit Organization

Technique	Explanation	Advantages	Disadvantages
Conveyance to public agency	Non-profit organiza-tion acquires and holds land until public agency is able to purchase.	A non-profit organization can enter the real estate market more easily than government, and can often facilitate a sale when the government agency would be unable.	Must have a public agency willing and able to buy within a reasonable time frame. Private fund raising can be difficult.
Conveyance to another non-profit organization	Non-profit organization acquires and holds land until another non-profit organization has been established or is able to finance acquisition.	Allows immediate acquisition even though acquiring group cannot or is not willing to hold property.	Requires existence or establishment of ultimate land holder that has solid support, funding and the ability to manage land.
Management by non-profit organization	Non-profit organization retains ownership and assumes management responsibilities.	Ownership remains within the community; local citizens can provide responsible care and management.	Land must fit criteria of acquiring organization. Organization must assume long-term management responsibilities and costs.
Saleback or leaseback	Non-profit organization purchases property, limits future development through restrictive easements or covenants, and resells or leases back part or all of property. May involve subdivision of property.	Acquisition is financed by resale or leaseback. Resale at less than fair market value (because of restrictions) makes land affordable for buyer. Sale can finance preservation of part of site.	Complex negotiations. A leaseback means the nonprofit organization retains responsibility for the land.

Financing Options for Government

Financing Option	Explanation	Advantages	Disadvantages
General fund appropriation	Appropriation from primary government funds.	Avoids interest and debt service cost.	Budget allocations unpredictable. Might not provide sufficient funds, and competes with other programs.
Bond act	Borrowing money through insurance of bonds. Usually approved through local or statewide referendum.	Distributes cost of acquisition. Does not impact general funds.	Requires approval of general public. Can be expensive - interest charges are tacked on to cost of project.
Land and Water Conservation Fund	Federal funds provided to local governments on a 50/50 matching basis for acquisition and development of land for public use.	Cost of acquisition for local government is lowered by subsidy.	Federal release of these funds is uncertain and has been extremely limited to date. Competition is extreme.
State grant/low interest loans	States provide matching grants or low interest loans for municipalities to acquire open space.	Encourages localities to preserve open space by leveraging local funds. Donated lands may be used as a match.	Localities must compete for limited funds and be able to match state funds.
Real estate transfer tax	Acquisition funds obtained from a tax on property transfers. Percentage and amount exempted varies with locality.	Growth creates a substantial fund for open space acquisition. Enables local communities to generate their own funds for open space protection.	Places greater burden on new residents than on existing residents. Can inflate real estate values. Effective only in growth situations.
Land gains tax	Capital gains tax on sale or exchange of undeveloped land held for a short period of time. Tax rate varies depending on holding period.	Discourages speculative development. Has a regulatory and revenue impact.	Can inflate real estate values and slow market.

Financing Option	Explanation	Advantages	Disadvantages
Payment in lieu of dedication	Local government requires developers to pay an impact fee to a municipal trust fund for open space acquisition.	New construction pays for its impact on open space.	Acquisition funds depend on development. May be lack of accountability for funds. Legality of method depends on relationship of open space to new development.
Special assessment district	Special tax district for area benefitted by a public benefit project.	Users finance acqui-sition and manage-ment.	Increases taxes. Timely and costly to implement. Requires 2/3 voter approval in California.
Tax return check off	On state income tax forms, a filer may appropriate a small amount of taxes owed toward revenues for natural lands acquisitions.	Convenient and successful means of generating funds.	Vulnerable to competition from other worthwhile programs.
Other funds/taxes	Taxes on cigarettes, sales, gasoline, and natural resource exploitation; revenue from fees and licenses for boat, off-road vehicle, and snowmobile use, park entry, hunting, etc.	Income from fees and licenses pays for resources.	Revenues from taxes can be diverted for other uses unless dedicated to open space. Fees create pressures for money to be spent on special interest uses.
Sale or transfer of tax default property	Sale of tax default property can provide a fund for open space acquisition. Also, if site meets criteria, it can be transferred to appropriate agency for park use.	Funds for acquisition are acquired with little cost to taxpayers.	Need to assure that sale proceeds are specially allocated to open space acquisition. Might not provide a significant income. Very political process.

Financing Options for Non-Profit Organizations

Financing Option	Explanation	Advantages	Disadvantages
Loan from institutional or private lender	Conventional loan from bank or savings and loan or private source, such as a foundation or corporation.	Less time-consuming process than fund raising.	Long-term financial commitment for non-profit organization. Higher interest costs than owner financing. Mortgage lien.
Installment sale	Buyer pays for property over time.	If seller financed, can lower taxes for seller. Buyer can negotiate better sale terms (lower interest rates).	Long-term financial commitment for non-profit organization. Mortgage lien.
Fundraising	No- or low-interest loans are acquired through program related investments from foundations, non-standard investments from corporations, or charitable creditors (community members).	Community fundraising creates publicity and support.	A long, uncertain, and time consuming process.
Revolving fund/loans or grants	A public or private organization makes grants to localities or non-profit organizations for land acquisition based on a project's revenue generating potential.	Encourage projects with revenue generating potential.	Projects with low revenue- generating potential have lower priority.
Partial development/ saleback or lease	Non-profit organization purchases property, limits future development through restrictive covenants, and resells or leases back part or all of property.	Acquisition is financed by resale or leaseback. Sale can finance preservation of part of site.	Complex negotiations. If leaseback, non-profit organization retains responsibility for land. Finding buyer for restricted property may be difficult, and land value will be lowered by restrictions.

Government Financial Incentives for Conservation

Incentive	Explanation	Advantages	Disadvantages
Preferential assessment	Under state laws, agricultural and forest districts can be established to assess land as farmland or forestland rather than at its highest and best use.	Promotes resource conservation and management. Especially benefits landowners in areas with development pressure. Tax base loss can be partially reclaimed through penalty tax on landowners who terminate enrollment.	Voluntary participation. Does not provide long-term protection. Minimum acreage for entry. Strength of program depends on penalty from withdrawals. Local government bears burden of reduced tax base.
Purchase of development rights	Local or state government purchases development rights to maintain land in farm use.	Landowner can derive income from selling development rights and continue to own land. Lower property value should reduce property taxes.	Can be costly, particularly in a community with high real estate values.
Land conservation grants	State programs pay or otherwise enable landowners to preserve land, enhance wildlife, and provide public access.	Landowners derive revenues from preserving land without selling interests in land.	Provision of public expenditures.

Safe Harbors Agreements

Incentive	Explanation	Advantages	Disadvantages
Create incentives by removing restrictions under section 9 of Endangered Species Act. Allows "take" of listed species beyond baseline conditions (i.e., those lands or animals protected at time of signing of agreement).	Private landowners and non-Federal property owners encouraged to restore, enhance and maintain habitats for listed species in return for assurances that additional land-use restrictions as a result of voluntary conservation actions will not be imposed.	Could garner non-Federal landowner's support for species conservation on non-Federal lands. By reducing fear of future additional property use restrictions under Endangered Species Act, landowners may enhance their lands for listed species. Could reduce habitat fragmentation and increase population numbers of listed species.	Could adversely affect snowy plover by serving as sink for birds attracted to enhanced habitat, only to have habitat later lost to development. May not be adequate incentives other than public relations value, and may not offer value over traditional Habitat Conservation Plans. Opportunities may be few in states with strong coastal protection regulations.

Regulatory Techniques - Growth Control

Technique	Explanation	Advantages	Disadvantages
Phased growth	Permits a limited amount of growth each year.	Effective as a comprehensive planning strategy.	There must be an equitable system to approve development. Future development pressures difficult to predict.
Moratorium	Legal postponement or delay of land development.	Useful as an interim measure during the formulation of a master development plan.	Provides only a temporary solution and can create a rush on land development prior to taking effect.
Transfer of development rights	An owner of publicly-designated land can sell development rights to other landowners whose property can support increased density.	Cost of preservation absorbed by property owner who purchases development rights.	Difficult to implement. Preservation and receiving areas must be identified.

Regulatory Techniques - Zoning and Subdivision Provisions

Technique	Explanation	Advantages	Disadvantages
Large lot zoning	Large minimum lot sizes restrict the density of the development.	An established land use control used as part of a comprehensive plan.	Since zoning is subject to change, not effective for permanent preservation. Can increase real estate values and infrastructure costs can foster urban sprawl.
Performance zoning	A zone is defined by a list of permitted impacts (based on natural resource data and design guidelines) as opposed to permitted uses.	Directs development to appropriate places based on a comprehensive, environmentally-based plan. Can be implemented through cluster development.	Difficulties in implementation since environmental impacts can be hard to measure and criteria are hard to establish. Plan can be expensive to prepare.
Carrying capacity zoning	Based on the ability of an area to accommodate growth and development within the limits defined by existing infrastructure and natural resource capabilities. Often called Current Planning Capacity.	Zoning is based on an area's physical capacity to accommodate development. Can be implemented through cluster development.	Requires a comprehensive environmental inventory for implementation. Determining carrying capacity can be a difficult process, subject to differing opinions, quality-of-life assumptions, and changing technologies.

Technique	Explanation	Advantages	Disadvantages
Cluster Zoning/planned unit development (PUD)	Maintains regular zoning's ratio of housing units to acreage but permits clustered development through undersized lots, thus allowing for open space preservation. A PUD provision allows clustering for a large, mixed-used development.	Flexibility in siting allows preservation of open space areas within development site. Can reduce construction and infrastructure costs.	Open space often preserved in small separate pieces, not necessarily linked to a comprehensive open space system. May increase processing time for development approval. Lack of infrastructure can inhibit technique.
Preservation overlay zoning	At discretion of municipality, overlay zones with development restrictions can be established to protect agricultural and natural areas, scenic views, and historic neighbor-hoods.	Special zones have regulations specific to the needs of a unique area and may be subject to mandatory clustering, performance standards, special permits, and site plan and architectural review.	Language in special district ordinance must be specific enough to avoid varying interpretations.
Exaction	As a condition of obtaining subdivision approval, local government requires developers to pay a fee or dedicate land to a municipal trust fund for open space. Also, states can require open space set-asides as part of environmental review.	New construction pays for its impact on open space.	Acquisition funds dependent on residential development. Commercial development often not subject to exaction fees. Difficult to calculate developer's fair share of costs. New case law restrictions.

Technique	Explanation	Advantages	Disadvantages
Conservation density subdivisions	Permit developers an option of building roads to less expensive specifi-cations in exchange for permanent restrictions in number of units built. Roads can be public or private.	Increases open space and reduces traffic. Discourages higher densities to pay for the higher cost of road building.	Requires enforcement of easements. Private roads limit public access and require homeowner association maintenance.

Regulatory Technique - Conservation/Mitigation Banks

Technique	Explanation	Advantages	Disadvantages
Conservation/ mitigation banks	Wildlife habitat areas are restored and permanently protected by selling credits to offset development impacts elsewhere.	Could advance regional habitat conservation by allowing mitigation credits at sites recognized to be high priority for regional conservation in exchange for areas of minimal habitat value.	If not carefully considered and development projects are not consistent with all Federal and state laws, could facilitate habitat loss. Environ-mentally contro-versial.

APPENDIX I

SUMMARY OF POTENTIAL FUNDING SOURCES FOR RECOVERY ACTIONS (Partial List)

Funding Program	Explanation	Funding Agency/ Organization
Adopt-a-Beach	Annual grant program to enrolled Adopt-a-Beach managers (Federal, state, local and nonprofit land managers). Designed to strengthen and encourage current Adopt-a-Beach programs, including public education, clean-up and enhancement of beaches. Average grant is $6,000.	California Coastal Commission
Borderlands Initiative	Joint U.S.-Mexico grant program for conservation of Mexico's fish, wildlife and plant resources. Priority given to projects that strengthen Mexico's capacity for sustainable management of its biological diversity which result in on-the-ground conservation actions. Annual grant program funding up to $50,000 for long-term training project; $30,000 for short-term training projects; and $25,000 for all other proposals.	U.S. Fish and Wildlife Service (cooperative programs with Mexico)
Coastal Ecosystem Program for San Francisco Bay	Program works in partnership with Federal, state and local governments, private organizations and individuals to protect and restore coastal habitats. Emphasizes on-the-ground habitat enhancement projects, developing information for decision makers, and public outreach. Annual funding is approximately $260,000. Average number of projects funded is 13-18 per year.	U.S. Fish and Wildlife Service

Funding Program	Explanation	Funding Agency/ Organization
Coastal Resources Grant Program	Annual grant program requiring local contributions. Part B grants can be awarded to coastal counties and cities with approved local coastal programs for coastal resources management activities, including projects which provide for the protection of wetlands, floodplains, estuaries, beaches, dunes, and fish and wildlife and their habitats within coastal areas. Annually provides approximately $600,000 for Part B grants; individual projects are generally limited to $100,000 each. Part A grants can be used for planning, assessment, mitigation, permitting, monitoring and enforcement, and for other activities related to offshore energy development, consistent with the State of California's coastal management program. Annually provides approximately $3 million; grant applications are generally limited to $500,000 for Part A grants.	State of California Resources Agency

Funding Program	Explanation	Funding Agency/ Organization
Conserving California Landscapes	Five-year (commenced 1998), $175 million initiative to preserve natural ecosystems and agricultural resources in 3 regions of California, including the Central Coast, which extends from the Golden Gate to the Santa Ynez River and the western drainage of the coastal watersheds, including the Big Sur coast, the watersheds of Elkhorn and Watsonville Sloughs, and select resources of San Luis Obispo, Santa Cruz, and San Mateo Counties. Provides grants and loans to enable private land trusts, other nonprofit groups, and public agencies to protect threatened California resources, to work with private landowners to maximize natural values on their lands, and to help communities achieve working landscapes. Provides grants to non-profit organizations for land acquisition, requiring 50 percent matching funds; grants for policy and planning relating to conservation (e.g., imple-mentation of county general plans); and program-related investments.	The David and Lucille Packard Foundation

Funding Program	Explanation	Funding Agency/ Organization
Federal Challenge Cost-Share Program	Program available to U.S. Forest Service and U.S. Bureau of Land Management to provide internal means of augmenting partnership funds for projects benefitting fish and wildlife resources. Requires matching funds by partner(s). Program also available to U.S. Fish and Wildlife Service. Highest priority is for projects providing endangered species recovery habitat. Projects on U.S. Fish and Wildlife Service refuges also have high priority. Requires matching funds by non-Federal partner(s).	U.S. Forest Service and U.S. Bureau of Land Management National Fish and Wildlife Foundation
Partners for Fish and Wildlife	Voluntary cost-sharing program with private landowners for fish and wildlife habitat restoration. Priority given to projects which benefit migratory birds, anadromous fish, and threatened and endangered species. Grants for projects can range from $1,000 to over $25,000.	U.S. Fish and Wildlife Service
Wetlands Reserve Program	Voluntary program offering private landowners the opportunity to protect, restore and enhance wetlands on agricultural lands. Covers up to 100 percent reimbursement for restoration costs.	U.S. Department of Agriculture, Natural Resources Conservation Service

Funding Program	Explanation	Funding Agency/ Organization
Whale's Tail Grant Program for Coastal Marine Education	Annual grant program funded by sale of Whale's Tail license plates, which have been available in California since 1998. Aimed at encouraging development of programs to teach California children and the general public to value and take responsibility for the health of the State of California's marine and coastal environments. Funds docent programs and educational projects (e.g. educational videos). Priority given to educational projects/programs for school children and to underserved populations (e.g., urban areas). Grants range from $1,500 to $10,000.	California Coastal Commission
Santa Barbara County Coastal Resource Enhancement Fund	Annual grant program that requires fees from major oil and gas projects offshore Santa Barbara County. Environmental review of these projects determined that the construction, operation, and eventual abandonment causes significant adverse impacts to four categories of coastal resources: environmentally sensitive resources, aesthetics, recreation, and tourism. Annually, this fund provides approximately $700,000 to enhance coastal resources. Typical projects include coastal acquisitions, improvements at existing coastal parks and beach accesses, and educational programs about the marine environment. These grants vary from a few thousand dollars to a few hundred thousand dollars.	Santa Barbara County

APPENDIX J

MONITORING GUIDELINES FOR THE WESTERN SNOWY PLOVER, PACIFIC COAST POPULATION

Contents

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Introduction

Western snowy plover populations must be monitored to determine progress toward recovery. Monitoring will be most efficient when its elements relate specifically to recovery objectives. Several types of biological monitoring are expected to provide information that will allow assessment of the recovery effort. However, a single monitoring prescription cannot address the varied research and management needs throughout the western snowy plover range. This protocol provides general guidance so each monitoring effort can be consistent with all others, even when specific methods differ from site to site. These guidelines relate to Federal requirements, but prospective surveyors must also assure that their activities comply with requirements under state law.

Two types of monitoring relate directly to recovery criteria:

Population:	Distribution and abundance.
Demographics:	Reproductive success, adult survival, juvenile survival, dispersal.

Other types of monitoring relate indirectly to recovery criteria:

Habitat:	Availability, suitability, enhancements.
Disturbance:	People, pets, vehicles, kites, horses, etc.
Predators:	Presence and impacts of corvids, gulls, raptors, shrikes, coyotes, foxes, skunks, house cats, opossums, other avian and mammalian predators.

Training and Qualifications

Prospective snowy plover surveyors should have good vision, the ability to spend several hours in the sun, and the ability to walk long distances in loose sand. In addition, the U.S. Fish and Wildlife Service has developed minimum training requirements for western snowy plover survey, management, and research activities. Five activity levels are recognized:

Level 1	Winter surveys, or surveys outside known nesting areas.
Level 2	Breeding season surveys and censuses.
Level 3	Erecting exclosures around nests.
Level 4	Breeding season studies or surveys that include handling eggs.
Level 5	Banding and color marking adults or chicks.

While activity levels 1 through 5 are increasingly intrusive, they are not strictly sequential. For example, a field worker may receive training and be certified at level 3, but cannot participate in level 1 or 2 activities without training specific to those levels.

No certification is required for Level 1 activities, but training is encouraged. Level 2, 3, 4, and 5 activities require a Section 10(a)(1)(A) permit from the U.S. Fish and Wildlife Service. Field workers must be certified at the appropriate activity level to qualify for a permit, or to work independently under the holder of an existing permit.

Classroom instruction will be made available for those involved with snowy plover surveys, management, and research (recovery task 1.1.5). At least 4 hours of instruction are required. Topics will include:

1. Biology, ecology, and behavior of 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 the existing Recovery Permit;
7. Other activities (for example: banding, determining incubation stage, erecting exclosures).

Field instruction is required for activity levels 2, 3, 4, or 5. Instruction should take place under the direct supervision of a 10(a)(1)(A) permit holder. Activities for field training include:

1. Locating, identifying, and monitoring nests (levels 2, 4, and 5);
2. Handling eggs and capturing and handling adults or chicks (levels 4 and 5);
3. Erecting exclosures around nests (level 3).
4. Specifics on the target activity for which a permit has been issued;
5. Practical field exercises;
6. Field review of appropriate classroom topics.

Previous experience with snowy plovers, piping plovers, or other closely-related species will not substitute for the training described above. Further detail on obtaining permits, or becoming certified to work under an existing permit, is available through these offices:

CALIFORNIA

U.S. Fish and Wildlife Service
Sacramento Fish and
Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825
(916) 414-6600

U.S. Fish and Wildlife Service
Ventura Fish and Wildlife Office
2493 Portola Road, Suite B
Ventura, California 93003
(805) 644-1766

U.S. Fish and Wildlife Service
Carlsbad Fish and Wildlife Office
2730 Loker Avenue West
Carlsbad, California 92008
(760) 431-9440

U.S. Fish and Wildlife Service
Coastal California Fish and Wildlife Office
1125 16th Street, Room 209
Arcata, California 95521-5582
(707) 822-7201

OREGON

U.S. Fish and Wildlife Service
Newport Fish and Wildlife Office
2127 S.E. OSU Drive
Newport, Oregon 97365-5258
(541) 867-4550

U.S. Fish and Wildlife Service
Oregon State Office
2600 SE 98th Avenue, Suite 100
Portland, Oregon 97266
(503) 231-6179

WASHINGTON

U.S. Fish and Wildlife Service
Western Washington Office
510 Desmond Dr SE, Suite 102
Lacey, Washington 98503
(360) 753-9440

Responsibilities

For effective rangewide monitoring, the network of participants must understand their roles and responsibilities. The following framework is suggested.

The *recovery leader* (recovery task 7) facilitates the work of recovery unit working groups to ensure comparable and consistent monitoring is undertaken throughout the Pacific coast range of the western snowy plover. The recovery leader also produces an annual report that describes results of monitoring throughout the population's range.

Recovery unit working groups (recovery task 3.1.1) should ensure thorough coverage of important sites in their units. They should collate data, prepare summary reports, and ensure appropriate data are submitted to the recovery leader.

Coordinators are landowners, land managers, wildlife managers, or other individuals responsible for monitoring activities at one or more sites. They recruit and train observers for their site(s) and ensure data are reported to recovery unit working groups. They coordinate with recovery unit working groups, beach managers, enforcement leaders, and other affected people to ensure an effective, responsive, and safe survey and management effort. Coordinators may also be observers.

Observers are field workers responsible for completing surveys and reporting results promptly to coordinators.

Population Monitoring

Population monitoring will provide information on distribution and abundance at all breeding and wintering locations listed in Appendix B. Results will be used to assess progress toward recovery criterion 1 and to guide local management, protection assessments, and planning.

The primary source of population data will be two annual, rangewide "window surveys" using the methods outlined below. The breeding season window survey should take place between May 24 and June 7. The winter season window survey should take place between December 1 and January 31. Surveys at adjacent sites should occur on or near the same date, to avoid double-counting individuals moving among sites. All sites occupied in recent years should be surveyed within the window period. Unoccupied sites with suitable habitat should be surveyed as time permits.

Although not all plovers are detected during window surveys, an index of abundance will be obtained for each surveyed site. To relate population indices to recovery criteria, site-specific correction factors will need to be determined. Recovery task 4.3.1 will guide the effort to produce correction factors that will improve abundance estimate accuracy and usefulness.

Methods for Population Monitoring (including "window surveys")

Caution and patience are required for surveying snowy plovers. Surveys should provide maximum coverage with the least possible disturbance to snowy plovers and other fauna and flora.

Early mornings at high tide on calm, dry, overcast days with few or no disturbances constitute ideal survey conditions. Surveys should be suspended or postponed in intense heat, heavy rain, or high wind.

Required equipment for surveys includes permit/certification, binoculars, field notebook, pencil, and timepiece. Recommended equipment includes spotting scope, site map, 2-way radio or cellular phone, emergency contact information, hat with visor, sunscreen, drinking water, camera, and educational handouts.

The following survey procedures are recommended:

Walk, don't drive. Walking increases the chance of seeing birds and decreases the chance of crushing nests and chicks.

Survey all potential habitat. If the area is associated with an estuary, survey the nesting habitat during high tide to reduce the chance that plovers will be feeding far from shore. One observer should be sufficient on narrow beaches. For beaches wider than 50 meters (164 feet), extra observers, spaced every 50 meters (164 feet), are advisable.

Observers should walk down the beach together with the person(s) closest to the dunes about 25 meters (82 feet) ahead of the person next to the water. Stop every 50 meters (164 feet) to scan at least 100 meters (328 feet) ahead with binoculars. Synchronize walking and scanning among team members. Carefully note the location of plovers in the distance; they may crouch and be difficult to find when you get closer. While walking, continue to watch for plovers and be careful not to step on nests. Avoid flushing plovers.

The observer by the water should be the survey recorder. Other observers should inform the recorder as soon as they sight a plover to avoid double counting.

Salt pond levees and lagoon margins can be surveyed similarly to beaches. Lagoon or salt pond playas should be surveyed from the edges. Move between vantage points, conceal yourself if possible, and use binoculars and a telescope to scan potential habitat for at least 15 minutes per vantage station.

Record age and sex. Indicate M(ale), F(emale), or U(nknown) for sex and A(dult), J(uvenile), C(hick), or U(nknown) for age. Chicks are incapable of flight, while juveniles are able to fly. Juveniles have pale feather edges on the back and wing coverts. In the fall, worn feather edges can give the appearance of a juvenile bird.

Track birds carefully. If plovers fly behind you (where you have already counted), they can be added to the total. If they fly ahead, to areas not yet covered, they should not be counted unless the number of flying birds is greater than the number of plovers subsequently encountered on the ground.

Check for color bands. Carefully record band combinations. Color-banded birds provide important information on survival and dispersal. At locations with enough color-banded birds, a more accurate population index can be obtained.

Duplicate the survey route. After working out a suitable route, try to duplicate it on future surveys to obtain consistent results among surveys.

Focus on plovers. Snowy plovers are difficult to observe and should be the sole focus of monitoring. Plover surveys should not be combined with monitoring for other species.

Demographic Monitoring

Population demographic monitoring will provide information on reproductive success, adult and juvenile survival, and dispersal. Results will be used to assess progress toward recovery (criterion 2) and to refine the Population Viability Analysis.

Precise data on productivity, survival, and dispersal will require most plovers within the studied population to be uniquely identifiable by color bands. Recovery task 4.3.2 will guide the effort to establish appropriate sampling methods for annually estimating reproductive success.

While the duration and intensity of monitoring required to obtain precise demographic data will be impractical at some plover nesting sites, coarse data are valuable and should be collected. Such data may be obtained through nest searches, nest monitoring, and careful population monitoring. At sites with limited resources, monitors should focus on accurate population monitoring, as described above, but should also attempt to record these breeding parameters:

Egg-laying dates
Number of nests
Number of eggs per nest
Egg-loss dates and causes
Hatching dates
Number of eggs hatched
Hatching success = number of eggs hatched/total number of eggs laid
Clutch success = number of clutches with at least 1 egg hatched/total number of nests
Age (in days) of chicks or juveniles at last observation
Fledging success = number of juveniles capable of flight or reaching age 28 days/number of eggs hatched
Reproductive success = number of chicks fledged/number of males
Causes of chick loss

Reporting

A repository for survey data has been established within the U.S. Fish and Wildlife Service, Sacramento Fish and Wildlife Office. Initially, only window survey data will be deposited. Other information (demographic data, for example) should be retained by coordinators and shared with recovery unit working groups. As survey procedures are developed and refined, additional data will be centralized by the recovery leader.

Reports of window survey data should include:

- Location and location code (Appendix B, or assigned by Sacramento Fish and Wildlife Office for new locations);
- Survey date, start time, end time, high tide time, tidal stage, wind speed;
- Survey coordinator and observers;
- Number of adult males, adult females, unsexed adults, and chicks and juveniles.

Standard report cards have been developed (Figure J-1). Winter window survey data should be reported before February 28; summer window survey data should be reported before July 31. Data should be submitted to coordinators and/or recovery unit working groups for compilation and submittal to the recovery leader at the U.S. Fish and Wildlife Service, Sacramento Fish and Wildlife Office.

Each year, the recovery leader will tabulate, summarize, and share window survey results with participants and other interested parties.

Reading and Reporting Color Bands

Standard U.S. Fish and Wildlife Service leg bands for snowy plovers are aluminum, but they are often wrapped with colored tape. Plastic color bands are also used to mark plovers. Color band combinations should be "read" from top to bottom and from the plover's left leg to its right. For example, seeing a plover with a red band over a green band on its left leg, and a red band over a yellow band on its right leg, would result in the notation R/G:R/Y. Colors frequently employed along the Pacific coast include:

V	violet (mauve)	L	light green (lime)	R	red
A	aqua (light blue)	Y	yellow	N	brown
B	dark blue	O	orange	K	black
G	dark green	P	pink	W	white

Some color bands are wrapped with a narrow stripe of a second color. These should be noted, for example, LKL (light green band with black stripe). Metal bands should be coded M.

Color band reports should be submitted to the recovery unit working group, the Point Reyes Bird Observatory, or the Bird Banding Laboratory. Standard U.S. Fish and Wildlife Service aluminum band numbers should be reported to the Bird Banding Laboratory.

USGS Biological Resources Division
Bird Banding Laboratory
12100 Beech Forest Road, Suite 4037
Laurel MD 20708
1-800-327-2263
bbl@usgs.gov

Point Reyes Bird Observatory
4990 Shoreline Hwy
Stinson Beach CA 94970

WESTERN SNOWY PLOVER WINDOW SURVEY REPORT

COMPLETE SUMMER WINDOW SURVEYS BETWEEN 24 MAY AND 7 JUNE. RETURN REPORT CARD BEFORE 31 JULY.
COMPLETE WINTER WINDOW SURVEYS BETWEEN 1 DECEMBER AND 31 JANUARY. RETURN REPORT CARD BEFORE 28 FEBRUARY.

Site No. _____ Site Name _____

Survey Date _____ (DD - MM - YYYY) Time _____ (24-HR FORMAT) Tide H / L Time _____ (24-HR FORMAT) Wind _____ (BEAUFORT)

No. males [ ] No. females [ ] No. unsexed [ ] No. young [ ] No. unknown [ ] TOTAL [ ]

COORDINATOR

NAME _____
ADDRESS _____
ADDRESS _____
CITY, STATE, ZIP _____
PHONE, E-MAIL _____

OBSERVERS

_____
_____
_____
_____

[ ] To list additional observers or provide comments on the survey, check here and write on reverse.

Please provide your comments here.

SNOWY PLOVER SURVEYS

_____
_____
_____
_____

Figure J-1. Western snowy plover survey report

Coordinating with Other Projects

Snowy plovers share some of their breeding and wintering sites with other sensitive species, such as least terns or marine mammals. Where these species are found in, or adjacent to, snowy plover sites, survey coordinators, researchers, and land managers should plan ahead to avoid conflicts and should consult with recovery unit working groups.

Public Interactions

Snowy plover observers often encounter members of the public while in the field. When responding to public questions or complaints, field workers are distracted from the task at hand, which can compromise the accuracy and safety of surveys.

Observers should carry educational pamphlets for distribution to curious members of the public, but should refrain from conversing at length about plovers or other issues until surveys are complete.

Field workers observing illegal, prohibited, or unauthorized activities should notify law enforcement authorities as soon as possible. Observers should carry a contact list and a communication device (e.g., 2-way radio, cellular phone) for this purpose.

Habitat Monitoring

Habitat is an important factor limiting snowy plover abundance, distribution, and productivity. Careful assessment of habitat characters include determining substrate characteristics and composition of vegetation in both managed and unmanaged areas. These must be the topic of specific habitat monitoring and research. Field workers are encouraged, however, to describe in general terms any changes in the quality or quantity of snowy plover habitat in monitored areas.

Disturbance Monitoring

Human-related activities directly and indirectly affect snowy plover abundance, distribution, and productivity. Effects of various types (e.g., people, pets, vehicles, kites, horses) and levels of disturbance must be determined through dedicated research. Field workers are encouraged, however, to describe in general terms the nature and extent of human-related disturbances in monitored areas.

Predator Monitoring

Observing predation on snowy plovers, or their eggs or chicks, is a rare event. However, some sign of predator identity is often available at plundered nests and should be noted by observers. Predator presence in monitored areas should also be noted (e.g., corvids, gulls, raptors, other avian predators, coyotes, foxes, house cats, opossums, other mammalian predators). Extensive predator monitoring is beyond the scope of snowy plover surveys, but should be undertaken when predator removal is considered, or when specific detail on predators is needed.

Suggested Readings

The preceding sections are necessarily abbreviated. Further information and guidance will be obtained during certification training sessions. In addition, the following reading should contribute to a better understanding of plover monitoring methods.

Blodget, B. G., and S. M. Melvin. 1996. Massachusetts tern and piping plover handbook: A manual for stewards (first edition). Massachusetts Division of Fisheries and Wildlife, Westborough. ~100 pp.

Although this document pertains to least terns and piping plovers, it contains instructive material on census techniques (8 pages), form instructions (3 pages), nest-finding procedures, and addressing enforcement issues.

Goldin, M. R. 1994. Recommended monitoring and management methodology and techniques for piping plovers (*Charadrius melodus*). Unpublished report to U.S. Fish and Wildlife Service, Hadley, Massachusetts. The Nature Conservancy, Providence, Rhode Island. 15 pp + attachments.

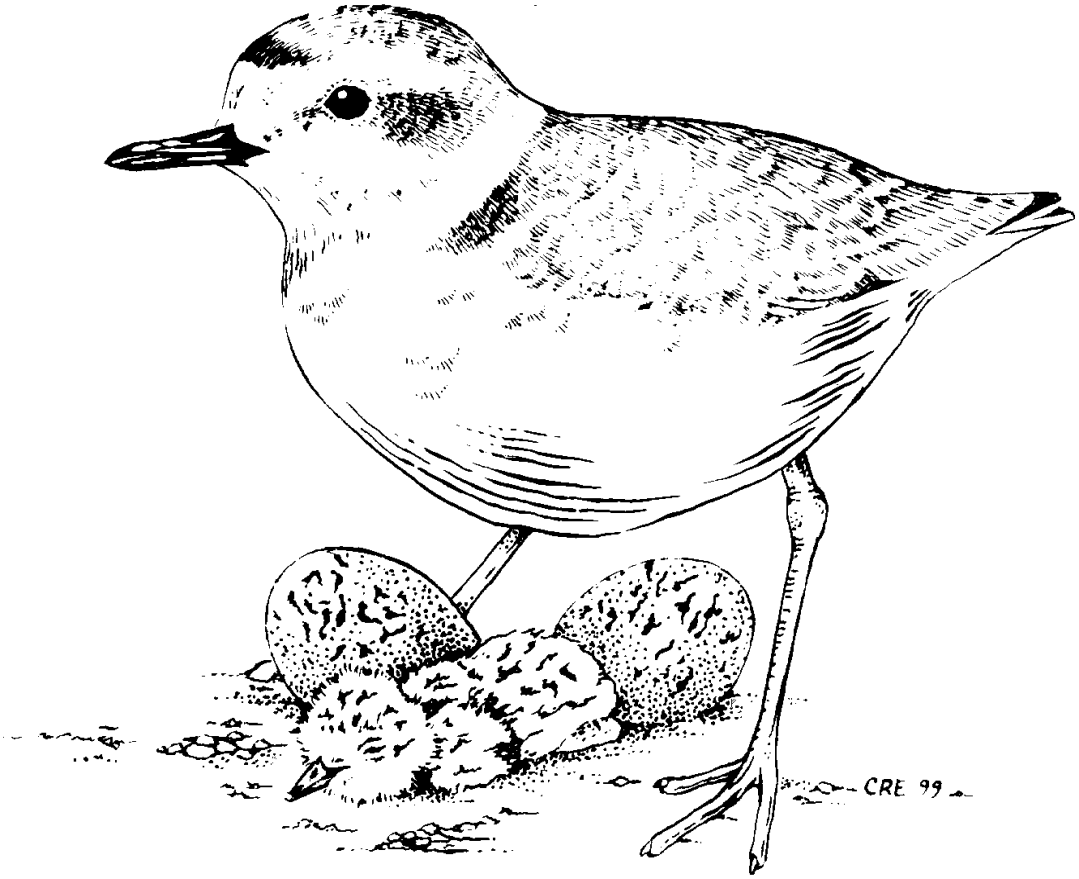
Personable instructions for field workers in the piping plover range. Includes "The Three Plover Commandments: I. Thou shalt be very, very patient and never disturb or harass a plover intentionally; II. Thou shalt never, ever walk through a plover nesting area without first looking wherest thou places each and every foot, each and every step of the way; III. Thou shalt record data simply and meticulously."

APPENDIX K

INFORMATION AND EDUCATION PLAN

for the

WESTERN SNOWY PLOVER PACIFIC COAST POPULATION



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INTRODUCTION

Public awareness of the western snowy plover's plight is a significant component of its recovery. Increased awareness can lead to greater acceptance and compliance with management measures. Increased awareness may also inspire advocates and volunteers to assist with monitoring and habitat restoration. This Information and Education Plan describes current interpretation activities along with actions and ideas for future work. Key messages, target audiences, strategies, costs, and volunteer management are among some of the elements addressed. This plan has been patterned after successful efforts employed for the piping plover, as well as programs focused on other species, such as the peregrine falcon and Kirtland's warbler.

This plan provides direction for an expanded and continuing effort to reach all those who have a stake in the recovery of the snowy plover. At the broadest level, this effort extends to the public-at-large as concern for endangered species increases, while at the same time demand for public beach access continues to grow. Attention will also be focused upon groups and individuals who have a particular interest in the bird's recovery.

Recreational activities and demographics vary greatly along the Pacific Coast. Therefore, this plan has been written as a programmatic document; to be used for overall guidance and to generate ideas for regional plans. Ideally, interpretive strategies should be written for specific locations or land ownerships. At a minimum, individualized plans should be developed for the six recovery units described in the Western Snowy Plover Recovery Plan.

While several of the described actions may already be in motion, the recommended time frame for initiating all actions is 2 to 5 years. These actions are an integral part of snowy plover recovery, and funding for implementation must be supported accordingly. Although budget constraints may prevent development of a complete program, some recommended actions can still be pursued even where budgets are limited.

The Western Snowy Plover Recovery Plan calls for the development and implementation of public information and education programs. This Information and Education Plan provides guidance regarding the information and education activities described therein. Specific activities outlined in the recovery plan include: (1) apprise volunteers, Federal, state and local resource/regulatory agencies, and local planning departments of threats to breeding and wintering snowy plovers; (2) develop and maintain updated information and education materials on snowy plovers; (3) alert landowners and beach users about access restrictions within snowy plover habitats; (4) provide trained personnel to facilitate protective measures and public education; and (5) establish a repository and distribution network for information and education materials.

PLAN GOALS

The primary goal of this Information and Education Plan is:

- To increase compliance with management efforts to protect and enhance snowy plover populations and their habitat.

Secondary goals are:

- To stimulate public interest, understanding, and support of research and management actions which in turn will increase compliance levels.

- To provide land managers, private landowners, and recreational interest groups with guidance to implement a snowy plover information and education program.

- To stimulate public concern and understanding of unique Pacific coast beach-dune ecosystems that support numerous and diverse aquatic and terrestrial species, including special status species.

- To develop internal and external support necessary for funding western snowy plover management programs.

These goals will be accomplished through the information and education program described in subsequent sections.

CURRENT SITUATION

The western snowy plover has received sporadic media attention, due both to the growing issue of conflicting beach uses and to specific controversies raised by restrictions at popular beaches. Controversy peaked during the public comment period for proposed critical habitat designation.

A number of outreach activities have been undertaken by various management agencies. Posters and brochures have been distributed to the public over the past 5 years, primarily in the vicinity of snowy plover nesting areas. More personalized activities have included a video, slide programs, forums, and other presentations. Attachment B provides a list of outreach products developed to date.

Existing information and education programs were reviewed to provide guidance and a basis for outlining activities in this appendix. The following sections summarize effective outreach tools and outreach needs.

EFFECTIVE OUTREACH TOOLS

Partnerships

Partnerships can include working groups and cost share programs. The Oregon and Monterey Working Groups are excellent examples of effective partnerships. Cooperation between resource and land management agencies, researchers, interest groups, and private individuals increase effectiveness of outreach efforts and bring more resources - both expertise and money - to the table. For example, each year the Oregon Working Group jointly funds a plover monitoring and protection program. This single contract is cost-effective and provides a standardized method of data collection along the Oregon coast.

Multi-Disciplinary

Effective management of western snowy plovers requires cooperation between different and often divergent interests working together using a positive, unified approach. Snowy plover management needs to incorporate input from biologists, land managers, interpretation specialists, and various interest and user groups to reach recovery goals.

Dedicated Conservationists

The exceptional commitment of professional and volunteer conservationists has been, and should continue to be, an important factor in snowy plover recovery.

Communications Techniques

The key to increased public understanding and awareness is using a variety of communication techniques and methods of distribution. Current public outreach includes a variety of techniques such as videos, brochures, posters, on-site programs, slide presentations, and news releases.

OUTREACH NEEDS

Improved Internal Communications

Many people within resource management agencies are not getting information about the snowy plover program and the role they can or should play. Improved dissemination of information and coordination between all levels of staff is needed.

Coordination

When agencies, groups, and individuals work independently, work is not done in an efficient, cost effective, or cohesive manner. Working as a team can alleviate inconsistent messages and prevent redundancy in work.

Targeted Audiences

Different groups of people will view snowy plover management in different ways. The range of western snowy plovers includes a large geographic area that incorporates both small towns and large cities with diverse political views, ethnic and socioeconomic

groups, literacy levels, environmental values, attitudes about government regulations, etc. People also use beaches for recreation in a wide variety of ways. Communications intended for different groups and geographic areas need to be designed to address their different perspectives.

Information
Little information is available on how the various target audiences feel about plover management. Experiences of agency personnel indicate that public sentiment varies considerably. An increased understanding will help managers design effective interpretive signs and programs.

Decreased Use of Jargon
Many communications products to date contain a large amount of technical jargon. This not only fails to communicate with readers or viewers, but may even make them antagonistic.

Increased Personalized Communication
The most effective communications, particularly with local residents, are those delivered via a "one-on-one" approach . Although many outreach strategies such as brochures and videos are cost effective and reach wide audiences, they may not sufficiently capture attention or promote understanding.

KEY MESSAGES

Different audiences have different questions, concerns, and values that need to be addressed to effectively meet the goals of this plan. Knowing your audience(s) will enable you to design a practical outreach strategy and product specifically tailored to their issues. The following key messages address some of the most frequently asked questions. Although many of the following key messages apply to all target audiences, several may be site- or zone-specific. Individual plans should choose key messages appropriate to their audience(s). Sentences within parentheses reflect considerations to tailor messages to individual plans or outreach materials.

Saving Endangered Species and Ecosystems

1. All species, no matter how small or seemingly insignificant, are a critical component of the earth's biodiversity. Maintaining native species diversity is key to sustaining healthy ecosystems capable of adapting to constant change.

2. Snowy plovers and other endangered species are like the miner's canary -- they are a barometer of the health of the ecosystem.

3. The coastal beach-dune ecosystem includes unique and increasingly rare habitats along the Pacific Coast. Several species are found in this system and no other.

Snowy Plover Plight and Biology

4. Snowy plovers lay their well-camouflaged eggs on bare ground. Newly hatched chicks are the size of a cotton ball and are very difficult to see. Therefore, snowy plovers are extremely vulnerable to trampling of nests and chicks, to disturbance-related nest abandonment, and adult/chick separation. (Beach users must understand some basic aspects of snowy plover biology to comprehend the need for special protective measures for this species).

5. All wildlife have distinct habitat needs. Specialized species, like the snowy plover, have specific adaptations, and therefore live in only one or a few habitats.

6. Habitat destruction is the main cause of the Pacific Coast snowy plover's decline. Habitat has been lost from development and recreational conflicts, and introduction of non-native plant species. Loss of beach-coastal dune habitat also affects other plants and animals tied to this unique landform.

7. Historically, western snowy plovers nested on beaches along the entire Pacific Coast. Now they are rarely seen.

8. When a population reaches extremely low numbers, it becomes vulnerable to even the smallest losses. If disturbances are combined (e.g., due to weather, heavy predation, and recreational disturbances), extinction of the snowy plover could occur.

Predation

9. Keep beaches litter free. Litter on the beach can attract predators. Crows, ravens, raccoons, skunks, feral cats, and introduced red foxes prey on snowy plovers and their eggs.

10. Feeding wildlife can attract and unnaturally concentrate predators in or near snowy plover habitat -- Do not feed the wildlife.

11. Exotic predators have hunting strategies to which native prey species have not adapted.

12. Feral cats can be a threat to western snowy plovers. Feral cats should not be fed, and managed feral cat colonies should not be allowed in areas managed for natural wildlife values. Transport unwanted cats to an animal shelter where they have a chance to be adopted. Do not abandon cats in natural areas. Millions of birds are

killed annually by cats. Report feral cats observed in natural areas to land managers.

13. Predators of snowy plovers, such as non-native red foxes, may have to be controlled. Removal of predators is sometimes necessary in cases where non-lethal methods are not effective or cost prohibitive. Sterilization of predators does not prevent them from killing snowy plovers. If no other effective option is available, predators shall be removed in a humane manner.

Recreation Conflicts and Desired Behaviors

14. Agencies are mandated by law to protect endangered species - this may require removal of all other uses. Lack of compliance may lead to increased restrictions and beach closures. Your cooperation will keep restrictions to a minimum.

15. Many people believe that just one person can't possibly harm the plovers. But, if just one person enters a closed area, a parent snowy plover will likely leave the nest. Without the parent, the eggs or chicks are exposed and vulnerable to predation or harsh weather.

16. Guidelines for using beaches in a way that protects snowy plover habitat should be specific. Beach recreationists need to understand that by their very presence, wildlife may be disturbed.

17. Specific sites and types of recreation affect snowy plovers in different ways. Develop key messages targeted to a specific audience explaining how their activity impacts plovers and how modifying their activity can reduce or eliminate these impacts.

18. Your cooperation will help increase the number of snowy plovers on our beaches. You can help by <u>fill in the blank</u>…(e.g., respecting restricted areas; leaving your pets at home or keeping them on a leash; keeping kites, fires and camping sites well away from nesting areas; observing birds at a distance; and keep beaches litter free).

19. Information for off-road vehicle users will focus on off-road vehicle-related impacts, ways to coexist (primarily through land allocation initiatives), and possible means of support that this user group could provide. In an effort to elicit a little empathy for the plight of the plover, the information presented may possibly draw upon parallels between plovers and off-road vehicle users and the impacts to both with a "loss of space."

20. Sunbathing, beachcombing and other non-motorized recreation near snowy plover nesting areas are not benign activities to snowy plovers. Beach users can easily

disturb breeding plovers. (Address how activities observed at specific locations such as picnicking, straying into nesting areas to retrieve errant Frisbees™, and loud behavior affect breeding plovers).

21. Equestrians, joggers, hikers, and other non-motorized beach users can aid in western snowy plover recovery by adhering to wet sand restrictions. Through cooperation, there can be plenty of beach for people and wildlife alike without a need for further restrictions.

22. Kite flying and fireworks are two activities that disturb nesting birds from greater distances than other activities.

23. Dogs cause a variety of impacts when unrestrained on beaches. They can disturb or kill a variety of wildlife species, including nesting snowy plovers. Migrating shorebirds can lose important fat reserves from being chased by dogs. Dogs can also destroy fragile beach vegetation.

24. Get Involved. Your participation can help increase compliance levels and snowy plover recovery, thus decreasing the need for further restrictions. Contact your state wildlife agency for further information.

25. Boaters should be made aware that their access to beaches and estuaries poses a threat to snowy plover nesting. Traditional signing methods for restricted areas may be readily missed by boaters.

26. While many user groups may not always act in ways that protect snowy plovers and beach habitat, they do have a fundamental appreciation for the outdoors. Increased awareness can set the stage for identifying possible areas of common interest and communicating our responsibility to protect the snowy plover when conflicts are inevitable.

27. Occasionally researchers or managers may be seen within restricted areas. These activities are monitored and performed within strict guidelines to minimize disturbance. This minimal disturbance is considered a worthwhile trade-off for increased understanding of plover biology that can in turn help recovery efforts. As an example, experimental predator exclosures were found to increase hatching rates upwards of fifty percent.

TARGET AUDIENCES

Audiences who have a stake in western snowy plover conservation and who should be the target of outreach efforts are described below. Each of these target groups influences or has the potential to influence plover management in a significant way. Audiences include those who will be affected by snowy plover management actions.

Regional and site-specific planning teams need to first evaluate audiences particular to their location. Strategies and key messages can then be tailored to these audiences.

Public at Large
In general, this alludes to a national constituency, although on a practical level it primarily includes people who live along the West Coast. Coordination of recovery efforts for Pacific Coast snowy plover populations and the Atlantic Coast piping plover may bring attention of plover issues to a national audience. However, the activities in this plan are targeted toward the Pacific Coast. Consider Key Messages: 1-9, 11, 14, 16 and 26.

General Interest Groups
Particular groups which may prove most receptive to information and education efforts include: civic organizations, scouts and other service organizations; environmental education and outdoor learning centers; and conservation groups. Consider Key Messages: 1-8, 14-18, 20, 23, 24, 26 and 27.

Beach Users and Coastal Recreation Interest Groups
Individuals and groups who most directly affect and are affected by efforts to manage and protect snowy plover habitat on public beaches include sunbathers and other summertime recreationists, surf fishermen, off-road vehicle enthusiasts, boaters, surfers (wave and wind), campers, hikers/walkers/joggers, people who bring their pets to beaches and equestrians. While often sympathetic to recovery efforts (especially following public outreach), these constituencies have frequently proven to be strongly opposed to habitat protection -- naturally enough, considering the trade-offs they must make. Messages may be somewhat different for individual users versus organized groups which are usually resident. Consider all Key Messages.

Local Communities
Communities with economic and quality-of-life ties to the beach environment have a strong and direct interest in snowy plover recovery efforts. Also, there are often many different voices speaking on behalf of the community, including those promoting tourist dollars and jobs, those defending traditional maritime industries such as fishing and clamming, those concerned with overcrowding and the quality of the environment, and those who support less tangible values such as individual freedom and community self-rule. While these interests can be found among the public-at-large, they are generally felt and expressed much more cogently in the vicinity of the "action." The local community

thus comprises not one audience, but a conglomeration of different audiences related by proximity. However, regional or individual outreach programs may want to develop specific messages targeting user groups within a given community or surrounding area. Consider all Key Messages.

Schools
School age children may help reach out to other household members with their knowledge and enthusiasm. Provide buttons, posters, pencils, litter bags and other materials. Consider Key Messages: 1-8, 14-18, 20, and 23-26.

Public Officials and Land Managers
Through their role as public servants these individuals often represent the myriad interests of the three preceding audiences. However, most are required to bring in the added perspective of stewardship responsibilities. They may also be interested in non-beach use aspects of plover management, such as predator control and habitat restoration. These topics can be a key concern to some audiences (especially predator control issues). Consider Key Messages: 3-8 (depending on knowledge level), 11, 13, 14-18, 23, 26 and 27.

Private Landowner
These individuals can provide invaluable support. Many landowners have cooperated by allowing research and management to proceed on their lands. Reaching this audience is extremely critical, but can be a time-consuming process. Consider Key Messages: 1-10, 15-18, 20, 23, 24, 26 and 27.

Conservation/Environmental Groups
These groups will generally be strong advocates of snowy plover recovery. They constitute an audience in their own right, but they can also be a conduit of information and education to more general audiences. However, these groups may also be interested in beach access for activities such as hiking, camping, and bird watching. Their compliance should therefore not be taken for granted. Consider Key Messages: 1-8 (depending on knowledge level), 9-18, 20, 23, 24 and 26.

INFORMATION AND EDUCATION GUIDELINES

The following guidelines should be considered in developing regional or site specific information and education. Evaluation is fundamental to the success of all plans. Be sure to incorporate routine assessment.

Biological

- Ensure the biological needs of the western snowy plover as identified in the recovery plan are the focus of outreach activities.

- Emphasize the importance of the entire beach and dune ecosystem.

- Incorporate and highlight with current and national issues such as biodiversity, neotropical migrants, human population growth, international conservation, Western Hemisphere Shorebird Reserve Network and Watchable Wildlife.

Logistical

- Incorporate evaluation. Develop questions to assess effectiveness of program and individual materials.

- Use a team approach. Establish a regional working group if one is not in existence. Utilize this combined expertise and additional resources for an effective and coordinated method.

- Communicate consistently to all land management agencies.

- Communicate continuously. Education is a process, not a single event. Target audiences, issues, management activities, and western snowy plover recovery actions are constantly changing.

- Land management agencies should include staff in all outreach efforts.

Specific Tips (Messages)

- Discuss negative aspects, concerns, and failures as well as successes. Be honest with people.

- Reward and acknowledgment of effort is important to consider when developing messages. Be sure to provide the reasoning behind compliance and provide alternatives.

Specific Tips (Methods)

- Communicate alternatives to restrictions imposed by snowy plover management such as bringing a leash, visiting another beach, or using a different trail.

- Communicate with local people “face to face” to the extent possible.

- Communicate in a way that is understandable to target audiences.

- Incorporate other languages if needed. Avoid jargon and don't put too many messages in one medium.

- Identify your target audience and be sure your methods and messages are targeted for that audience.

- Involve local people in the process of communicating snowy plover information. Invite participation in a regional working group.

MATERIALS AND FORUMS

Direct Contact
Land managers have found one-on-one interaction with beach-users to be the most effective and well received of any outreach method. On-site interpreters can provide explanation to sometimes confusing restrictions, as well as a conscience to those who want to violate a closure. They also provide valuable feedback to the program and provide answers to questions from the public.

Brochures
Brochures can furnish basic facts about snowy plover biology and the need for its protection. They lend themselves to modification for more specific audiences, such as off-road vehicle users and pet owners, by focusing on the particular conflicts caused by certain activities. Maps of restricted areas at specific locations can also be added through modification or as an insert.

Brochures are well suited to on-site audiences. Snowy plover monitors have reported that being able to hand out information to beach-users is valuable. These items provide a handy reason to approach a stranger. Most are happy to receive this information and listen to a summary from a monitor. Brochures can also be distributed through commercial outlets, incorporated into presentations and interpretive programs, or mailed.

Fact Sheets/Flyers/Trading Cards
One-page fact sheets (or multi-page pamphlets) involve minimal production effort and cost. They consist primarily of typed information in a format that can be easily copied. Along with standard information, fact sheets and flyers can address points of concern for particular audiences and locales. They can also be used as summaries updating snowy plover recovery efforts. Fact sheets can be handed out at distribution points that serve user groups (e.g., entrance points), used in meetings, or mailed. Trading cards provide information and a photograph in an appealing package. These cards work well for handing out at nesting locations.

Restaurant Placemats and Table Tents
While waiting for their meal at a restaurant, many people will read materials placed on tabletops. Advertisers take advantage of this vulnerability by placing ads on tri-fold "table-tents" and placemats. Information could be condensed from brochures onto these formats. This forum would be especially useful for tourists and communities near plover sites and could be placed in hotel rooms to inform visitors of a nearby snowy plover nesting beach.

Posters
Attractive posters illustrating the snowy plover with a short caption have also been developed. Use of these posters in displays and around nesting areas is eye-catching. New posters could be developed to complement videos or other materials.

Maps
Colored maps showing specific habitats, restricted areas, designated trails and/or population/species range can be useful in meetings and publications. Large maps that can be reduced could serve both purposes. Maps may be most useful in conjunction with fact sheets and signs.

Curriculum
Curriculum could be developed for different age groups. Supplemental teacher packets and hand-outs could focus on biodiversity using the snowy plover as a case study.

Newsletters/Postcards
Newsletters are useful during important decision-making processes, especially those that actively consider public input. A standard newsletter format that can be modified for particular purposes could expedite public information and involvement. Postcards can also be used as a modified version of a newsletter. Planning and conflict mediation processes may benefit from information exchange through newsletters. Recovery status is well-suited to a newsletter format.

Interpretive Exhibits and Portable Displays
An interpretive exhibit can convey a variety of information about the plover and recovery efforts. A standard exhibit could be designed for both indoor and outdoor display. This display could be permanent or portable for use in schools and at conferences and meetings. A more elaborate exhibit could incorporate slide-tape or video displays. Ideally, this type of exhibit could be built into interpretive facilities.

Signs
High-quality interpretive signs explaining seasonal aspects of snowy plover behavior and habitat use can be used on site, either near parking areas and beach access routes or directly adjacent to nesting areas. A clear portrayal of the direct link between plover survival and human activities, with suggestions for appropriate behaviors, is important.

Directional signs (closed areas, nesting sites) should be consistent across agency and ownership lines.

Media Releases
Public notices and news articles informing the public of beach closures, planning efforts, habitat restoration projects, recovery successes, etc. are issued as an ongoing effort. Unofficial stories and features can also be used to solicit interest. As an example, slides could be sent to weather reporters with verbiage for them to discuss while doing their broadcast. The use of press releases in connection with conservation planning will be a significant aspect of recovery efforts in the future.

Radio Messages
Messages on special Traveler Information frequencies could alert beach users and summer recreationists to beach closures, and could provide capsule information about the need for protection of snowy plover habitat. Public service messages on commercial and public radio stations could also promote protection of snowy plover habitat and elicit general support for such protection among a variety of general audiences.

Web Sites/CD-ROM
Access to the Internet is an effective means of communication that can reach a variety of audiences at relatively low cost, especially if skills for web site development exist within an agency or are donated. Updates and other site maintenance require an investment of time. A master web site could be developed and operated by the U.S. Fish and Wildlife Service with links to other agency plover homepages. These local homepages can also be area- and site-specific. A CD-ROM could include portions of a video program, ideally with interactive elements.

Video Programs
Video programs can allow the distribution of accurate information in a popular form. These videos can be used in a variety of settings, including interpretive facilities, public meetings, classrooms, and for television broadcast. Regional- or site-specific videos addressing coastal dune ecosystem needs and variable local audiences which have an interest in snowy plover conservation are recommended.

Slide-Tape Program
In situations where video display terminals are not available, a slide-tape program could be used, both as part of exhibits and during presentations. The slide-tape program could potentially be customized for certain audiences. Slide programs with a script instead of a tape back-up could provide a cheaper alternative.

Speaking Engagements
Articulate and persuasive speakers could be engaged to address various groups, either in conjunction with audio-visual programs or on their own. Presentations to general interest and advocacy groups could introduce a forum for constructive dialogue and education.

Participation in Fourth of July festivities or other summer activities could provide outreach opportunities.

Private Meetings
Meetings held during the course of consultations and negotiations regarding habitat protection can provide a forum for education as well as information exchange about the snowy plover.

Public Meetings
Public meetings may occur during the course of conservation planning processes and through environmental review for the designation of critical habitat for the snowy plover. These meetings could be used to air various concerns about land use conflicts and to gather support for habitat protection. Ultimately, strategies to protect plover habitat with the least possible impact on other interests may develop from the discussions in these meetings.

STRATEGIES FOR REACHING AUDIENCES

This Information and Education Plan is designed to use two means to disseminate information and gain support. The first strategy is to reach general target audiences through a variety of methods. The second strategy is to reach affected parties through official planning and consultation processes. To this end, actions developed for this plan consider the following:

- A variety of activities will be directed toward stimulating the interest and support of the general public, including specific target audiences, for the snowy plover's recovery; and

- Planning, consultation, and negotiation processes will be used to elicit the cooperation of affected parties such as beach users, landowners, and managers. Particular emphasis will be placed on public information as a component of the consultation process.

Materials and programs that can effectively increase understanding of snowy plover issues among beach users and local communities are an immediate priority. These materials will be developed and distributed by land managers, the U.S. Fish and Wildlife Service, and regional working groups as funds allow. Materials such as annual updates of recovery activities, information packets focusing on habitat protection, and teaching packets will be developed for specific audiences.

Distribution of materials and programs will "fan out" from key areas of concern, such as the vicinity of closed beaches and areas designated for critical habitat. In addition, major

media contacts and visitor centers will be identified for initial contacts. In this way, the snowy plover information and education program will reach both the key target audiences and the broadest possible segment of the general public in as short a time as possible.

As an adjunct effort, a fairly standardized public involvement process will be followed during the course of planning and consultation processes for the snowy plover, in order to expedite education of the involved parties.

Whenever possible, information and education activities for the snowy plover will also be used as an opportunity to stimulate public concern for broader or less-prominent endangered species issues. Using "spin-off" techniques to raise awareness of other endangered species issues during snowy plover recovery activities could prove beneficial in gathering broad-based support.

ACTIONS

The following eighteen actions should be undertaken to achieve the goals of this Information and Education Plan. The list is in general order of priority. For each action, the target audience(s) and a brief description are provided.

INITIAL ACTIVITIES
In the short term, these activities lay the groundwork for future outreach efforts, or are already underway and need to be completed (varies regionally).

Action 1. Develop regional western snowy plover information and education working groups.

Audience: Biological resource and land management agencies, conservation/environmental groups, other interested parties.

Description: Establish a working group dedicated to the implementation of an information and education program for each region described in the recovery plan. These groups will coordinate and customize outreach efforts to their local needs. Regional resources will then be combined to accomplish tasks, develop a regional communication strategy, and apply for grant opportunities.

Each working group will coordinate snowy plover outreach efforts by maintaining current information on the programs of other working groups. In review, they will seek to identify areas of overlap; and possibly combine efforts to effectively reach a broader, even national audience. This could prove particularly true for activities such as widely-circulated articles, public service announcements, curriculum, exhibits, and press releases.

As appropriate, the working group will draw other agencies and individuals into this effort to inform and educate the public. They will assist any agency or individual involved or interested in plover recovery to design a program that draws from or augments strategies in this plan. Especially encouraged is coordination with individuals representing law enforcement, recreation, interpretation, management, and other disciplines.

Action 2. Develop a master mailing/contact list for each region.

Audience: All

Description: Include the following for each region:

- Media contacts
- Chambers of Commerce and similar groups
- Affected businesses (beach recreation concessionaires)
- Special interest groups and affected beach-users
- Conservation groups
- Local government leaders
- Affected landowners
- Federal, state, county and city land management agencies
- Civic groups and schools
- Commercial outlets for off-highway vehicle enthusiasts, pet owners (e.g., pet shops and veterinary clinics), sunbathers, surfers, and other beach recreationists
- Other interested individuals or groups
- Respondents to press releases, Federal Register notices, meeting attendees, etc.

Initiate development of the mailing list by defining target areas and providing field personnel, refuge managers, outdoor recreation planners, and others with this plan and/or other instructions for compiling their contacts. Consolidate the lists into a sortable, automated data base. Update/expand the list on a continual or periodic basis.

Action 3. Implement a media relations campaign.

Audience: Public at large, beach user groups, local communities, tourists.

Description: Use various opportunities for exposure of snowy plover issues such as habitat restoration projects, beginning or end of nesting seasons and successful partnerships between affected user groups. Development of many of these action items will also provide a chance for media exposure or assistance in disseminating

information to target audiences through television, radio, newspaper, and magazines. News releases on specific stories or a general information package can be developed to generate media interest. Consider public service announcements and paid programming (commercials or ads) if needed.

Action 4. Develop customized materials for key target audiences.

Audience: The highest priorities are:

- Affected communities
- Beach user groups
- Tourists
- Landowners and managers
- Agency personnel

Description: Materials will summarize reasons for implementation of management measures and how users can help in snowy plover recovery. General flyers could be developed with inserts available for explanations of site specific circumstances (e.g. maps or messages to particular user groups). As funding allows, develop customized fact sheets or pamphlets (using a standard question and answer format), brochures, slide tape programs, and/or videos for special audiences. Important audiences include sunbathers, pedestrians, surfers and other beach recreationists, off-road vehicle enthusiasts, surf fishermen, campers, equestrians, and pet owners.

Active involvement of these groups in information development will assure responsiveness to questions and concerns about what effect snowy plover recovery efforts will have on their pursuits. Solicit ideas from the various user groups about how protection of the plover can be achieved while still allowing individuals to pursue their interests. Incorporate feedback in a question/answer or discussion format to address specific concerns of each user group in the most direct way possible.

Develop annual updates regarding the progress made in the snowy plover's recovery and future needs in terms of both research and management. Distribute these to landowners and land management agencies, either during consultation and negotiation procedures or via the mailing list, as appropriate. Use these updates to invite feedback about their current concerns and any support they may want to offer.

Develop customized brochures, flyers, signs, posters, placemats, and restaurant “table tents.” Design some materials for groups inclined to support plover protection, outlining how they can most effectively provide their support.

Augment this effort with customized presentations and video showings. Post interpretive signs where appropriate.

When appropriate, bring into play the bigger picture of endangered species. Use the plover situation as a catalyst for building upon the growing concern of the general public about environmental issues. Pursue these efforts within environmental education and interpretive settings where it is likely that the snowy plover will be one among a variety of topics.

Action 5. Develop customized regional displays.

Audience: All

Description: Develop a standard display that can be exhibited in visitor centers, on kiosks, on portable stands for use in meetings, classrooms, etc. When possible, erect kiosks with the display near posted closures. When feasible, incorporate a video display or slide-tape program into the exhibit.

Action 6. Establish site-specific western snowy plover outreach programs.

Audience: All

Description: Outreach requires significant time and energy to fully inform the public. A skilled outreach coordinator would be useful for this recovery effort; this person should be well versed in the biological issues related to snowy plovers and have experience with the public.

Action 7. Develop on-site monitoring programs.

Audience: Beach user groups

Description: Face-to-face contact is an effective technique to educate beach users and increase compliance with management measures. Volunteers or paid employees would be stationed near nesting locations to explain restrictions, monitor compliance, and distribute brochures. Encourage Friends groups to adopt a site.

Action 8. Establish coordinated clearinghouse for western snowy plover outreach materials.

Audience: Agency personnel, local governments, conservation/environmental groups.

Description: Provide repository of existing materials for use as templates or to be copied to prevent "reinventing the wheel." Announce the availability of new materials to interested individuals and agencies identified on the mailing list.

ONGOING OR PERIODIC ACTIVITIES

Activities which occur on a continuing basis or at different times throughout the year need to be pursued in as timely a manner as possible over the foreseeable future.

Action 9. Continue or expand current efforts to distribute customized materials to key target audiences.

Audience: All

Description: Expand distribution to include various groups on the mailing list. As appropriate, distribute outreach materials at local town and land use planning meetings.

Distribute outreach materials to specific distribution points near snowy plover habitat.

Outlets to consider:

Canoe/kayak retailers
Surf/dive retailers
Outdoor and fish bait retailers
Horse riding/rental establishments
Campgrounds
Local mailings to target groups
User group associations
Visitor centers
Offices that issue fishing and camping permits
Wind/Water surfing retailers
Kite retailers
Pet shops
OHV rental and retailers
Veterinary clinics
Local motels
Tourist bureaus
Local restaurants

Action 10. Follow a standardized public outreach process during recovery plan release, agency planning and large section 7 consultations.

Audience: All

Description: Use the following planning guidelines for public outreach to gather comments and understanding of the process and decision:

At a Minimum:

- Develop a project-specific mailing/contact list, using the master mailing list as the basic source. Include government officials, agency and organization representatives, affected landowners, media contacts, and interested individuals.

- Issue press releases if informing the general public about the planning effort is warranted.

- Distribute a fact sheet/pamphlet and cover letter to all interested parties. Use maps when appropriate.

- Inform all interested parties of the outcome of the decision-making process.

- Distribute a customized fact sheet during meetings with agencies and landowners. This fact sheet will explain various means of protecting nesting plovers and managing their habitat.

- Use maps when appropriate.

Optional:

- Actively solicit public input via newsletters, public scoping meetings, and meetings with involved parties.

- Inform the public that all input will be considered and utilized as appropriate.

- Distribute available educational materials to involved groups. Give presentations upon request.

NESTING SEASON ACTIVITIES

Outreach activities will be intensified during snowy plover nesting season. Direct appeals for public cooperation and vigorous efforts to heighten public awareness are critical to nesting success. These activities will be pursued seasonally.

Action 11. Implement a media exposure effort.

Audience: All

Description: Launch a broad-based media exposure effort at least 2 weeks prior to the start of season and again at the beginning of the high-use summer season. Inform beach-users of the presence of nesting snowy plovers and educate them about responsible behavior on beaches with plovers. Use the system put into place in Action number 3. Provide volunteers with a “talking points” and "tip sheet" about how to communicate effectively when approached by the media.

Action 12. Implement a nest site outreach and monitoring program.

Audience: All

Description: Train volunteer wardens each nesting season in appropriate outreach techniques. Provide wardens with materials to distribute, and expand the roles of individuals who demonstrate a particular interest in plover protection and rapport with the public. Train biologists and volunteers to respond to local compliance or Endangered Species Act violations and threatening situations through established protocols. Obtain required permits to dispose or transport dead or injured birds. Set up a transport system with local rehabilitation centers that are qualified and equipped to handle injured shorebirds.

As appropriate, schedule meetings with beach user groups to offset potential conflicts in any given area. Publicize beach closures and distribute customized materials as described above.

Action 13. Conduct “by invitation” tours.

Audience: All

Description: There is no better way to communicate what plover management is all about than to have people accompany a knowledgeable, enthusiastic expert into the field. A significant effort should be made to get key people on the tours (the best way is to ask). Groups to include are: chambers of commerce, agency employees, community leaders, legislators, media, school groups, and conservation organization leaders. Special meetings or presentations should be given before or after the tours.

Action 14. Enlist corporate support for plover protection.

Audience: All

Description: Manufacturers of suntan lotion, recreational equipment, pet food, off-highway vehicles, as well as local businesses could be approached for providing support. If this strategy is pursued, a prospectus-type brochure should be prepared explaining the public service aspects and the marketing advantages that could be gained by promoting an image of environmental responsibility. Corporate support could range from underwriting recovery projects to making a simple statement of support in their advertisements or on their packaging (the milk carton route). Regional working groups should research and solicit grant opportunities as an avenue to corporate support.

OPTIONAL ACTIVITIES

As opportunity allows, expand the snowy plover information and education program, selecting from among the following activities.

Action 15. Develop educational curriculum.

Audience: Schools, environmental educators, interpreters, youth clubs, civic groups.

Description: Develop curriculum with lesson plans and activities targeted to grade levels. Utilize materials from other activities, such as brochures, posters, fact sheets, maps, videos, or a slide-tape program.

Modify the above teaching package into a fairly standardized presentation for civic and school groups, and other general interest organizations. Inform key groups of the availability of such a program through the mailing list or through notices in brochures.

Action 16. Produce videos.

Audience: All

Description: Produce customized video(s) for specific audiences. Ideally, several videos could be produced; each targeted to a different audience. Otherwise, produce a 15-minute video to use primarily in educational and planning settings; and a 30-second public service announcement to use in informational and commercial contexts.

Announce availability of the videos to field office staff and through the mailing list. Provide press releases to distribute them to the media, commercial outlets, and for public and private functions. Also, distribute copies of the videos to key visitor contact points, including Federal and state facilities. In particular, distribute the educational video to individuals whose property is located within or near important breeding and wintering sites.

If possible, designate a video coordinator for each region to oversee a marketing strategy, to handle requests and generate interest, and to design a presentation which incorporates the 15-minute video as a major component. In particular, they will emphasize distribution of the video to target audiences with important breeding and wintering sites within or near their property or use areas.

Action 17. Produce a short radio message for seasonal airing.

Audience: All

Description: Produce a short radio message for seasonal airing on particular traveler information frequencies, including visitor information frequencies if possible. Also if possible, use the audio portion of the proposed new video for airing over commercial stations, or develop a public service announcement specifically for radio broadcast. Corporate sponsors could be effective by making a statement of support during their own commercials.

Action 18. Coordinate snowy plover information and education program with Mexico.

Audience: Mexican authorities, biologists and educators.

Description: Share plans, information and products with interested parties in Mexico. Establish contacts and information exchange programs. 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. Coordinate with existing programs such as Partners in Flight, North American Waterfowl Management Plan, and the Borderlands Initiative.

RESPONSIBILITIES

Assistance to agencies who manage snowy plover habitat is an ongoing activity that occurs primarily under section 7 of the Endangered Species Act. In particular, U.S. Fish

and Wildlife Service works closely with the Oregon Working Group, the Monterey Working Group and resource agency staff to implement nesting area closures, information and education efforts, predator control, and other management actions to protect plover habitat. State agencies also play a role in plover management in their oversight of state wildlife regulations and the Coastal Zone Management Act. Although these Federal and state agencies provide oversight and support to plover management, ultimately responsibility lies with individual land managers. Local land managers need to ensure that snowy plover information and education efforts are appropriately and adequately implemented to support protection of snowy plovers at sites under their jurisdiction.

Western snowy plovers range over three states, through numerous counties and other jurisdictions, making a coordinated outreach effort difficult and complicated. Regional working groups will ideally reduce some of this complication. However, there needs to be a means for connection between these groups. The U.S. Fish and Wildlife Service is best suited to play a leadership role in providing advice and coordination and can also be valuable clearinghouse for existing materials. The U.S. Fish and Wildlife Service should assure that long-term funding is allocated to support a staff position to coordinate outreach efforts as part of other recovery plan implementation duties. Partnerships will be the key to employing an effective information and education program aimed at recovering the Pacific Coast population of the western snowy plover.

ATTACHMENT A

COST ESTIMATES FOR ACTIONS IN THE INFORMATION AND EDUCATION PLAN FOR THE WESTERN SNOWY PLOVER

A. Initial Activities

ACTION	DESCRIPTION	COST ESTIMATES
1. Regional Western Snowy Plover I&E Working Groups	Approximately 0.50 FTE per recovery unit to coordinate meetings, develop communication strategy, apply for funds, and oversee task implementation. Two meetings of working group per year.	**Personnel** $84,000 per FTE **Meetings, Goods and Services** $6,500
2. Master Mailing/ Contact List for Each Recovery Unit	Approximately three weeks of clerical time per recovery unit for compilation and data entry of initial list.	$3,600
3. Media Relations Campaign	Approximately 0.25 FTE staffing per recovery unit	$84,000 per FTE

INFORMATION AND EDUCATION PLAN COSTS

(Initial Activities Continued)

ACTION	DESCRIPTION	COST ESTIMATES
4. Customized Materials for Key Target Audiences		**Fact Sheets** (per 3,000) *Development and printing* $200-$500 *Distribution* $300-$960 **Tricolor Brochures** (per 3,000) *Development and Printing* $1,750-$2,800 *Distribution* $300-$960 **Slide Shows** *Development and Production* $300-$1,500 *Reproduction of six copies* $300-$900 **Signs** $1000 - $5,000 **15 Minute Video** *Development and Production* $15,000-$60,000 *Reproduction of 200 copies* $600-$1,000 *Distribution of 200 copies* $250-$500 **Radio Message Production** $1,000-$3,000 **Radio Message Distribution** $800-$2,000 **Web Page** $1,500-$15,000 **Bi-Annual Regional Newsletters** *Development and Distribution* $2,850- $3,500

INFORMATION AND EDUCATION PLAN COSTS

(Initial Activities Continued)

ACTION	DESCRIPTION	COST ESTIMATES
5. Develop Customized Displays for Recovery Units		$500-$2,000
6. Establish Site Specific Outreach Programs	Approximately 0.50 FTE per recovery unit to monitor sites, train and supervise volunteers and distribute information.	**Personnel** $84,000 per FTE **Goods and Services** $ 9,000
7. Onsite Monitoring Program	Approximately 2 FTE per recovery unit to monitor sites, train and supervise volunteers, and distribute information.	**Personnel** $84,000 per FTE **Goods and Services** $ 9,000
8. Coordinated Clearinghouse for I&E	Approximately 0.05 FTE per recovery unit.	$4,200

INFORMATION AND EDUCATION PLAN COSTS

B. Ongoing or Periodic Activities

ACTION	DESCRIPTION	COST ESTIMATES
9. Continue or Expand Current Efforts To Distribute Customized Materials to Key Target Audiences		$1,500-$12,000
10. Standardized Public Outreach Process During Recovery Plan Release, Agency Planning, and Major Section 7 Consultation		**Project Specific Mailing List** *Clerical costs* $300 **Press Releases** *Development and distribution of 3 press releases* $2,250 **Fact Sheets with Maps (per 3,000)** *Development and printing* $185-$600 **Informing All Parties of Decision-Making Outcomes (through e-mail, mailings, etc.)** $900-$6,500 **Solicit Public Input via Scoping Meetings** $1,800-$3,500

INFORMATION AND EDUCATION PLAN COSTS

C. Nesting Season Activities

ACTION	DESCRIPTION	COST ESTIMATES
11. Media Exposure Effort		**Press Releases** *Development and Distribution per Release* $600-$900 **Radio Message Production** $1,000-$3,000 **Radio Message Distribution** $800-$2,000 **TV Public Service Announcement Production** $1,000-$5,000 **TV Public Service Announcement Distribution** $800-$2,000
12. Nest Site Outreach and Monitoring Program	Approximately 1 FTE per recovery unit.	**Personnel** $84,000 per FTE **Goods and Services** $15,000
13. "By-Invitation" Tours	Approximately 0.10 FTE per recovery unit	$8,400
14. Enlist Corporate Support for Plover	Prospectus Package	**Development** $900 **Printing (500 copies)** $2,500 **Distribution** $800

INFORMATION AND EDUCATION PLAN COSTS

D. Optional Activities

ACTION	DESCRIPTION	COST ESTIMATES
15. Develop Educational Curriculum	Teaching Packet	**Development** $3,000 **Distribution of 750** $3,000
16. Customized Videos	15 minute video	**Video Production** $15,000- $45,000 **Copies of Video** (per 200) $600-$1,000 **Video Customization** $750-$1,500 **Video Distribution** $2,000
17. Short Radio Message for Seasonal Airing	60-second radio message	**Production** $500- 1,000 **Distribution** $1,000-$3,000
18. Coordinate Program with Mexico	Share plans and products	**Production** $500- $2,500 **Distribution** $2,000

ATTACHMENT B

PUBLIC INFORMATION AND EDUCATION MATERIALS FOR THE WESTERN SNOWY PLOVER

TITLE	AUTHOR(S)	TARGET LOCATION	TARGET AUDIENCE	TYPE OF MATERIAL
Siuslaw National Forest Species of Interest: Western Snowy Plover	USDA-Forest Service, Siuslaw National Forest, California	Siuslaw National Forest	General Public	Brochure
Sharing the Pacific Coast with Snowy Plovers: The Life and Times of the Snowy plover	Karen Miller/San Francisco Bay Wildlife Society	Pacific Coast	General Public	Brochure
Threatened Species: Western Snowy Plover	U.S. Fish and Wildlife Service	Pacific Coast	General Public	Fact Sheet
The Western Snowy plover is Threatened with Extinction! You Can Be Part of the Solution	Marina State Beach, California	Local	Potential Volunteers	Fact Sheet with sign-up form
Clamming and Plovers	U.S. Fish and Wildlife Service, Washington	Willapa National Wildlife Refuge	Clammers	Flyer
Traveling Displays (with plover and eggs in case)	Oregon Snowy Plover Working Team	Oregon Coast	General Public	Display
Plight of the Plovers	National Park Service, Golden Gate National Recreation Area, California	Golden Gate National Recreation Area - Ocean Beach, San Francisco, California	Beach Visitors (Dog Owners)	Fact Sheet (2 pages)

PUBLIC INFORMATION AND EDUCATION MATERIALS

TITLE	AUTHOR(S)	TARGET LOCATION	TARGET AUDIENCE	TYPE OF MATERIAL
Usted Puede Ayudar a Proteger al Charrancito Menor Californiano y el Chorlitejo Patinegro Nevado (You Can Help Protect the California Least Tern and the Western Snowy Plover)	The Nature Conservancy of California	Guadalupe-Nipomo Dunes	Spanish speaking beach visitors	Brochures
Key Facts about the Snowy Plovers at Ocean Beach	Nancy Read, Vandenberg Air Force Base, California	Ocean Beach within Vandenberg Air Force Base, California	Media reporters (TV and newspaper)	Fact Sheet
Naval Operational Training and Natural Resources Conservation Brochure	Naval Amphibious Base, Coronado, California	Local	Navy Audiences	Brochure
Sharing the Beach: How you can help the Western Snowy Plover	Oregon Working Team	Oregon Coast	General Public	Brochure
Plover Biology, Plight and Recovery Efforts	U.S. Fish and Wildlife Service, Oregon	Oregon Coast	General Public	Flyer
Plover Biology, Plight, ESA...	U.S. Fish and Wildlife Service, Oregon	Pacific Coast	General Public	Flyer
Trading Cards (laminated) with plover picture on front and narrative on back	Marina State Beach 61 Reservation Road Marina, CA 93933	Pacific Coast	General Public	Handout

PUBLIC INFORMATION AND EDUCATION MATERIALS

TITLE	AUTHOR(S)	TARGET LOCATION	TARGET AUDIENCE	TYPE OF MATERIAL
Slide Show	Oregon Snowy Plover Working Team	Oregon Coast	General Public	Slide Show
Video entitled "Life at the Ocean's Edge, the Western Snowy Plover and the California Least Tern."	La Purisima Audubon Society in association with Pygmy Mammoth, Productions, California	Central California Coast	General Public	Video
Closed Area Sign (English and Spanish versions)	California Dept. of Fish & Game and Point Reyes Bird Observatory	Point Reyes	Beach Visitors	Directional Sign
Closed Area Sign	U.S. Fish and Wildlife Service, Washington	Willapa National Wildlife Refuge	Beach Visitors	Directional Sign
Closed Area Signs (Nest in Peace and Do Not Disturb) both Carsonite posts and traditional	Oregon Snowy Plover Working Team	Oregon Coast	Beach Visitors	Directional Sign
Oregon Coastal Treasure Sign	Oregon Snowy Plover Working Team	Oregon Coast	Beach Visitors	Interpretive Sign
Web Site	Bureau of Land Management, Oregon	Oregon Coast - BLM Sites	General Public	Web Site
Plovers, Pets and People - Sharing the Beach	Oregon Snowy Plover Working Team	Local	Dog Owners	Poster for Veterinary Offices

ATTACHMENT C

VOLUNTEER PROGRAM
FOR THE
WESTERN SNOWY PLOVER

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Introduction

Purpose and Goals

The following information is provided as guidance to managers of western snowy plover habitat who may need to use volunteer help to accomplish tasks of western snowy plover management (including survey work) and habitat protection. Under the overall goal of the recovery of this species, the purpose of this appendix is to give some guidance on setting up and managing a program of volunteers, with tips from other resource managers currently using volunteers as part of the western snowy plover recovery effort. The ideas covered in this appendix are meant to offer suggestions from which the program manager can choose to start a new volunteer effort or enhance an existing volunteer program, depending on the needs of each western snowy plover habitat area, and the need for and availability of volunteer help.

The purpose of a volunteer program is to expand the ability to do work beyond that which existing staff and other resources can accomplish. In addition to helping accomplish the goals of western snowy plover habitat management projects, a successful volunteer program can also increase public awareness on this and other ecological issues. It also helps the public understand their place in the natural world and their role in helping to preserve the planet's biodiversity.

The Value of Volunteers

Volunteers can provide inexpensive help where funds for western snowy plover management and habitat protection work are limited or not available. Working with volunteers also gives the local community opportunities to become actively involved with western snowy plover management. Volunteers can also gain a sense of ownership of their natural resources, which could increase public support for western snowy plover protection, and help the public to better understand coastal beach management decisions.

Volunteers can provide service on a temporary basis (for just one season or project), or make a long-term commitment. A long term commitment could bring consistency to western snowy plover monitoring and data collection.

Who Are Volunteers?

Volunteers are people who give freely of their time and effort to support a cause in which they believe (in this case, sensitive species protection). People volunteer for many reasons. In addition to having an interest in wildlife, birding, and/or the western snowy plover in particular, they have an opportunity to learn about wildlife and habitat protection, to teach others, and share in the hands-on stewardship responsibilities of wildlife managers. Learning something new, getting outdoors, and/or meeting new people are just a few of the reasons that could motivate volunteers while obtaining satisfaction in doing much needed work. Volunteering can also give people opportunities and experiences that supplement those associated with their regular jobs. Volunteers

have different abilities and desires, which must be kept in mind when planning a volunteer effort.

Advantages and Disadvantages

The advantages of volunteer help center around increasing your workforce without accompanying increase in cost. Other advantages can include obtaining needed expertise, fresh perspectives, and enthusiasm for the recovery process.

Volunteers do require some budgeting. The costs and benefits of a volunteer program should be carefully weighed. It must be worthwhile for a manager to use volunteers. Volunteer programs can create unrecognized demands on regular staff and impact program funding. Organizing a volunteer program includes recruiting and training participants. This effort will require a volunteer coordinator. Volunteer work and volunteers have different incentives than career staff (i.e., career advancement and monetary compensation). It can be a challenge to direct volunteers, keep them focused, and maintain a high level of interest and commitment. Supervision of volunteers can become nearly a full-time job, depending on the program, the projects, and the people involved. Monetary costs associated with a volunteer program include training materials, provision of equipment, incentives or awards, and staff time needed for management and supervision.

Volunteer Opportunities

In the western snowy plover recovery effort, there are a number of areas in which volunteers could play a role. Volunteer monitors may be needed in most areas. Monitoring requires a higher level of training, time, and commitment from volunteers. They need to be well-trained in finding and identifying western snowy plovers and willing to spend a fair amount of time to complete the survey work. A regular commitment throughout the breeding season will be necessary. Under careful supervision, there may also be opportunities for volunteers to be involved in plover capture and banding work, erecting exclosures, treating oiled plovers, and/or specimen handling, storage, and tracking.

Volunteers with a talent for numbers can aid in the analysis and/or manipulation of monitoring data, or preparation of the final report. The volunteers who monitor may or may not be interested in the data analysis and report writing aspects of the work.

Volunteers can also be useful for beach patrol and public contact work. Although volunteers cannot give citations, they can give informal warnings and interpret the western snowy plover habitat protections to beach users. This is an important aspect of the western snowy plover recovery effort. If volunteers are monitoring and making public contacts, there may be a conflict in both time and attention to with their work. Effective public contact also takes diplomacy and a certain degree of extroversion along with a dedication to and through knowledge of the species. If possible, separate the jobs of

monitoring and public contact according to the volunteers' preferences. Volunteers can also participate in outreach efforts, and developing interpretive materials such as written articles for newsletters and local newspapers. They can also do other public relations work, including fund raising, which is a specialized skill in itself.

Habitat restoration activities are another area in which volunteers may be useful. Removal of non-natives such as European beach grass, or revegetation with native species (keeping western snowy plover habitat needs in mind) can be gratifying for the volunteer, and can give a balanced view of western snowy plover habitat management as a whole.

Experienced volunteers that have committed to regular participation in the recovery program could also help to operate the program itself. Training new volunteers and organizing the season's work are two areas which would be useful as long as there is program leader oversight.

Unpaid college and high school internships provide the opportunity for students to augment their studies with related work experience. The work performance for those interns receiving academic/course credit for volunteer work usually needs to be formally evaluated, by the project leader to assess the work accomplished by the student.

Volunteer Background Logistics

Volunteer Eligibility
Anyone is a potential volunteer, regardless of gender, race, religion, age, or disability, as long as the individual can adequately perform the work assigned in a safe manner. However, project managers are not required to accept all who volunteer their services. Juveniles under the age of 18 may need to provide acceptable parental or guardian consent. While work permits are not required, they are recommended, and all appropriate labor laws governing the work hours of juveniles should be followed. The program manager should determine minimum age requirements, if necessary, such as for the operation of certain types of equipment.

Background Checks
Background checks are not necessary for western snowy plover volunteers unless the volunteer duties include supervising or having exclusive control over minor children when no other adult supervision is present, or the volunteer has access to confidential records, purchase documents, or master keys and expensive equipment. Background checks are time-consuming (2 weeks to 2 months), and a processing fee is involved.

Medical Conditions
A health questionnaire may not be necessary unless, based on the duty statement, the land manager decides to request one. If the volunteer has indicated a medical condition or

physical limitation which may restrict performance of assigned duties, a health questionnaire may be required, and the prospective volunteer can be allowed to participate only if the described condition or limitation will not impact the volunteer's ability to safely complete the prescribed work, and if it will not place the volunteer in an unsafe work situation.

Registering Volunteers
Volunteers should be registered with the participating agency. Registration can be delegated to the program leader unless confidential information such as social security numbers, drivers' license numbers, or date of birth is requested on the forms, in which case the land manager or agency representative should be responsible for registration.

For the purposes of workers' compensation insurance and tort liability, any disclaimer information must be made available (by distributing copies or posting). Volunteers should read and sign any disclaimer information. An opportunity for all participants to ask questions must be provided.

Recommended Forms
Registration forms should include a Volunteer Application, a Volunteer Service Agreement for long-term volunteers, a Volunteer Group Services (volunteers in an established group), a Parental Permission form for juveniles, and Special Project or Activity Sign-In Form (for short-term projects). Additional registration forms may be necessary depending upon the volunteer's stated health status, and whether the individual will be working alone with juveniles, using vehicles or other specialized equipment, or performing other specific duties. Examples of forms that have been used for volunteer registration may be found at the end of this attachment. These are to provide an example of the kinds of information that can be collected when registering volunteers.

Under the Information Practices Act, all personal information collected from volunteers or volunteer applicants must be kept confidential.

Legal Authority and Requirements
Various land managers (Federal or state governments, local county or city jurisdictions, natural preserve managers, etc.) may have different policies regarding the legal status and management of volunteers. For example, the State of California formally recognized the value of volunteers in 1978 with the California State Government Volunteers Act (Government Code §3110 through §3119.2) which grants state agencies the authority to utilize volunteers under certain general and specific requirements. Other land managers may or may not have similar enabling policies.

Workers' Compensation Insurance and Tort Liability
People can be careless and accidents do happen. In addition to pain and lost work time, such incidents can result in costly workers' compensation claims. Also, unsafe actions of a volunteer resulting in injuries to another can result in tort liability suits filed against the

volunteer and the land manager. Land managers policies can vary on the amount of responsibility assumed for volunteers' mishaps depending on whether the volunteer is long-term or short-term (may not be covered by workers' compensation insurance). A student intern whose salary is paid by outside entities (the school or college foundation) may be covered by that entity, while unpaid student interns who volunteer their time may be covered by the land manager's insurance. Organized groups, such as interest groups, civic and non-profit organizations, and corporations and small businesses, may agree to provide workers' compensation insurance for its volunteering participants.

Workers' compensation insurance is a state-mandated benefit provided by employers to their employees which provides for physical injuries and other medically related disabilities which are caused by work-related actions. Tort liability, as applied to volunteer management is an action by a volunteer which results in personal injury to another person or damage to the property of another. When a properly registered volunteer is acting within the accepted limits and scope of their assigned job responsibilities, the land manager can choose to assume responsibility for tort liability claims.

Risk Management
To reduce the risk of accidents and injuries:

- Volunteers should be given proper supervision;
- Volunteers should not be assigned to do work which they do not feel comfortable completing or willingly agree to perform;
- Volunteers who will operate equipment or machinery in the course of their duties should be able to demonstrate proficiency in its safe operation and a thorough understanding of all applicable safety measures. The age of the volunteer should also be considered;
- Volunteers need adequate training, initial and ongoing if necessary, in any equipment operation (records should be maintained), and in general safe work practices. Personal safety during survey work should be addressed;
- All accidents and injuries should be reported immediately, thoroughly investigated, documented, and analyzed to determine what factors, conditions, or practices contributed to the incidents, so that action can be taken to prevent reoccurrence.

Equipment and Vehicle Use
Volunteers may operate equipment and motor vehicles other than their own during the course of their work or as required in their volunteer duty statement. A number of requirements are necessary:

- The volunteer that will be driving must have the appropriate valid state driver's license (Class A, Class B, or Class C) and be at least 18 years old;

- If volunteers drive agency or private vehicles during the course of their duties, a driving record check could be requested, and a driving test for each type of vehicle to be operated could be given;

- If a volunteer drives a private car during the course of volunteer duties, its use should be authorized by the program leader;

- Each volunteer who will drives should be briefed on proper vehicle operation, maintenance and safety, including the use of seat belts and accident reporting;

- Similar requirements should be considered for volunteer use of other kinds of special equipment;

- Volunteers should not operate law enforcement or emergency vehicles unless the vehicle is clearly marked "out of service";

- Under California Vehicle Code 17151, the driver of a vehicle has the primary liability for accidents arising out of maintenance or use of that vehicle. Accidents must be reported to the volunteer driver's insurance company within 48 hours, which is obligated to provide defense and indemnification for claims;

- If volunteers use personal property or equipment while doing volunteer work, and that personal property is lost, damaged or stolen, the program manager or agency cannot be held liable;

- Volunteers should not use equipment for personal use.

Passes, Parking and Miscellaneous Expenses

Volunteers regularly entering a park or other such control-fee areas in the course of their volunteer duties should be issued a pass that will permit free access. A pass can be in excess of what is needed for the volunteer to accomplish assigned tasks. This pass can also be used as a means of incentive to continue volunteer activities, and as a reward for work accomplished. A regular parking space should be provided if parking is limited. If extended periods in the field are necessary, a campsite or designated camping area should be made available. Also, efforts should be made to reimburse volunteers for miscellaneous expenses associated with completing tasks requested by land managers (e.g., film and processing costs, etc.).

Creating and Managing a Volunteer Program

Starting a New Program
The first step in creating a volunteer program that will meet your needs is to clearly identify those needs in a needs assessment. The needs for western snowy plover management will be site-specific, and may be approached with a variety of tools (e.g., more staff, more or better interpretive materials, etc.). With a clear statement of needs that are carefully identified and analyzed, and with development of potential solutions, the manager can better determine if a volunteer program will best meet those needs.

A needs assessment should include a comprehensive and specific list of all the desired tasks/activities not performed by staff members, and those tasks currently performed by staff where assistance is needed. Specific training or skills not found in existing staff should also be included. The listed items should be ranked according to the commitment of time, training, and supervision that will be needed and which can be made available. Priorities can then be established based on habitat needs and the available levels of support.

For instance, survey work requires a regular program with committed, consistent participants. Special events or a regularly-scheduled program that draws a large number of people or a regularly-scheduled event is more likely to reach a greater number of serious participants, and can have the potential to grow and require more volunteers. Also, for the same effort it takes to publicize a special event, an ongoing one can be listed with occasional updates to keep the listing current. A regular and committed program also has greater potential to increase public awareness of the issue, and to have an impact on the participants' lives. The program can also become popular with volunteer exchanges, colleges, corporations, and other sources of future volunteers, who may contact you for volunteer opportunities. Examples of regularly-scheduled volunteer programs are the Habitat Restoration Program and Stewardship Education Program at Point Reyes National Seashore.

Duty Statement
After a needs assessment is completed, job descriptions or duty statements for every position or function desired should be developed. The descriptions detail volunteer duties or responsibilities, including their performance standards and supervisory chain of command, if appropriate. Duty statements should define the knowledge and skills needed to do the job safely and effectively, and include all training needed to ensure that job performance standards are met. If a Volunteer Service Agreement is used, the duty statement should be attached, or referenced on the form.

Recruitment
Recruitment consists of the many methods from which you can choose to reach volunteers. Begin recruitment only after the rest of the snowy plover program is in place.

Recruitment requires time, patience, and persistence, particularly with a new program. A volunteer program takes time to build momentum and as is does become established, satisfied volunteers will promote the program and may become an important resource for recruiting additional help. An annual recruitment drive can also be considered, with a theme, slogan, and press release.

The first step is to develop a written recruitment message which gathers all information about the volunteer position - parts of this information can be used for the different recruiting methods chosen. The basic recruitment message should cover the following key points:

1. Statement of need, why the job is important;
2. How a volunteer can help solve the problem; and
3. How a volunteer can benefit from doing the job.

Personal contact is the most effective way to recruit volunteers. Other less interactive methods of recruitment include distributed printed material and other media which can reach a greater number of people. A new recruiting tool to consider is the Internet.

Complete information on the program should be compiled, including what the program does, when, where, and what volunteers can do, experience required, and what training encompasses. All recruiting methods must include a contact (name of a specific person, address, and/or phone number) prospective volunteers can reach for further information. A printed information sheet, giving specific information about the program provided, making participation sound fulfilling and fun, should be sent to interested callers, along with reprints of articles about the program or an article about the species. If there is more to the program than survey work, such as habitat restoration or public relations projects, develop a schedule of volunteer events including information on the task(s), locations, dates, and times. Send out the schedule with the information sheet to give volunteers activities to look forward to.

Developing a written recruitment strategy can help to guide volunteer efforts. Such a strategy would cover the following points:

- Volunteer job description;
- Skills and qualities needed to perform the job;
- The types of people most likely to have these qualities (age, gender, education, experience);
- The best sources for finding volunteers;
- Best recruitment techniques or methods to use;
- Benefits to the volunteers; and
- Recruitment officer and/or Program Lead, and why.

Recruiting Opportunities by Personal Contact
The opportunities for recruiting by personal contact are many and diverse, and will depend on the local area and the interests and values of the people who live there. On site, there may be interested individuals among current staff and concessionaires (and/or their families), or among retired staff. Staff and volunteers wearing buttons saying "Ask me about volunteering…" could also help spread the word. The program leader or other trained staff can speak to individuals or groups, and an accompaniment of a slide show or a videotape could help introduce the program.

Student volunteers and interns can be found on nearby college and university campuses and can be reached through college clubs focused on related topic areas. Probably a good way to reach students is by asking professors who teach courses related to ornithology, biology, and conservation or environmental studies for interested students. Other campus recruitment opportunities include student union information networks, college newspapers, and job placement centers.

Special interest groups may be recruited for western snowy plover work that relates to their specific interests, and can be reached through active members or by providing a guest speaker for a meeting. For example, a local chapter of the Audubon Society or another birder organization could adopt a beach or habitat area for regular monitoring activities. Local chapters of other conservation organizations and professional societies (e.g. Cooper Ornithological Society, The Wildlife Society) and their conferences may provide another appropriate venue for the purposes of interesting potential volunteers in helping with the western snowy plover. A possible advantage of mobilizing such groups, including organizations as local hiking groups or off-highway vehicle clubs, is that they may have their own leadership and infrastructure. Often this allows them to maintain their own insurance and makes project supervision easier for the program manager or project leader.

Making presentations at meetings of the local chamber of commerce, philanthropic organizations, community clubs, social functions, and staffing a western snowy plover information booth during special events that take place near the site (such as a state park) or at local fairs and community events are other possible means of recruiting. Related businesses/industries, service organizations, and governmental agencies could be contacted as well. A local community volunteer center or volunteer exchange may provide additional ideas for recruiting, and may be a source of people looking for volunteer opportunities.

Other Recruiting Opportunities
Many more volunteers may be reached by other, less personal means, however these methods are not as immediate and require more work on the part of the recipient to call with further questions or to actually volunteer. Adequate information should be given in any printed appeal including: project description, location, time/day commitment, length of commitment needed, skills needed and the training offered, equipment required and

other logistics, and, most importantly, a contact and a deadline date by which to call. All of these quasi-published methods should have frequent follow-up to keep them current.

Printed materials that can be utilized for recruitment purposes include:

- Articles or ads in the park publications;
- Entries on the managed area's Internet homepage;

- Posters or enticing informational flyers posted in appropriate places such as:

    - colleges and universities,
    - volunteer bureaus,
    - libraries,
    - company/church/community bulletin boards,
    - military base recreation centers, and
    - shopping malls

- Articles in newsletters or journals of related interest groups and professional organizations:

    - entries in job announcement listings for both paid positions and volunteer work in publications.

- Job listing directories such as the American Bird Observatory's Directory of Volunteer Opportunities for Birders which annually lists volunteer birding opportunities from all over the world (contact the administrative offices of the American Birding Association, P.O. Box 6599, Colorado Springs, CO 80934 for more information).

Less-focused printed recruitment methods use the local newspapers, sometimes free of charge for local events listings. An in-depth article appearing each year at the appropriate time would help to alert the community and recruit volunteers as well. A notice or advertisement of the western snowy plover habitat protection program and information on volunteer opportunities in the local newspaper and businesses such as banks can be asked to carry a related message in their advertising.

Other media opportunities include advertising through radio or TV stations - public service announcements may be broadcast free of charge by some stations. A written public service announcement should be prepared and distributed to all stations - if your program is ongoing, you may need to send one regularly or your listing will be dropped. Appearing as a local interest spot on the news or participation in a local talk show can also be effective in reaching the local community.

Interviewing and Selection
Volunteer selection can have a significant effect on the program. Volunteers with the qualities (skills or abilities, outgoing personality for public contact work, etc.) should be appropriate for the project(s).

The interview process lets the potential volunteers know what to expect, familiarizes them with the program and the land management entity/agency before they commit, and indicates the agency's commitment the snowy plover recovery program. The volunteer's qualifications, their ability to do the tasks, their availability, and their willingness to commit to doing the work are all needed information as they are the representatives of the land managing entity/agency. It is also useful to determine whether the job can fulfill the volunteer's needs.

Orientation/Training
Volunteers will be given an orientation on the concepts of western snowy plover habitat protection/management and trained for the specific tasks they will be performing.

Orientation
The orientation can help the volunteers feel welcome and introduce them to the agency or land manager. Job performance expectations will also be outlined.

A formal orientation session should inform volunteers of their assignment . Any liability protection or injury compensation they are eligible for while working within the scope of their assignment as described in their duty statement should be covered at this time. A Volunteer Orientation Checklist (an example is provided in the forms section at the end of this attachment) can be an important tool to insure all pertinent topics are covered.

Training
Training is used to provide the volunteers with the necessary depth of knowledge and the skills needed to do the jobs assigned. Initial on-site training is required, and periodic refresher training can also be incorporated into the program, if needed. Training should be as clear as possible in identifying the skills/knowledge to be learned or refined, should be as job-specific as possible, and should involve experienced volunteers and staff. Be realistic about what can be accomplished in the allotted time, draw on the skills and experiences of those attending, and look for opportunities to train volunteer and existing staff together.

Training materials for western snowy plover volunteers should be based, in part, on information contained in Appendix J, Monitoring Guidelines for the Western Snowy Plover, Pacific Coast Population. The tasks involved in western snowy plover habitat management (including monitoring) are varied, and the training should provide adequate coverage of each aspect. A western snowy plover habitat management program may have volunteers participating in a limited portion of the program. Any one volunteer may do only one task, more than one task, or an individual may be given the opportunity to go

from one task to another sequentially. With tasks as diverse as survey work, public interaction, plover capture and banding (State and Federal permits required), erecting exclosures, treating oiled plovers, data analysis, and specimen handling, storage, tracking, and dispensation, the volunteer (and staff) training could be a challenging part of the program.

Because the U.S. Fish and Wildlife Service requires supervised field training, a training schedule should be established and the volunteers notified by letter, which should include times and locations of training sessions, trainers' names, and a list of all equipment required and other recommended gear. In accordance with the minimum training requirements developed by the U.S. Fish and Wildlife Service, training should include classroom and field instruction. During the classroom instruction, the duty statement should be given to the volunteers and reviewed, safety and equipment use should be discussed, and any other necessary paperwork should be completed. Instruction should be provided regarding who to contact when injured or dead birds are found. A printed training agenda can keep things on track and provide the students with an outline of the course. Written background information should be supplied to the volunteers for further home study. Videos, pictures, and slides will help volunteers to become familiar with the target species. Conveying some of the information while in the field should be considered - people tend to be more receptive to short explanations with real life, visible illustrations than to extended lectures. Lunch periods during training sessions can also be an opportunity to transmit information in a more casual way.

In the classroom, volunteers should be instructed in the biological background information on western snowy plover, its legal status and restrictions, and on the survey and habitat management programs. Information should also be given on the least tern if this species will be included in the survey work. Sanderlings should be covered as well, since they are often confused with western snowy plovers. Field Survey Data Sheets (for western snowy plover and disturbance factors) and detailed instructions for completing them should be distributed, discussed, and reviewed during the field training sessions. Western snowy plover color bands should be discussed. Tips on public contact and outreach information consistent with program goals should be covered, as well as information on other projects involved in western snowy plover habitat management.

Various levels of field instruction are required for winter surveys, breeding season monitoring, plover handling, and banding or marking. A Field Training Checklist should be used to assure that all requirements have been met, and copies furnished to the volunteers. Participants can be certified when the appropriate level of training has been met and the volunteers' names added to an existing Recovery Permit.

Program Leadership

Good program leadership helps volunteers feel productive, successful, supported, recognized, and rewarded. Since volunteers receive no pay for their work, their reward is a feeling of accomplishment and a sense of contributing to the preservation of the species.

A successful program leader keeps volunteer morale and participation high by making them feel wanted, valuable, and a part of the team. Complimenting volunteers for a job well done and showing them how their work helps in the management of western snowy plover habitat gives volunteers a sense of special recognition and accomplishment.

Assessment and Review

Any volunteer effort needs to be assessed periodically to be sure the goals of the program are being met. Evaluation can also be used as a reference for identifying training needs for current and future volunteers. Frequent informal evaluation by the program leader can provide volunteers with feedback on the quality of their work, in addition to identifying potential program-wide problem areas that may need to be addressed with additional training or other actions. In addition to compilation of the data collected, an Annual Program Activity Report should be prepared to assess the program as a whole, and the volunteer program specifically. If personal (rather than program) evaluations are written, copies must be given to the volunteer.

Conversely, when the volunteers can evaluate the program and their training, they can identify its successes and where improvement is needed, things that may not be obvious to the program leader. Ensure that volunteers are given an opportunity to provide written or oral review of the program.

Problem Solving

When working with people, problems can develop. Conflicts or concerns are most quickly resolved if addressed at the lowest level possible. The problem-solving procedure of addressing the issue/situation, generating possible solutions, evaluating all possible solutions, deciding on a solution, and implementation of that solution, can work if everyone is willing to participate in an open and honest manner with a professional work demeanor. Addressing the specific problem (not past conflicts), confronting the issue rather than the person, remaining objective, being creative with solutions, and compromising are good points to remember when trying to solve problems that arise. If problems cannot be resolved verbally at lower levels, a written report may be needed to present the problem for resolution to higher supervisory levels.

Motivation, Recognition, and Rewards

Motivating volunteers to regularly participate, to remain with the program, and to return year after year can be a challenge. Volunteers will stay with the program if they feel that the program has worthwhile goals that are being accomplished, that they are instrumental in helping the program reach its goals, that the program leadership is effective, and that they are stimulated and are enjoying the experience. To get people to return to a program, they must remember their experience positively. A successful program that provides a sense of continuity and commitment not only benefits the projects, but visible continuity (and the completion of large projects) is stimulating to continuing participants. Special recognition and rewards can also be tools to help increase volunteer consistency and retention.

It is important to acknowledge to the volunteers and to other staff that volunteers are providing an important and valuable service. Volunteers should feel comfortable discussing their work or expressing their concerns. Constructive feedback, both to the volunteers about their work and from them about the program's strengths and weaknesses, can be given informally on-the-job, or more formally, such as in a meeting. If appropriate, they can be included in staff meetings and encouraged to participate. A suggestion box can also be used to solicit suggestions.

Variety can be provided by including volunteers in other, related projects, or tasks can be traded with other volunteer groups, particularly if the volunteers are involved in habitat restoration. Opportunities for increased responsibility within the program can be offered.

Stimulating discussion is a learning tool, an inspiration, and a reward in itself. Topics of interest include the value of nature, western snowy plover and other sensitive species, surveys and habitat restoration. Interpretive hikes on site, perhaps at the end of a training session, are educational and can help communicate the importance of the work to the species and the ecosystem. Volunteers can be encouraged to return in the future to see the changes they have helped to bring about.

For unpaid college and university student interns in the sciences (and others working in the field), volunteering can provide the opportunity to augment their studies with related work experience, which will also make valuable resume material. There is always the opportunity to get future job references, and to make contacts in the field. Some kind of academic credit can be given to field biology students for regular monitoring during the spring semester and other western snowy plover habitat management tasks.

Some programs have used specially designed T-shirts that can be given after a specified amount of volunteer work is done as a form of recognition and reward. Volunteer uniforms are not necessary, but may or may not be desired to identify the western snowy plover volunteers for easy recognition by other staff and the public. Caps, windbreaker/jackets, or other useful items displaying an appropriate logo or patch can also be used as volunteer incentives.

Providing snacks or drinks to volunteers (donated by the management agency/organization) is a courtesy, and taking the volunteers to lunch can be another kind of recognition/reward. A special appreciation picnic, potluck, or barbeque can be planned. Part of the encouragement is in the camaraderie, bonding to the other volunteers, the program, and the information exchange between the participants.

Stories in a newsletter or local newspaper highlighting the volunteers' efforts and the impact they have on the western snowy plover habitat management program can be both recognition and an effective recruiting tool.

Certificates and plaques have been awarded in some programs when a volunteer puts in a designated number of hours. An example of a simple Award Application can be found in the forms section of this attachment. Established awards currently available that recognize volunteers' accomplishments include "The First Lady of California Volunteer Award," and "Take Pride in California", for which volunteers can be nominated. National Volunteers Week, celebrated in mid-April, and "Make a Difference Day" (last Saturday in October), sponsored by USA Weekend and the Points of Light Foundation, can be used as times to recognize volunteers and their efforts.

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Vineyard, S. 1989. Beyond Banquets, Plaques and Pins: Creative Ways to Recognize Volunteers.

FORMS

Examples of Forms Used in Volunteer Program Management

VOLUNTEER APPLICATION

NAME	HOME PHONE NO.	ALTERNATE PHONE NO.
STREET ADDRESS	CITY/STATE/ZIP CODE	

IF UNDER AGE 18, PROVIDE NAME ADDRESS AND PHONE NO. OF PARENT OR GUARDIAN

HAVE YOU EVER SERVED AS A ☐ Yes *(List locations and approximate dates below.)* ☐ No

POSITION YOU ARE SEEKING | HOW DID YOU HEAR ABOUT OUR VOLUNTEER PROGRAM?

WHY DO YOU WISH TO BECOME A

CURRENT OCCUPATION

HIGHLIGHT YOUR EDUCATIONAL AND EMPLOYMENT BACKGROUND/EXPERIENCES THAT YOU FEEL MAY CONTRIBUTE TO THE VOLUNTEER PROGRAM
(You may attach a resume.)

LIST THREE PERSONS NOT RELATED TO YOU WHO KNOW OF YOUR WORK QUALITY.

Name	Phone No.	Relationship

FOR CAMPGROUND HOST APPLICANTS ONLY

I understand that additional information, such as driver's license, Social Security Account Number and a background check may be required for certain volunteer positions. I hereby certify that all statements made on this application are true and complete.

SIGNATURE DATE

VOLUNTEER SERVICE AGREEMENT

A copy of the volunteer duty statement, or title and location of a master duty statement must be attached.

NAME *(First, MI, Last)*	HOME PHONE NO.	ALTERNATE PHONE NO.
HOME ADDRESS	CITY/STATE/ZIP CODE	

CHECK ONE

☐ I am 18 years of age or older. ☐ I am under 18 years of age *(Attach a signed Parental/Guardian Permission Form)*

CHECK ONE

☐ I know of no health limitations which may restrict my performance of assigned duties. ☐ I DO know of health limitations which may restrict my performance of assigned duties.

The following information is to be provided *only* if it is indicated as being required for a specific volunteer position, which may include authorized travel, handling of money, driving a personal vehicle or other duties.

SOCIAL SECURITY NO.	DRIVER'S LICENSE No.: State:	DATE OF BIRTH

I hereby allow *a background check.*

SIGNATURE DATE

▶

SERVICE AGREEMENT

I agree to comply with all policies, regulations, directives and instructions, and to conduct myself in a professional manner, consistent with the same standards as established for employees.

Further, I understand that I will not be compensated for any work performed as a Volunteer, other than for reimbursement of necessary and allowable expenses when authorized in my duty statement

VOLUNTEER ASSIGNED TO	WORK LOCATION

I hereby volunteer my services as a ***Volunteer for the job duties attached.***

VOLUNTEER SIGNATURE DEPARTMENT REPRESENTATIVE DATE

▶ ▶

EMERGENCY NOTIFICATION

IN CASE OF ACCIDENT, SERIOUS ILLNESS OR EMERGENCY, I WOULD LIKE TO HAVE THE FOLLOWING PERSON NOTIFIED.

FIRST

NAME	RELATIONSHIP	HOME PHONE NO.	BUSINESS PHONE NO.
STREET ADDRESS		CITY/STATE/ZIP CODE	

SECOND

NAME	RELATIONSHIP	HOME PHONE NO.	BUSINESS PHONE NO.
STREET ADDRESS		CITY/STATE/ZIP CODE	

VOLUNTEER SEPARATED ON *(Date)* SUPERVISOR SIGNATURE

▶

VOLUNTEER GROUP SERVICES AGREEMENT

SPONSORING GROUP OR ORGANIZATION *(Include name, address, zip code, and telephone number.)*

SPONSORING GROUP OR ORGANIZATION LIAISON *(Include name, address, zip code, and telephone number.)*

PERSON FROM SPONSORING GROUP OR ORGANIZATION TO BE NOTIFIED IN AN EMERGENCY *(Include name, address, zip code, and telephone number.)*

PROJECT DESCRIPTION *(If more space needed, continue on reverse.)*

AGREEMENT BY THE GROUP OR ORGANIZATION

We agree to volunteer our services to accomplish the work described above to assist the with the following conditions:

- ***Roster:*** *We agree to provide with an attendance roster including name, address, and phone number of participants.*
- ***Juveniles:*** *Our group represents that if juveniles (under age 18) are participating, we assume all responsibility for obtaining formal parental/ guardian consent for their attendance and participation.*
- ***Waiver of Liability and Hold Harmless Agreement:*** *We understand and acknowledge that does not provide insurance coverage for recognized volunteer groups or for the volunteer activities encompassed by this agreement. We accept the responsibility for providing accident insurance and/or workers' compensation coverage for the individuals participating in this volunteer activity, and if requested, agree to provide evidence of insurance coverage. We agree to indemnify and hold harmless and its employees, officers, sponsors, and agents, from any claim for injury or damages to any person arising out of or in any way connected to this volunteer activity.*
- ***Termination:*** *Either we, or may terminate this agreement, at any time, by notifying the other party in writing.*

GROUP/ORGANIZATION REPRESENTATIVE'S PRINTED NAME AND SIGNATURE TITLE DATE

AGREEMENT BY

accepts this offer, and agrees, while this agreement is in effect, to provide technical guidance and such materials and supplies, equipment, and facilities as are needed and are available to accomplish this project, except as may be specified in an attachment.

REPRESENTATIVE'S SIGNATURE DATE

THIS AGREEMENT WAS ☐ COMPLETED ☐ TERMINATED ON *(Date)*_____

REPRESENTATIVE'S SIGNATURE DATE

PARENTAL/GUARDIAN PERMISSION
FOR JUVENILE VOLUNTEERS

Juveniles are defined as individuals under the age of 18. They may register and become volunteers if they provide written consent from a parent or guardian. reserves the right to accept or deny any juvenile (under age 18) volunteer's application based on:

1) program/operational needs,
2) the applicant's maturity and knowledge,
3) the applicant's demonstrated interest in department programs, and
4) the availability of adult supervision.

Juvenile volunteers must be assigned an adult supervisor. Arrangements for this supervision must be approved by the

NAME OF PARENT OR LEGAL GUARDIAN (Please print)	TELEPHONE NO.

STREET ADDRESS

CITY/STATE/ZIP CODE

_____, a juvenile, has my permission to participate in
(Volunteer's Name)
volunteer activities. I have read and agree to the requirements stated above.

☐ I know of no health limitations which may restrict this volunteer's performance of assigned duties.

☐ I DO know of health limitations which may restrict this volunteer's performance of assigned duties.

PARENT OR LEGAL GUARDIAN'S SIGNATURE DATE

▶

UNIT/LOCATION

ACTIVITY/PROJECT	DATE(S) OF ACTIVITY/PROJECT

CHECK ONE:

☐ **Long-Term Volunteer** *(more than 3 days)*: As part of the application process, prospective long-term underage volunteers are required to sign a Volunteer Services Agreement and have this parental permission form signed by the same parent or guardian.

☐ **Short-Term Volunteer** *(3 days or less)*: Volunteer Services Agreement not required.

EVENT SUPERVISOR OR VOLUNTEER PROGRAM LEADER SIGNATURE	DATE
▶	

SPECIAL PROJECT OR ACTIVITY SIGN-IN

LOCATION	ACTIVITY/PROJECT	LEADER	DATE(S) OF ACTIVITY/PROJECT

AGREEMENT, WAIVER AND RELEASE OF CLAIMS
(To be read aloud to the group)

Each of the undersigned agrees as follows:

1. *That I am volunteering my services for the above-described event on a voluntary basis without anticipation of payment of any kind;*
2. *That I will perform assigned tasks which are within my physical capability to the best of my ability, and that I will not undertake tasks that are beyond my ability or physical capability;*
3. *That I am familiar with the safe operation and use of equipment and tools that I may utilize in connection with this volunteer activity, and that I will not undertake to use any equipment or tools with which I am unfamiliar or do not know how to operate safely;*
4. *That I will perform only those tasks assigned, observe all safety rules, and use care in the performance of my assignments;*
5. *That I hereby release and discharge, agree to indemnify and hold harmless, and their agents, employees and representatives, from all claims, demands, actions or judgments which I, or my heirs, executors, administrators or assigns, may have for any and all injuries and damages, known or unknown, caused by or arising out of the above-described activity;*
6. *That I specifically acknowledge that I am engaging in this activity as a volunteer, at my own request and risk, and not as a agent, official, officer or representative, and further acknowledge that I am not entitled to any compensation, benefit or insurance coverage from nor will I make any such claim;*
7. *That I have read this agreement, waiver and release of claims, and understand its terms, and that I voluntarily execute it with full knowledge of its significance.*

SIGNATURE	PRINTED NAME	ADDRESS *(optional)*	TELEPHONE NO. *(optional)*
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERSONS UNDER 18 YEARS OF AGE MAY NOT SIGN THIS FORM *(Use reverse if needed)*

Form OR1114-3 (May, 1993)

Volunteer Hours Record

Date Completed _____
Reassign Volunteer ☐

Name: _____ Supervisor: _____

Job Title: _____ Schedule: _____

In the squares below, indicate the daily number of hours worked. List reimbursements on the back.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total
Jan																																
Feb																																
Mar																																
Apr																																
May																																
Jun																																
Jul																																
Aug																																
Sep																																
Oct																																
Nov																																
Dec																																

Reimbursements received *(through travel voucher or imprest)*

Date	Amount	Description	Sub Activity Code

Training - Work Related Training Completed *(formal and informal)*:

Date Completed	Title (or description)	# of Hours	Certified yes or no? (if applicable)

Volunteers

Orientation Checklist

Name _____ **Date** _____

_____

___ Sign Volunteer Service Agreement

___ Discuss volunteer's job description

___ List all property issued (keys, uniforms, books, etc. issued)

___ Overview of history and philosophy of

___ Introduce volunteer to staff

___ Provide tour of the office and other facilities

___ Appearance standards

___ Schedule

___ Sexual harassment, discrimination, and related policies

___ Conflict of interest and standards of professional conduct

___ Worker's compensation and tort liability

___ Provide initial training

___ Review general safety procedures and for specific job responsibilities

___ Explain practices (obtaining supplies, vehicle/equipment operation, telephone use, etc.)

___ Assure that volunteer knows whom to contact to have any other questions answered.

___ Other _____

___ Other _____

___ Other _____

___ Other _____

Lead person completing checklist _____

Date orientation completed _____

EVALUATION FORM I
VOLUNTEER EVALUATION

(To be completed by the volunteer's supervisor upon request of the volunteer at the end of a project, upon termination of the volunteer's tour of duty, or every six months for long term volunteers).

1. Supervisor's Name _____

2. Volunteer's Name _____

3. Volunteer's Dates of Service _____ to _____

4. Office or Field Station _____

5. Projects Completed _____

_____

_____

6. Were the projects completed to your expectations? If not, why? _____

_____

_____

_____

7. Did the volunteer fulfill the criteria established in his/her project description? If not, what was not addressed?

_____

_____

_____

8. What were the volunteer's major strengths in relation to the assigned volunteer duties?

_____

_____

_____

_____

9. What were the volunteer's weaknesses in relation to the assigned volunteer duties?

_____

_____

_____

10. What were the major skills used by the volunteer to complete his/her duties and their proficiency in using these skills?

_____

_____

_____

_____

11. Additional Comments:

_____

_____

_____

_____

EVALUATION FORM II (Optional)
PROGRAM/PROJECT EVALUATION

(To be filled out by the volunteer upon completion of a major project, termination of their tour of duty, or once a year.)

1. Volunteer's Name (optional) _____

2. Dates of Service _____ to _____

3. Office of Field Station _____

4. Project(s) Completed _____

_____

_____

_____

5. Were clear directions provided on the duties you were to perform? Did you receive a copy of your volunteer services agreement?

_____

_____

_____

_____

6. Were you given adequate training for these duties? _____

_____

_____

_____

_____

7. Were you given adequate supervision for these duties? _____

_____

_____

_____

_____

8. How would you improve the volunteer program at this site? _____

_____

_____

_____

9. What are the strengths of the volunteer program? _____

_____

_____

_____

_____

10. Did the volunteer experience meet your expectations? If not, why? _____

_____

_____

_____

_____

11. Additional Comments: _____

_____

_____

_____

_____

AWARD APPLICATION

Name of Recipient:_____

Brief explanation of what the recipient did or does to warrant the award:

Short description of contribution to be placed on award.
(approximately 25 words)

Name of who will sign award:

_____

Date to be placed on award (usually date of presentation):

_____

A two-week lead time is requested.

APPENDIX M

SUMMARY OF PUBLIC COMMENTS ON DRAFT RECOVERY PLAN AND SERVICE RESPONSES

(Placeholder for appendix which will be included AFTER draft recovery plan goes out for public review and comments)