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DISTRIBUTION OF WINTERING SNOWY PLOVERS IN CALIFORNIA AND ADJACENT STATES

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Snowy Plovers of the subspecies *Charadrius alexandrinus nivosus* nest on sandy coastal beaches, around salt evaporation and agricultural drainage ponds, and on barren margins of interior alkaline and saline lakes in western North America. Human encroachment has caused nesting birds to disappear from many coastal breeding locations in California (Page and Stenzel 1981). Because of the continued threat of encroachment and the species' general scarcity, the California Department of Fish and Game has categorized the Snowy Plover as a species of special concern. Additionally, Snowy Plovers are considered threatened in Oregon by the Oregon Department of Fish and Wildlife, and endangered in Washington by the Washington Department of Game (U.S. Fish and Wildlife Service 1985). On a broader geographical basis, the U.S. Fish and Wildlife Service lists the Snowy Plover as a sensitive species, indicating its candidacy for threatened or endangered status if active management or removal of threats does not occur.

The conservation of any species requires, as its basis, detailed knowledge of population size and distribution during all seasons. Considerable progress toward this objective has been made for the Snowy Plover through recent statewide breeding bird surveys (Herman et al. 1981, Page and Stenzel 1981, Wilson-Jacobs and Meslow 1984, C. Bruce in litt.). About 5500 breeding birds have been located by these surveys in Washington, Oregon, California, and Nevada. Comparable information is now being collected for wintering birds in some of the same states.

We use the results of statewide censuses in California and Oregon between 1979 and 1986, along with published and unpublished records, to describe the abundance and distribution of wintering Snowy Plovers in California and other western states. In addition we estimate the size of the post-breeding population in western North America and attempt to reconcile that estimate with the results of the winter surveys and reported sightings.

METHODS

Between 1979 and 1985 hundreds of skilled volunteer observers counted Snowy Plovers monthly on coastal beaches in California. We asked counters to report the location covered, the starting and ending points of the census, date and time, beach conditions, the number of plovers checked and unchecked for color bands, and the color combinations of banded birds. Appropriate census sites were selected on the basis of published and unpublished knowledge of the occurrence of plovers or knowledge of suitable habitat (e.g., Page and Stenzel 1981). Our aim was to obtain a minimum of four censuses per site per winter, but at some sites, particularly those with limited access, census effort varied within and between years. Many additional sites, of questionable suitability, also were surveyed one or more times to determine if they were used by plovers.

The color-banded birds were primarily breeders from coastal Oregon and California sites at Monterey Bay, Morro Bay, and Mono Lake. Sightings of banded birds provided information on the wintering sites of breeders, use of multiple sites by breeding and wintering plovers, and dispersal of juvenals.

We define winter as 1 November through 28 February to exclude the breeding season and most migration (Warriner et al. 1986) and divide California into mainland coast, San Francisco Bay, Channel Islands, and interior regions. Winter population estimates for the Channel Islands and the interior are based largely on pre-existing information and incidental sightings; estimates for the mainland coast and San Francisco Bay are from surveys. Following Page and Stenzel (1981) we identify census locations along the mainland coast with names and latitudes from topographic or highway maps and categorize locations by the following types:

BLUFF-BACKED BEACH (B): beach backed by cliffs, bluffs, or other non-dune upland habitat.
DUNE-BACKED BEACH (D): beach backed by dunes that may be interrupted by a river, creek, pond, lagoon, or salt pan.
POCKET BEACH (P): beach at a river or creek mouth or lagoon, delimited and dominated by bluffs or rocky points.
SPIT (S): a sand spit or bar (long enough not to be dominated by nearby bluffs) separating the ocean from a coastal wetland. (Pescadero Beach, San Mateo County, is the shortest beach so categorized.)
ESTUARINE (E): a disturbed or naturally open area in or at the margin of an estuary or lagoon, including salt pans or levees in salt evaporators.
URBAN SHORELINE (U): a sandy beach or other area backed by residential or commercial development and usually receiving heavy human use. This includes harbor shorelines.

We differ from Page and Stenzel (1981) on categorization of the lagoon areas of northern San Diego County; whereas Page and Stenzel categorize them as estuarine because birds nested on salt pans, we categorize them as spits or pocket beaches because the salt pans usually flood in winter and wintering birds were generally found on the beach.

Because the plovers flock in winter and these flocks sometimes use more than one site, a description of plover occurrence at winter sites should entail an estimate of the flock size and an estimate of the proportion of the time that the flock uses the area. For most sites we have too few surveys to estimate

the proportion of time the site was used, but to estimate flock size we were able to use the survey data as described below. For each site and census year we calculated the total number of censuses, the total number of censuses with plovers, and the maximum and median plover counts, ignoring zero counts in calculating medians and maxima unless all were zeros at a particular site in any year. These data were then summarized for the six-year period (Table 1), including zero yearly medians and maxima in calculations of the median of the median numbers and median of the maximum numbers for each site. Only locations with plovers on one or more counts are included in Table 1. We chose medians over means since we did not know, *a priori*, what the data would look like and wanted a robust estimate of flock size for each site. We also chose to give each year equal weight so that years with unusually sparse or thorough coverage did not unduly bias the estimate for all years. These "grand" medians, summed over all sites, are two potential estimates of the coastal winter population size.

We compared the above estimates to counts obtained on two surveys of 25 beaches between San Luis Obispo and Orange counties from 10 to 27 November 1984 and from 12 to 26 February 1986. On each survey, the one or two skilled observers covering each site moved between sites as quickly as possible to minimize chances of counting the same birds at different sites.

We resolved the problem of comparing winter and summer densities of plovers along the coastline by using the length of outer sandy beach in our calculations of densities for both seasons. This causes our breeding density estimates to differ somewhat from those of Page and Stenzel (1981) because their calculations and densities were based strictly on the habitat used during the breeding season (including inner shorelines of coastal embayments and excluding bluff-backed sandy beaches).

To increase readability, in presenting results we omit one reference frequently used and abbreviate two others. All references to kilometers of coastline and the amount of sand beach in each county are from Anon. (1971). ABN refers to *American Birds* notebooks, an unpublished compilation of bird records submitted by observers to the editors of the regional report for the Middle Pacific Coast Region published quarterly in *American Birds*. CBC refers to Christmas Bird Counts, also published in *American Birds*.

RESULTS AND DISCUSSION

California Mainland Coast Populations

The estimated winter population sizes for the mainland coast were 1555 birds from summed medians and 2511 from summed maxima (Table 1). The 1984 and 1986 winter surveys of the 25 selected sites from San Luis Obispo to Orange counties were 665 and 801 Snowy Plovers, respectively. Summation of the medians gave an estimate of 431 birds; summation of the maxima gave an estimate of 722 birds for the same areas. For the medians this was equivalent to 65% and 54%, respectively, of the birds tallied on the two surveys; for the maxima the equivalents were 109% and 90% of the tallied birds. These results suggest that the median of the maximum counts corresponds most closely to results that would be obtained in a comprehensive

survey, and that approximately 2500 Snowy Plovers wintered along the mainland coast during our survey period. The "grand medians" of the maximum survey counts are indicated in Figure 1.

The ratio of wintering to breeding Snowy Plovers along the mainland coast is about 2.6:1. The differences between the two population sizes are most striking between Sonoma and San Mateo counties, because, from north to south, the density of wintering birds begins to increase in Sonoma and Marin counties whereas the density of breeders does not increase until Santa Cruz and Monterey counties (Table 2). The low number of breeders relative to wintering birds suggests that suitable nesting habitat in the region from Sonoma to San Mateo counties is scarcer than suitable foraging and roosting habitat.

Spits and dune-backed beaches, each with 32% of the estimated 2511 birds, were the coastal habitats with the most wintering Snowy Plovers. Pocket beaches were not used by wintering plovers in the northern part of the state, in contrast to the region from San Mateo County south (Table 1); apparently longer segments of beach are required to support Snowy Plovers on the northern coast. Urban and bluff-backed beaches were used by some wintering plovers (Table 1), whereas neither habitat supports breeding birds (Page and Stenzel 1981). Although tidal flats and lagoon margins provide foraging habitat for birds in many instances, roost sites are typically on beaches, where the birds are usually counted. The close proximity of tidal flats for foraging may be one reason that so many wintering plovers are found on adjoining spits. Estuarine areas we identified as providing both foraging and roosting sites for plovers in winter were San Diego Bay, San Francisco Bay, and the Moss Landing salt evaporators in Monterey County.

Coastal Winter Plover Distribution by County

Del Norte County: About 54% of Del Norte County's 73-km shoreline is sandy beach. Small numbers of plovers winter irregularly here. We recorded them only at Lake Talawa (Table 1), but there is an additional record of six birds on 18 December 1983 at the Smith River spit (ABN). Single surveys of Pelican State Beach, Smith River mouth, and Crescent Beach turned up no plovers.

Humboldt County: We estimated 63 wintering Snowy Plovers for the 195 km of Humboldt County shoreline, 68% of which is sandy beach. Page and Stenzel (1981) did not find breeding plovers on bluff-backed beaches, whereas wintering plovers were found along bluff-backed Gold Bluffs Beach during two of three winters (Table 1). Wintering plovers also occurred regularly at Stone Lagoon even though none were reported breeding there. Two winter censuses, each in different years at Big Lagoon, produced only one plover although 13 were found here during the 1977 breeding season (Page and Stenzel 1981). Our methods produced a zero winter estimate for the Mad River mouth, which had 17 breeders in 1977 (Page and Stenzel 1981). On many winter censuses the entire spit was not covered, so possibly some plovers were missed. Wintering birds were found here in two of six census years (Table 1). Other sites, checked once or twice, which produced no plovers were Agate, Moonstone, and Luffenholtz beaches, Arcata Oxidation Pond, Humboldt Bay Reserve, and Mattole River mouth.

Figure 1. Distribution of wintering Snowy Plovers in California. Closed circles indicate data that represent a minimum of two years of survey, with three surveys per year. Open circles indicate data based on fewer surveys.

Table 1. Results of winter Snowy Plover counts along the mainland California coast.

Site	Latitude	Beach type[a]	Total years[b]	Total counts[b]	Yearly median bird numbers[c]	Yearly maximum bird numbers[c]
Del Norte County						
Lake Talawa	41° 50′ 00″	D	4 (2)	6 (4)	1 (0-2)	1 (0-3)
Humboldt County						
Gold Bluffs Beach	41° 25′ 00″	B	3 (2)	10 (7)	1 (0-5)	2 (0-9)
Stone Lagoon	41° 14′ 30″	S	4 (4)	15 (12)	8 (7-12)	9 (7-14)
Clam Beach/Little R. Mouth	41° 00′ 00″	D	6 (4)	8 (6)	10 (0-27)	11 (0-29)
Mad River Spit	40° 56′ 00″	S	6 (2)	19 (2)	0 (0-11)	0 (0-11)
Humboldt Bay North Spit	40° 47′ 00″	S	2 (1)	3 (1)	2 (0-3)	2 (0-3)
Humboldt Bay South Spit	40° 45′ 00″	S	5 (5)	17 (10)	14 (12-27)	27 (20-34)
Eel River North Spit	40° 40′ 00″	S	1 (1)	2 (2)	3	6
Eel River South Spit	40° 35′ 00″	S	1 (1)	5 (1)	6	6
Mendocino County						
MacKerricher Beach	39° 29′ 30″	D	6 (4)	12 (6)	22 (0-40)	23 (0-40)
Manchester Beach	38° 58′ 30″	D	4 (3)	28 (4)	2 (0-2)	2 (0-3)
Sonoma County						
Salmon Creek Beach	38° 20′ 30″	D	6 (6)	102 (65)	17 (3-31)	45 (6-66)
Doran Beach	38° 19′ 30″	S	6 (6)	125 (98)	23 (19-25)	48 (38-71)
Marin County						
Dillon Beach	38° 15′ 00″	D	6 (6)	30 (28)	32 (25-54)	38 (32-55)
Pt. Reyes: Kehoe-North Beach	38° 07′ 00″	D	6 (6)	42 (42)	22 (10-38)	49 (10-156)
Pt. Reyes: North Beach south	38° 01′ 30″	B	5 (5)	25 (16)	7 (4-15)	15 (4-27)
Drakes Spit	38° 01′ 45″	S	6 (6)	43 (28)	32 (15-60)	54 (33-70)
Limantour Spit	38° 01′ 30″	S	6 (6)	65 (54)	27 (20-58)	48 (23-127)
Bolinas Spit	37° 54′ 30″	S	6 (6)	81 (79)	21 (13-29)	29 (14-35)
San Francisco County						
Ocean Beach	37° 45′ 00″	U	6 (6)	26 (21)	8 (2-14)	14 (4-16)

Table 1 (Cont.)

Site	Latitude	Beach type[a]	Total years[b]	Total counts[b]	Yearly median bird numbers[c]	Yearly maximum bird numbers[c]
San Mateo County						
Sharp Park Beach	37° 37′ 30″	P	2 (2)	4 (2)	12 (10-13)	12 (10-13)
Linda Mar Beach	37° 36′ 00″	P	6 (5)	33 (26)	9 (0-15)	13 (0-23)
Princeton Harbor	37° 30′ 00″	D	6 (6)	44 (32)	22 (12-30)	29 (22-39)
Half Moon Bay State Beaches	37° 28′ 00″	D	6 (5)	29 (11)	12 (0-29)	19 (0-40)
San Gregorio State Beach	37° 19′ 30″	P	4 (2)	11 (6)	1 (0-5)	1 (0-7)
Pomponio State Beach	37° 18′ 30″	P	6 (6)	32 (19)	6 (2-28)	8 (2-40)
Pescadero State Beach	37° 16′ 00″	S	6 (6)	69 (56)	12 (4-19)	29 (13-52)
Gazos Creek Mouth	37° 10′ 00″	D	5 (5)	20 (18)	7 (6-25)	13 (7-25)
Año Nuevo Beach	37° 07′ 00″	D	4 (3)	12 (3)	4 (0-10)	4 (0-10)
Santa Cruz County						
Waddell Creek	37° 05′ 30″	P	6 (5)	53 (45)	16 (0-26)	29 (0-35)
Scott Creek	37° 02′ 30″	P	6 (6)	58 (55)	13 (5-34)	25 (13-47)
Davenport Beach	37° 00′ 30″	P	6 (3)	36 (3)	1 (0-4)	1 (0-4)
Laguna Creek	36° 59′ 00″	P	6 (6)	66 (37)	3 (3-8)	9 (3-14)
Wilder Creek Beach	36° 57′ 00″	P	6 (6)	112 (104)	24 (14-43)	36 (27-51)
Seabright State Beach	36° 57′ 30″	U	5 (4)	76 (38)	11 (0-15)	16 (0-17)
San Lorenzo River Mouth	36° 58′ 00″	U	5 (1)	30 (2)	0 (0-12)	0 (0-14)
Sunset Beach	36° 53′ 30″	B	6 (6)	71 (31)	3 (1-6)	5 (1-10)
Pajaro River Mouth	36° 51′ 00″	S	6 (6)	271 (234)	41 (11-65)	81 (28-117)
Monterey County						
Moss Landing Beach	36° 48′ 30″	S	6 (6)	130 (90)	25 (12-39)	69 (45-124)
Moss Landing Salt Ponds	36° 49′ 00″	E	6 (3)	25 (22)	25 (0-118)	45 (0-130)
Salinas River Mouth North	36° 46′ 30″	D	6 (6)	60 (53)	18 (2-39)	33 (5-60)
Salinas River Mouth South	36° 45′ 00″	S	5 (5)	33 (29)	18 (8-32)	30 (10-80)
Marina Beach	36° 42′ 00″	D	6 (6)	35 (25)	9 (2-28)	22 (2-48)
Del Monte Beach	36° 36′ 30″	D	6 (6)	69 (62)	38 (24-51)	50 (44-69)

Table 1 (Cont.)

Site	Latitude	Beach type[a]	Total years[b]	Total counts[b]	Yearly median bird numbers[c]	Yearly maximum bird numbers[c]
Asilomar Beach	36° 37′ 30″	P	6 (4)	45 (15)	18 (0-23)	19 (0-26)
Carmel River Mouth	36° 32′ 30″	P	6 (6)	47 (28)	14 (4-18)	17 (11-19)
Point Sur Beach	36° 18′ 30″	P	3 (3)	6 (6)	50 (28-52)	52 (28-68)
San Luis Obispo County						
San Carpoforio Creek	35° 46′ 00″	P	3 (3)	6 (6)	20 (10-31)	21 (21-31)
Point Sierra Nevada Beach	35° 43′ 00″	P	2 (2)	5 (3)	10 (8-11)	15 (8-21)
Arroyo de la Cruz	35° 42′ 00″	P	2 (1)	2 (1)	1 (0-1)	1 (0-1)
Sidney's Lagoon	35° 41′ 00″	P	2 (1)	6 (4)	5 (0-10)	10 (0-20)
Point Piedras Blancas	35° 40′ 00″	P	4 (2)	20 (9)	2 (0-14)	2 (0-31)
Arroyo Laguna Creek	35° 39′ 00″	D	6 (6)	39 (26)	23 (13-33)	30 (23-33)
Pico Creek	35° 37′ 00″	P	3 (2)	5 (4)	0 (0-6)	0 (0-8)
San Simeon State Beach	35° 35′ 00″	P	6 (6)	37 (32)	17 (0-26)	34 (0-45)
Villa Creek	35° 27′ 30″	P	4 (4)	7 (7)	5 (0-13)	7 (0-16)
Cayucos Creek	35° 27′ 00″	U	4 (2)	137 (2)	1 (0-5)	1 (0-5)
Toro Creek	35° 24′ 30″	D	4 (1)	25 (11)	0 (0-5)	0 (0-12)
Atascadero Beach	35° 23′ 00″	D	6 (6)	105 (83)	44 (10-58)	71 (43-130)
Morro Bay Spit	35° 21′ 00″	S	6 (6)	40 (28)	31 (22-47)	72 (39-182)
Avila Beach	35° 10′ 30″	B	2 (1)	5 (1)	3 (0-6)	3 (0-6)
Pismo Beach North	35° 08′ 30″	U	2 (2)	6 (4)	4 (1-7)	7 (7-7)
Pismo Beach South	35° 03′ 00″	D	5 (5)	21 (13)	35 (17-78)	57 (25-105)
Oso Flaco Beach	35° 02′ 00″	D	2 (2)	7 (7)	16 (9-23)	19 (11-26)
Santa Maria River Mouth	34° 58′ 00″	S	6 (6)	50 (50)	20 (15-65)	48 (23-150)
Santa Barbara County						
Shuman Creek North	34° 50′ 30″	D	4 (4)	10 (8)	25 (16-26)	28 (18-34)
San Antonio Creek North	34° 48′ 00″	D	5 (5)	12 (11)	53 (24-179)	77 (59-179)
Purisima Point North	34° 45′ 30″	D	4 (4)	9 (9)	18 (3-26)	22 (3-154)
Santa Ynez River Mouth	34° 41′ 30″	D	6 (6)	37 (37)	23 (5-27)	65 (22-150)

Table 1 (Cont.)

Site	Latitude	Beach type[a]	Total years[b]	Total counts[b]	Yearly median bird numbers[c]	Yearly maximum bird numbers[c]
Jalama Beach	34° 30′ 30″	P	4 (3)	9 (7)	22 (0-32)	25 (0-35)
Devereaux Beach	34° 24, 30″	S	6 (6)	22 (19)	38 (27-61)	57 (31-100)
Goleta Beach	34° 25′ 00″	P	6 (6)	28 (23)	24 (4-72)	33 (6-72)
Santa Barbara Harbor	34° 24′ 30″	U	5 (4)	22 (18)	14 (0-34)	22 (0-68)
Carpenteria State Beach	34° 23′ 30″	U	3 (1)	3 (1)	0 (0-9)	0 (0-9)
Ventura County						
San Buenaventura Beach	34° 15′ 30″	U	2 (2)	13 (10)	24 (17-31)	28 (23-32)
Santa Clara River Mouth	34° 14′ 00″	D	5 (5)	33 (28)	14 (8-29)	25 (20-80)
Ormond Beach	34° 08′ 00″	D	2 (2)	6 (5)	24 (22-25)	41 (38-44)
Mugu Lagoon	34° 06′ 00″	S	3 (3)	18 (17)	20 (19-89)	116 (100-127)
Los Angeles County						
Zuma Beach	34° 01′ 00″	B	4 (4)	11 (10)	35 (31-39)	37 (31-59)
Corral Beach	34° 02′ 00″	U	1 (1)	6 (6)	8	8
Malibu Lagoon	34° 02′ 00″	U	6 (6)	48 (39)	19 (10-36)	31 (15-50)
Santa Monica Beach	34° 00′ 00″	U	2 (1)	3 (1)	2 (0-4)	2 (0-4)
Ballona Cr./Playa del Rey	33° 57′ 00″	U	4 (4)	9 (8)	3 (1-8)	3 (1-8)
El Segundo/Hermosa	33° 52′ 00″	U	4 (3)	32 (29)	13 (0-14)	14 (0-26)
Redondo/Torrance Beaches	33° 49′ 00″	U	2 (2)	12 (10)	8 (3-12)	10 (3-17)
Orange County						
Bolsa Chica	33° 42′ 00″	S	5 (5)	32 (15)	3 (1-16)	4 (1-39)
Huntington Beach	33° 39′ 00″	U	2 (1)	8 (3)	2 (0-3)	3 (0-5)
Balboa/Newport Beaches	33° 36′ 30″	U	3 (1)	6 (1)	0 (0-4)	0 (0-4)
Crystal Cove	33° 34′ 30″	B	6 (6)	134 (122)	7 (5-13)	12 (7-19)
Aliso Beach	33° 30′ 30″	P	4 (1)	8 (2)	0 (0-1)	0 (0-1)
Doheny State Beach	33° 27′ 30″	B	5 (4)	20 (13)	6 (0-17)	8 (0-34)

Table 1 (Cont.)

Site	Latitude	Beach type[a]	Total years[b]	Total counts[b]	Yearly median bird numbers[c]	Yearly maximum bird numbers[c]
San Diego County						
San Onofre Beach	33° 23′ 00″	B	2 (1)	2 (1)	3 (0-6)	3 (0-6)
Santa Margarita R. Mouth	33° 14′ 00″	S	5 (5)	16 (12)	16 (2-30)	25 (2-63)
San Luis Rey R. Mouth	33° 12′ 00″	U	4 (2)	16 (4)	3 (0-7)	3 (0-14)
Agua Hedionda Lagoon	33° 08′ 30″	S	4 (3)	9 (4)	4 (0-6)	4 (0-10)
Batiquitos Lagoon	33° 05′ 30″	P	4 (2)	14 (5)	3 (0-16)	3 (0-38)
San Elijo Lagoon	33° 00′ 30″	S	5 (5)	38 (28)	11 (1-29)	25 (20-77)
San Dieguito R. mouth	32° 58′ 30″	S	5 (5)	35 (34)	10 (6-24)	21 (9-38)
Los Penasquitos Lagoon	32° 56′ 00″	S	5 (5)	39 (33)	16 (7-20)	20 (10-28)
Whispering Sands	32° 52′ 00″	U	5 (3)	53 (28)	2 (0-4)	3 (0-7)
Fiesta Island, Mission Bay	32° 46′ 30″	E	2 (2)	6 (4)	21 (4-37)	50 (4-96)
Bonita Cove, Mission Bay	32° 46′ 00″	E	2 (2)	9 (8)	42 (30-54)	60 (40-80)
San Diego R. Flood Control Channel	32° 45′ 00″	U	3 (3)	4 (3)	11 (2-18)	11 (2-18)
North Island	32° 41′ 00″	D	1 (1)	1 (1)	17	17
Silver Strand State Beach	32° 39′ 00″	S	4 (3)	5 (4)	6 (0-27)	6 (0-36)
Delta Beach, San Diego Bay	32° 29′ 00″	E	2 (2)	2 (2)	16 (14-18)	16 (14-18)
Sweetwater R. mouth	32° 38′ 30″	E	2 (2)	3 (3)	33 (32-33)	36 (33-38)
Imperial Beach	32° 35′ 00″	S	3 (1)	3 (1)	0 (0-22)	0 (0-22)
Tijuana R. mouth	32° 33′ 00″	S	6 (5)	18 (16)	29 (0-93)	43 (0-100)

[a] For explanation of codes, see Methods section in text.
[b] Numbers in parentheses are numbers of counts on which plovers were found.
[c] Numbers are grand medians; numbers in parentheses are range of medians.

Table 2. Densities of Snowy Plovers along the mainland California coast.

Counties	Km of sand beach[a]	Breeding density[b]	Winter density[b]	Winterer/ breeder ratio[b]
Del Norte, Humboldt & Mendocino	196.8	0.41	0.45	1.1
Sonoma & Marin	69.8	0.57	4.67	8.2
San Francisco & San Mateo	54.5	0.24	2.61	10.9
Santa Cruz & Monterey	69.7	2.37(1.69)	7.73(7.09)	3.3(4.2)
San Luis Obispo & Santa Barbara	193.3	1.26	3.76	3.0
Ventura, Los Angeles, & Orange	200.2	0.77(0.68)	1.71(1.71)	2.2(2.5)
San Diego	102.2	2.51(1.22)	3.39(1.80)	1.4(1.5)

[a] From Anon. (1971).
[b] Densities in parentheses exclude birds in coastal wetlands and salt flats. For density calculations see Methods.

Mendocino County: Only 13% of Mendocino County's 193-km shoreline is sandy beach. We estimated 25 wintering plovers (Table 1); Page and Stenzel (1981) estimated 15 breeders in 1977. MacKerricher Beach was the main area used by plovers at both seasons. Other sites, checked once or twice, which produced no plovers were the Howard Creek, Wages Creek, Noyo River and Navarro River mouths, and the Caspar, Russian Gulch, Van Damme, and Fish Rock beaches.

Sonoma County: Only 18% of the 100-km Sonoma County shoreline is sandy beach. Our estimate of 93 winterers, at two sites in the Bodega Bay area (Table 1), likely overestimates the population size. Frequent and coordinated censuses showed that birds shifted between sites during the winter, making the sum of the maximum counts higher than the number of birds actually present. From censuses conducted simultaneously at the two sites, the median of maximum winter counts over the six years was only 72 birds. Other sites, which produced no plovers, were the Sonoma Coast State Beaches, surveyed 9 to 17 times over to a 2- to 3-year period, and the Gualala River mouth, surveyed 10 times between 1982 and 1985 and monthly from October 1975 to March 1979 (W. Eastman pers. comm.).

Marin County: Forty-six percent of Marin County's 113-km shoreline is sandy beach with an estimated 233 wintering Snowy Plovers (Table 1). The main wintering areas are Drakes and Limantour spits, Point Reyes Beach, Dillon Beach, and the spit at Bolinas Lagoon. All but Dillon Beach are breeding sites (Page and Stenzel 1981). The north and south sections of Point Reyes Beach are contiguous and should be considered as one area. They are separated in Table 1 because census data for the two segments were frequently obtained on different dates. Wintering Snowy Plovers shift between Drake's and Limantour spits during the winter. A subset of censuses

taken on the same or consecutive days at Drakes and Limantour spits indicated that 80 birds, rather than the 102 indicated by our general technique, would be a more accurate estimate for the two areas combined. Other sites, which produced no plovers, were Estero de San Antonio (9 surveys over 2 years), Estero Americano (8 surveys over 2 years), McClures Beach (7 surveys in 1 year), Blakes Landing on Tomales Bay (1 survey), Muir Beach (48 surveys in 6 years), and Rodeo Lagoon (28 surveys in 6 years).

San Francisco County: We estimated a winter population of 14 plovers for the 9.3 km of sand beach in San Francisco County, which extends along 13.4 km of coastal shoreline. All plovers occurred on Ocean Beach, which receives very heavy recreational use.

San Mateo County: We estimated 128 wintering Snowy Plovers for the 45 km of sandy beach along San Mateo County's 90-km shoreline. Wintering birds occurred at nine sites (Table 1), whereas the species is known to breed at only four: Pomponio, Pescadero, Año Nuevo, and Gazos Creek (Page and Stenzel 1981, authors' unpubl. data). It is likely that there was considerable overlap between wintering birds counted at Princeton Harbor and on the state beaches around Half Moon Bay. We also found color-banded plovers moving between Gazos Creek and Pescadero, between Gazos Creek and Año Nuevo, and between Pescadero and Pomponio beaches. Other sites, checked one to four times, that produced no plovers were Thornton, Montara, Moss, Pillar Point, Tunitas Creek, Fiddlers Cove, and Bean Hollow beaches.

Santa Cruz County: Forty-five percent of the 68-km shoreline of Santa Cruz County is sandy beach. We estimated 202 wintering plovers at nine sites (Table 1); the Pajaro River mouth is clearly the most important of these. The birds at Sunset Beach were part of the Pajaro River mouth population. The Pajaro River mouth was frequently visited by birds from as far north as Wilder Beach and infrequently visited by birds from as far south as the Salinas River. Birds at Wilder Creek, Seabright State Beach, and the San Lorenzo River mouth were largely the same individuals. Color-banded birds also moved between Scott and Waddell creeks and between Scott and Laguna creeks. Santa Cruz sites used only by wintering birds were Scott Creek, Davenport Beach, Seabright State Beach, and the San Lorenzo River mouth. Davenport Beach and the San Lorenzo River mouth received only incidental winter use (Table 1). Several sites were checked regularly and produced no plovers: Yellowbank Creek, Majors Creek, Younger Lagoon, Natural Bridges (each 23 to 29 surveys over 3 to 5 years), and Moran/Corcoran Lagoons Beach (81 surveys over 6 years). Sites, surveyed once or twice a winter, that held no birds were Greyhound Rock and Baldwin Creek (each 1 year), Twin Lakes State Beach, (3 years), Capitola Beach (5 years), and New Brighton Beach (4 years).

Monterey County: We estimate 337 wintering Snowy Plovers (Table 1) along the 22% of Monterey County's 179-km shoreline that is sandy beach. Except for birds at Point Sur, all the wintering plovers in Monterey County are on or close to Monterey Bay. The major roosting sites are Moss Landing (both in the salt ponds and at Jetty Road), the Salinas River mouth, Marina Beach, Del Monte Beach, Asilomar Beach, and the Carmel River mouth. We found little evidence that wintering Snowy Plovers used the salt

evaporators at Moss Landing until 1982 when some levees broke and the evaporators were subjected to tidal action. Subsequently, wintering plovers have occurred there regularly. Birds from as far north as Wilder Beach and as far south as Marina Beach intermittently moved from their usual roosting sites to the salt ponds. Since 1983 there has been a regular movement of birds between the Pajaro River mouth and the salt ponds. Snowy Plovers breed at all sites listed in Table 1 except for Del Monte Beach, Asilomar Beach, and the Carmel River mouth. The Little Sur River mouth, near Point Sur, was not found to hold plovers on five checks made over four years.

San Luis Obispo County: We estimated 398 wintering Snowy Plovers (Table 1) along the 53 km of sandy beach in this county with 150 km of coastline. The plovers occurred at several pocket beaches north of Morro Bay, but the major concentrations were at Morro Bay and at the Nipomo Dunes, including the Santa Maria River mouth. Cayucos Creek received only incidental plover use (Table 1). For the area from San Carpoforio Creek to Morro Bay sandspit, we recorded movements of color-banded birds between San Carpoforio and Arroyo Laguna Creek, San Carpoforio and San Simeon State Beach, San Carpoforio and Atascadero, Arroyo Laguna Beach and San Simeon, Arroyo Laguna Creek and Atascadero, San Simeon State Beach and Atascadero, Cayucos Creek and Atascadero, and Atascadero and the Morro Bay spit. At the Nipomo Dunes we found that marked birds moved between Pismo Beach and the Santa Maria River mouth. Many of the pocket beaches with wintering birds between San Carpoforio and Cayucos creeks are not Snowy Plover breeding sites. Breeding occurs mainly in the Morro Bay and Nipomo Dune areas (Page and Stenzel 1981). Beaches at Arroyo Honda, San Simeon Bay, Little Pico Creek, Leffingwell Landing, Old Creek, and Port San Luis were each checked once and Santa Rosa Creek Beach was checked 7 times, but no wintering plovers were found.

Santa Barbara County: We estimate 329 wintering plovers for this county (Table 1), which has 177 km of coastline and 140 km of sand beach. Surveys of all Santa Barbara sites, except Carpenteria State Beach, in November 1984 and February 1986 produced counts of 242 and 340 birds, respectively. The major concentrations of wintering birds were at Purisima Point Beach (reported as Shuman Creek north, San Antonio Creek north, and Purisima Point north in Table 1), at the Santa Ynez River mouth, and at Devereaux Beach. Marked Snowy Plovers moved between Devereaux and Goleta beaches; it is likely that there is interchange between these areas and Santa Barbara Harbor as well. Sites used by wintering but not by breeding birds include Jalama Beach, Goleta Beach, Santa Barbara Harbor, and Carpenteria State Beach. Beaches at Gaviota, Refugio, El Capitan, and Leadbetter were also surveyed once or twice, but no plovers were found.

Ventura County: Ninety-nine percent of the 66-km Ventura County shoreline is sand beach, holding an estimated 210 wintering Snowy Plovers (Table 1). Our November 1984 survey of all sites except San Buenaventura Beach (28 of the 210 birds) produced 171 Snowy Plovers. The main concentrations of wintering and breeding birds (Page and Stenzel 1981) are at Mugu Lagoon and Ormond Beach, which are contiguous. The Santa Clara River mouth and San Buenaventura Beach are also contiguous and probably

have an interchange of birds. Beaches at Solimar and Port Hueneme were surveyed once, and Emma K. Wood State Beach 5 times, but no plovers were found.

Los Angeles County: Sand beach occurs along 68% of the 119-km Los Angeles County shoreline. We estimated a winter population of 105 birds (Table 1) but found only 58 birds on our November 1984 survey. Although we list birds at seven sites, Malibu Lagoon and Corral beaches are contiguous as are the last four Los Angeles County sites in Table 1. Thus wintering Snowy Plover areas in Los Angeles County are more accurately considered as three: Zuma Beach, Corral Beach to Malibu Lagoon, and Santa Monica to Torrance beaches. We have no information on winter movement of plovers among these areas. Single surveys of beaches at Long Beach and Bluff Cove yielded no plovers.

Orange County: Eighty percent of Orange County's 68-km shoreline is sand beach, with an estimated 27 winterers (Table 1). Our November 1984 survey tallied 38 birds, mainly at Crystal Cove, Doheny State Beach, and Bolsa Chica. Bolsa Chica, Huntington, Balboa, and Newport beaches are contiguous and probably have an interchange of birds. Of the areas with wintering birds only Bolsa Chica is also used by breeders (Page and Stenzel 1981). Four to five censuses each at Seal Beach, Upper Newport Bay, and Laguna Beach yielded no plovers.

San Diego County: San Diego County has 122 km of shoreline, 83% of which is sand beach. We estimate 346 wintering birds for the county (Table 1), as compared to 257 winterers on our November 1984 survey. We have no estimate for the Western Salt Works, which had 31 breeding birds in 1978 (Page and Stenzel 1981) and for which there is one winter specimen dated 13 January 1968 in the San Diego Natural History Museum. Our survey team found 21 plovers at Las Flores Creek mouth at Camp Pendleton on 29 November 1984, but no plovers were found on a single survey done the previous winter. One banded bird was seen at Silver Strand and at the San Dieguito River estuary during the 1982 winter, and at San Dieguito and Los Penasquitos lagoons during the 1983 winter. We have no other information on the movement of birds in San Diego County. The beach at Buena Vista Lagoon was surveyed 7 times over 2 winters and yielded no plovers. Sites surveyed 1 to 4 times that held no plovers include Aliso Canyon mouth, Carlsbad Beach, Whale Point, La Jolla Beach, Mission Beach, and Point Loma.

San Francisco Bay

Snowy Plovers have wintered on San Francisco Bay since at least the late 1800s, as evidenced by specimens dated 25 December 1893 (1) and 14 December 1898 (3) in the California Academy of Sciences. Our survey coverage of the extensive and virtually inaccessible privately owned salt evaporators on south San Francisco Bay was limited and undoubtedly resulted in an underestimate of current winter numbers. Our winter population estimate of 153 birds (Table 3) compares with breeding-period estimates of 351 birds in 1978 (Henderson and Page 1981) and 270 in 1984 (Point Reyes Bird Observatory [PRBO] unpubl. data). The only winter area covered regularly was Alameda South Shore, where there are records of

Table 3. Summary of winter Snowy Plover counts in San Francisco Bay.

Site	Years[a]	Counts[b]	Yearly maximum numbers[c]
Alameda South Shore	6 (6)	63 (32)	33 (21-58)
Hayward Shoreline Park	2 (2)	7 (2)	4 (1-7)
W of Baumberg salt evaporators	3 (3)	3 (3)	61 (42-87)
Coyote Hills to Hetch Hetchy Aqueduct salt evaporators	3 (3)	17 (15)	5 (1-28)
Hetch Hetchy Aqueduct to Coyote Creek salt evaporators	2 (2)	8 (6)	36 (7-66)
Foster City area salt evaporators	3 (2)	4 (4)	5 (0-33)
Redwood Cr. to Steinberger Slough	4 (2)	9 (6)	9 (0-38)

[a] Numbers in parentheses are numbers of years in which plovers were found.
[b] Numbers in parentheses are numbers of counts on which plovers were found.
[c] Numbers are grand medians; numbers in parentheses are range of medians.

Snowy Plovers dating back to at least 1962 (ABN). Our high count for this area was 58 birds (Table 3); however, there is a report from there of 100 Snowy Plovers on 24 February 1964 (ABN). Elsewhere in San Francisco Bay most wintering Snowy Plovers were found at salt evaporators. The largest concentration was west of Baumberg, which had a high count of 87. birds (Table 3). Larger numbers of Snowy Plovers were reported here during and after our surveys. On 14 February 1980 there were at least 100 birds (ABN), on the Hayward-Fremont CBC, 23 December 1985, 113 birds (ABN), and on 22 February 1986, 332 birds (H. Cogswell pers. comm.). We did not survey Oakland International Airport, where there were 30 Snowy Plovers on 18 December 1983 (ABN), or San Pablo Bay, where eight were reported on 3 February 1983 at Point Pinole, Contra Costa County (R. Erickson pers. comm.). On the basis of currently available information, we suspect the wintering plover population of San Francisco Bay to be 350 to 500 birds.

The Channel Islands

Spear (1981) estimated at least 260 breeders on San Nicolas, San Miguel, and Santa Rosa islands combined, from censuses conducted between 1978 and 1980. Snowy Plovers winter on all of these as well as on San Clemente, Santa Catalina, and Santa Cruz islands. L. Jones (in litt.) describes the Snowy Plover as common on San Nicolas Island in the winter. He noted monthly peaks of 46 birds on 10 February 1974, 33 on 17 November 1976, 39 on 11 December 1977, and 49 on 14 January 1977. Additionally we have censuses for Jetty and Daytona beaches of 14 birds on 22 December 1976, 17 on 15 January 1977, and 15 on 12 February 1977, and for Dutch Harbor of 14 birds on 26 February 1984. We have no records for San Miguel Island but agree with L. Jones (in litt.) that this is undoubtedly due to the lack of winter visits by ornithologists. Monthly peaks for Santa Rosa Island of 40

birds on 12 December 1973, 1 on 23 February 1976, 10-15 on 8 November 1976, and 1 on 25 January 1977 were reported by L. Jones (in litt.). For San Clemente Island, Jones (in litt.) has records of 10 birds on 8 December 1976 and 1 on 16 December 1976. There are additional records of single birds at Horse Beach on 16 December 1972 and 3 January 1980, 3 birds at Northwest Harbor on 9 November 1975, 6 birds at Pyramid Cove on 10 November 1975, and 2-23 (median = 15) birds at West Cove on nine dates between 7 January 1976 and 21 January 1981 (L. Salata in litt.). The only records for Santa Catalina Island are of 1 bird on 1 January 1975, 8 on 28 February 1976, and 8 on 23 November 1976 (L. Jones in litt.). L. Jones' (in litt.) monthly high counts for Santa Cruz Island were 33 birds on 9 November 1975, 40 on 7 December 1975, 11 on 18 January 1976, and 18 on 22 February 1976. We have additional records of 3 birds at Fraser Point on 21 December 1976 and, for beaches on the southwest portion of the island, 21 birds on 25 January 1977 and 28 birds on 20 February 1977 (PRBO unpubl. data). If the ratio of winterers to breeders on the Channel Islands is similar to that on the mainland coast nearby, there could be up to (2.63 × 260 =) 684 Snowy Plovers wintering on the Channel Islands; however, given the low numbers reported above (under 240, total), it is likely that many fewer than this number winter there.

The Interior of California

The only confirmed, regularly used, interior wintering area is the Salton Sea. However, Snowy Plovers probably winter regularly now in the newly created irrigation-runoff evaporation ponds on the former Tulare Lake bed, 30 km south of Corcoran, Kings County.

Up to 37 Snowy Plovers have been recorded on Salton Sea CBCs since 1968. Our surveys located 1-6 Snowy Plovers at Salt Creek on six dates between 12 Janaury and 5 February from 1980 to 1983, 8 at Niland Marina on 19 December 1979, 12 at the south end of the Salton Sea on 18 December 1979, 8 at the end of Poe Road on 18 January 1982, and 15 along the Salton City shore on 19 December 1979. These sites supported 112 of the 226 breeders found by Henderson in the 1978 survey (Page and Stenzel 1981). At one additional site, Red Hill Marina near the Alamo River mouth, two surveys done in January 1985 turned up no birds. Although we currently cannot estimate the size of the winter population, given the information obtained thus far, we believe that it is smaller than that of the breeding population.

In Kings County there were 3 birds in the South Wilbur Flood Area, Tulare Lake, on 10 January 1980 (ABN). H. Coe (in litt.) found up to 36 Snowy Plovers on 18 censuses of varying areas of the irrigation-runoff ponds at Tulare Lake during the 1983 winter. The ponds were constructed between 1980 and 1983; up to 126 adult-sized birds were found there during the summer of 1982 (Ivey 1984). It is likely Snowy Plovers now winter regularly at the evaporation ponds but more data are needed to confirm this. The only other winter records from this area are two birds at Tulare Lake on 1 November 1983 (ABN), one bird on the old lake bed on the Creighton Ranch-Corcoran CBC, 29 December 1985 (R. Hansen pers. comm.), and eight birds in the Tulare Lake basin on 22 December 1985 (ABN).

Elsewhere in the California interior the Snowy Plover is currently known as only an irregular winterer; however, most potential inland sites are seldom visited by observers in winter. In Los Angeles County there are winter records of 1 bird at the Lancaster Sewage Ponds from December 1981 through February 1982 (McCaskie 1982), and at Rosamond Lake of 26 birds on 17 December 1983 and 2 birds on 15 December 1984 (F. Heath in litt.). All these birds were located on Lancaster CBCs, which commenced in 1979. There are four winter records for Owens Lake, Inyo County: 1 bird on 27 December 1890 (Fisher 1893), 2 birds on 3 January 1975 (McCaskie 1975), 2 birds on 11 Janaury 1976 (T. Heindel in litt.), and 1 bird on the Lone Pine CBC, 15 December 1984 (D. Gaines pers comm.). Further survey of Rosamond and Owens lakes specifically for Snowy Plovers might show that they winter there more regularly than current records indicate. Other interior records are from El Dorado County, Lake Tahoe, 1 bird on 11 and 12 November 1961 (McCaskie in litt.); Merced County, Volta, 1 bird on 17 February 1965 (Chase 1965); Kern County, Lake Isabella, 1 bird on 25 January 1985 (McCaskie 1985); San Bernardino County, East Cronese Lake, 1 bird on 19 November 1978 (McCaskie 1979); Riverside County, Lake Elsinore, 6 birds on 11 December 1981 (D. Willick in litt.) and 10 birds on 30 January 1982 (McCaskie 1982); and San Diego County, Lake Henshaw, 1 bird on 5 November 1978 (McCaskie 1979), and Lake Hodges, 2-3 birds during the 1979-80 winter (Garrett and Dunn 1981) and 2 birds on 6 November 1982 (PRBO unpubl. data). Unitt (1984) considered the 5 November Lake Henshaw bird to be a migrant, as may be true of the other early November sightings.

We suspect that at most 300 Snowy Plovers winter at the interior of California, mostly at the Salton Sea and in the San Joaquin Valley. A few other areas, such as Owens Lake and dry lakes in the Mohave Desert, may prove to have small but regular wintering populations; however, it appears that the Snowy Plover is an irregular winterer throughout most of the interior of the state.

Historical California Winter Population

We suspect that development and human recreation, by altering habitat quantity and quality, has reduced winter numbers of Snowy Plovers along the California coast within the past 100 years, as has been described for the breeding period (Page and Stenzel 1981). However, the historical data on winter numbers needed to test this hypothesis are insufficient.

We examined coastal Christmas Bird Counts made annually from 1962 to 1984 to detect any trends in winter numbers of Snowy Plovers during this period. For both northern and southern California CBCs we used the raw sums of the Snowy Plover totals to test the hypothesis of no change in winter numbers against an alternative hypothesis of a downward trend. The effect of a probable increase in area coverage (due to increased numbers of observers) over the 23-year period undoubtedly makes this a conservative test. In southern California, the Spearman rank correlation, -0.489, between number of plovers and year, is significantly less than 0 ($P = 0.019$), while in northern California the rank correlation, 0.152, is not significantly less than 0 ($P = 0.7623$) (Fig. 2). Many factors contribute to variability in these

Christmas Count totals, so this strong circumstantial evidence for a decrease in the size of the southern California winter population is particularly interesting. The quality of the habitat in winter might be diminished by direct disturbance factors such as heavy human use and indirect factors that could reduce food resources on beaches. During a survey of southern California beaches, D. Shuford (pers. comm.) noted that the daily mechanical raking of some beaches in winter effectively removed all wrack and thoroughly disturbed the upper layer of sand. It would be valuable to know the effect of this activity on the plovers' invertebrate prey.

We examined the locations of 103 museum specimens collected at 29 California sites during the winter between 1861 and 1978. During our 1979 to 1985 survey period, wintering Snowy Plovers were recorded at, or within a few kilometers of, all these locations. They were also recorded at, or within a few kilometers of, all locations confirmed as historical breeding areas by the presence of eggs in museum collections as recorded by Page and Stenzel (1981). Consequently we can report that Snowy Plovers winter at, or close to, all known areas of historical use. A decline, if it has occurred, must be manifested mostly by reduced numbers using particular coastline segments rather than by the elimination of all birds from formerly used wintering habitat.

Other Western States

Snowy Plovers winter in small numbers on the Oregon coast and sparingly along the lower Colorado and Gila rivers in Arizona. They are rare and irregular in winter in other western states. Winter surveys of plovers in coastal Oregon between 1979 and 1985 (Table 4) suggest that up to 100 birds winter in that state. The only interior Oregon winter record is of three birds seen by J. Scharff at Harney Lake on 27 February 1968 (G. Ivey in litt.); these may have been early spring arrivals. R. Widrig (in litt.) reports that wintering birds are rare in coastal Washington, where there are sightings of 1-9 birds at Leadbetter Point between 19 December 1978 and 26 February 1979. We are unaware of any winter records for interior Washington or Nevada. Breeding-population estimates for the same areas are: Washington coast, 32 (E. Cummins pers. comm.); Oregon coast, 84 (C. Bruce pers. comm.); Oregon interior, 1032 (Herman et al. 1981); and Nevada, 969 (Herman et al. 1981). Consequently only about 100 Snowy Plovers winter where the breeding population is estimated at 2117 birds.

In the Southwest, Snowy Plovers winter regularly but sparingly along the lower Colorado and Gila rivers (Monson and Phillips 1981). Additionally, there are Arizona winter records of a bird at Phoenix on the 28 December 1963 CBC, one to two at Tucson between 11 October and 3 December 1971 (Monson 1972), one at Lake Havasu on 20 January 1982 (Witzeman 1982), and one at Wilcox on 31 December 1976 (Witzeman et al. 1977). The only winter Snowy Plover records for New Mexico are 1 to 2 birds in the vicinity of Salt Lake, east of Loving, from 9 to 27 January 1975 (Witzeman et al. 1975), a single bird at Laguna Grande on 28 December 1976 (Witzeman et al. 1977), and one at Hollomon Lakes, Otero Co., on 23 February 1985 (Hubbard 1985). Twenty individuals at Bitter Lake National Wildlife Refuge until at least 2 November 1973 (Parker 1974) were likely late

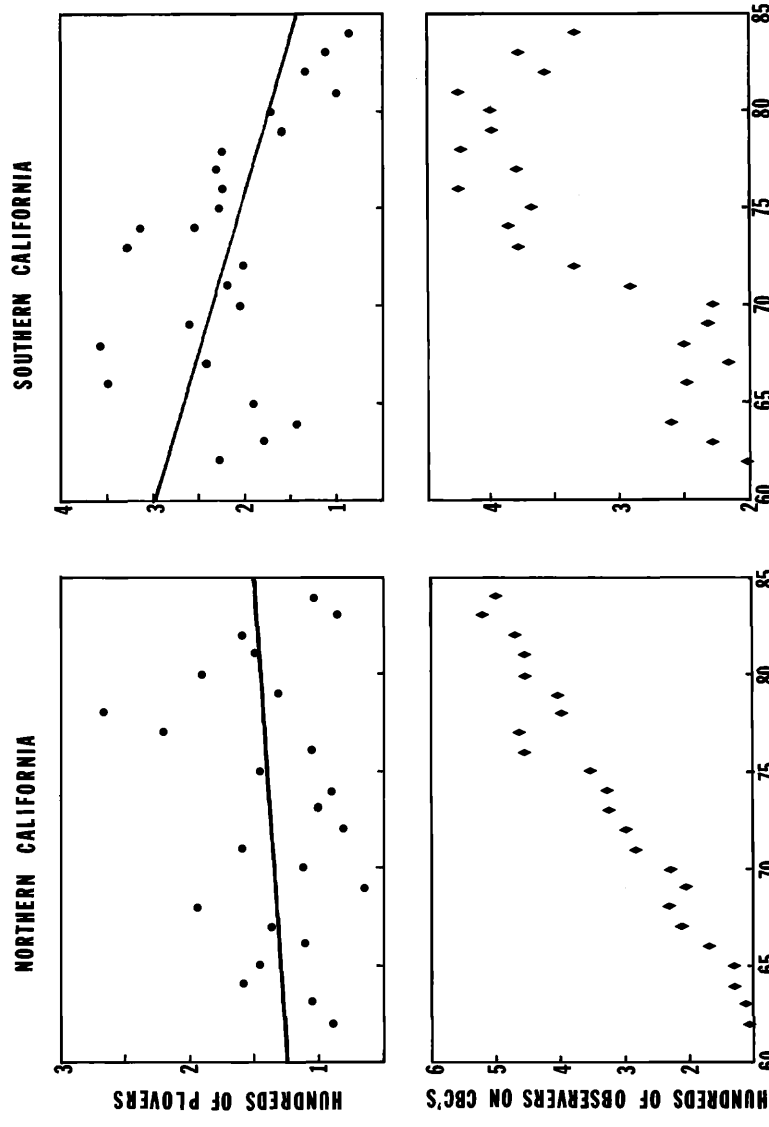

Figure 2. Total numbers of Snowy Plovers, above, and observers, below, on California Christmas Bird Counts, 1962-1984. Northern California counts are Centerville Beach, Crystal Springs Reservoir, Palo Alto, San Jose, Monterey Peninsula, and Morro Bay. Southern California counts are Santa Barbara, Los Angeles, coastal Orange County, Oceanside-Vista-Carlsbad, and San Diego. Weighted least squares regression lines of Snowy Plover number on year (weights proportional to number of observers) are shown for reference.

Table 4. Number of Snowy Plovers at coastal Oregon sites during five winters.

Site	1979	1983	1984	1985	1986
Clatsop County					
Clatsop Beaches	—	0	0	1	0
Tillamook County					
Nehalem Spit	—	2	—	0	0
Bayocean Spit	—	10	10	11	13
Sand Lake Spits	—	7	0	0	0
Lane County					
Sutton Beach	30	28	5	24	11
Siltcoos River area	6	0	0	12	13
Douglas County					
Umpqua River area	10	4	12	0	0
Coos County					
Horsfall Beach	—	0	3	0	0
Coos Bay Area	42	12	0	9	18
New River area	6	13	13	8	17
Curry County					
Euchre Creek	8	2	0	1	0
TOTALS	102	78	43	66	72

migrants. A specimen labeled Roswell Lake, December 1925, which was questioned by Hubbard (1970), may be valid in light of the other recent winter records from New Mexico.

Baja California and Mainland Mexico

Wilbur (1987) described the Snowy Plover as a common resident locally on sandy beaches of both coasts of Baja California. He speculates that it may occur more widely in winter than in summer. We confirm that wintering Snowy Plovers occur in widely separate locations along both Baja coastlines (Table 5). Application of our methods to Wilbur's data and to sightings reported to us from 1979 to 1985 produced a winter estimate of 397 birds (Table 5), but this probably represents a small proportion of the actual numbers because most winter records resulted from casual observations rather than directed surveys. Additionally, the records are few and represent only a small fraction of the extensive potential habitat. We suspect the number of Snowy Plovers wintering in Baja California approaches or exceeds the number in Upper California.

On the eastern shore of the Gulf of California a sizable Snowy Plover population winters at Puerto Peñasco. Five Puerto Peñasco CBCs during our survey years had 48 to 252 (median = 243) birds. Wintering Snowy Plovers occur along the same coastline at least as far south as San Blas, where six

Table 5. Counts of wintering Snowy Plovers in Baja California, 1978-1985.[a]

Site	Years[b]	Counts[c]	Yearly maximum numbers[d]
Pacific Coast			
Rosarito Beach	3 (2)	4 (3)	2 (0-8)
Las Gaviotas	1 (1)	1 (1)	8
La Salina	1 (1)	2 (2)	47
Bahia de Todos Santos	2 (2)	3 (3)	96 (8-184)
Isla San Martin	4 (3)	9 (8)	4 (0-10)
San Quintin area	3 (3)	5 (5)	19 (5-222)
Laguna Manuela	3 (3)	8 (8)	22 (18-31)
Laguna Manuela Island	1 (1)	1 (1)	28
Estero de San Jose	1 (1)	1 (1)	19
Guerrero Negro	3 (3)	3 (3)	4 (3-8)
San Ignacio Lagoon	5 (5)	6 (6)	37 (17-45)
Magdalena Bay	6 (6)	12 (12)	44 (5-75)
Punta Marques	1 (1)	1 (1)	11
Cabo San Lucas	3 (3)	4 (3)	3 (1-3)
Gulf Coast			
Bahia de Pescadero	2 (2)	2 (2)	16 (12-20)
Punta Chivata	3 (3)	3 (3)	10 (3-15)
Bahia Concepcion	1 (1)	1 (1)	1
El Requesion	1 (1)	1 (1)	3
Rancho Liqui	1 (1)	1 (1)	3
San Jose Del Cabo	1 (1)	1 (1)	20

[a] Data from our surveys and Wilbur (1987).
[b] Numbers in parentheses are numbers of years in which plovers were found.
[c] Numbers in parentheses are numbers of counts on which plovers were found.
[d] Numbers are grand medians; numbers in parentheses are range of medians.

CBCs during our survey period reported 1 to 33 (median = 17) birds. We are uncertain about the winter status of Snowy Plovers in the remainder of Mexico, especially in regard to race and origin. Birds wintering in eastern Mexico likely are probably of the paler race *C.a. tenuirostris*, which occurs from the southern Great Plains and Gulf of Mexico coast through the West Indies to northern South America (Johnsgard 1981). The validity of the distinction between *nivosus* and *tenuirostris* has been disputed (e.g., Blake 1977).

Population Shifts between Breeding and Wintering Grounds

We found only a few hundred Snowy Plovers wintering in the interior of the western states in contrast to recent counts of 3844 breeders in interior California, Oregon and Nevada (Page and Stenzel 1981, Herman et al. 1981). Our surveys revealed 6 of 86 females but none of 44 male breeders color-banded at Mono Lake, Mono County, wintering on the California coast. One female was sighted on 15 dates between 9 September 1981 and 25 March 1982, and on 13 dates between 14 September 1982 and 23

March 1983 at Del Monte Beach, Monterey Bay. Two breeding females from Mono Lake wintered at Devereaux and Goleta beaches in Santa Barbara County. One was seen at Devereaux Beach on four dates between 27 November 1981 and 20 March 1982, and on seven dates between 6 August 1982 and 6 November 1982. The other bird was sighted at both Goleta and Devereaux beaches 21 times over dates spanning five winters from 1981 to 1985. One female from Mono Lake was encountered during four winters (1979-1982) and another during two (1981 and 1982) at Malibu Lagoon, Los Angeles County. One other Mono Lake female was sighted during the winter of 1980-1981 and in the late fall of 1981 on San Clemente Island.

Birds marked as chicks at Mono Lake also were found on the coast between fall and spring. One was seen either at Pismo Beach or the Santa Maria River mouth on five dates between 14 December 1979 and 25 February 1980, one at Purisima Point Beach, Vandenberg Air Force Base, on 5 January 1983 and 14 November 1984, another at Purisima Point Beach on 20 April 1982 and 19 January 1983, and one at Atascadero Beach on four dates between 5 September and 25 November 1982 and on 8 and 13 September 1983. One was seen in Baja California at Magdalena Bay on 31 January 1984. These results verify that many birds breeding in interior western North America migrate to coastal sites for the winter.

Some coastal birds also are migratory. In Oregon several adults color-banded on nests in 1978 were relocated near their nesting site during winter in 1979 (Wilson-Jacobs pers. comm.). However, two males that bred near Newport, Oregon, spent the winter in the Point Reyes area in 1978 and 1979. Those plovers that migrate from Monterey Bay breeding sites for winter may go either north or south. Breeders from Monterey Bay have wintered as far north as Humboldt Bay in northern California and as far south as San Quintin Bay in Baja California. These results, too extensive to report here, are the subject of continuing analysis.

Comparison of Wintering and Breeding Numbers in the West

Warriner et al. (1986) found that Snowy Plovers fledged at least 0.8 to 0.9 young per female over a six-year period; therefore in early winter there could be $0.8N$ (where N = number of female breeders) more birds than in the preceding summer. Males outnumber females by as much as 1.4:1.0 in the breeding population and, at least in the interior, are more readily detected on censuses than females (Warriner et al. 1986). Both in the interior and on the coast raw survey data likely underestimate population size (Page and Stenzel 1981, Warriner et al. 1986). We use data available in the two publications listed above to estimate the potential sizes of breeding and wintering Snowy Plover populations in the western United States. These estimates exclude Utah, which may contribute a significant number of additional birds, and New Mexico and Arizona, with relatively small numbers; suitable data are unavailable for these states.

Recent breeding-season surveys for coastal Washington, Oregon, and California (including San Francisco Bay) totaled 1682 Snowy Plovers (Page and Stenzel 1981, C. Bruce pers. comm.). This could be an undercount by as much as 28% (Page and Stenzel 1981). Consequently, the coastal breeding population might reach $(100/72 \times 1682) = 2336$ birds and the

winter population (2336 + 2336 × (1/2.4 × 0.8)) = 3115 birds (including first-year birds).

As noted above, breeding surveys for interior Oregon, Nevada and California totaled 3844 birds. At Mono Lake, one of several major breeding sites, a typical census detected only 1 marked male for every 1.643 known to be present and 1 female for every 3.010 present (Warriner et al. 1986). If these rates are characteristic of the interior as a whole, the size N of the female breeding population may be estimated from

$$N/3.010 + 1.4N/1.643 = 3844,$$

giving $N = 3246$. So the size of the male population is $1.4\,N = 4544$, for a total breeding population of 7790 birds. We exclude from this estimate a few hundred Snowy Plovers that have colonized agricultural drainage ponds in the Tulare Lake basin since the statewide surveys (Ivey 1984, Campbell et al. 1985) on the assumption that these birds are immigrants from other localities rather than an added component to the existing population. The early winter population is, then, estimated at 7790 + (3246 × 0.8) = 10,387 birds (including first-year birds, assuming reproductive rates similar to those along the coast). Coastal and interior estimates combined give a potential breeding population as high as 10,126 birds and a wintering population as high as 13,502 birds.

Allowing 100 wintering Snowy Plovers for coastal Oregon, 2500 for coastal California, up to 500 for San Francisco Bay, and up to 900 for the Channel Islands, the California interior, and the remaining western states combined, we account for only 4000 Snowy Plovers. Even with rather severe mortality between the breeding season and winter, a substantial proportion of the estimated wintering population is unaccounted for in our surveys.

Many breeders and their progeny apparently winter farther south in Baja California and other parts of Mexico, despite the failure of limited recent fieldwork there to reveal substantial numbers of wintering plovers. This speculation is supported by the discovery of a few marked birds in Baja California and the disappearance of many marked coastal breeders for the winter. During 1984 and 1985, 78 marked males and 85 females bred on Monterey Bay. Forty-one percent of the males and 51.8% of the females were residents; the remainder migrated from the area for the winter. We located 41.5% of the migrant females and 10.9% of the migrant males wintering in coastal California and 2 males, representing 4.3% of the migrants, in Baja. Given the extensive coverage of our coastal survey in California, we believe that most color-marked plovers were not missed there, but were in Mexico, where survey coverage was minimal.

SUMMARY

The size of the Snowy Plover population in western North America (except Utah) at the end of the breeding season is estimated at approximately 13,500, including breeders and juvenals. Surveys of mainland coastal sites in California (including San Francisco Bay) and Oregon between November and February, 1979 to 1985, suggest that approximately 3100 plovers

winter there. Most of the major concentrations were found from the Bodega Harbor, Sonoma County, south. Up to 900 plovers may also winter in interior California, on the Channel Islands, and in other western states; this liberal estimate is based on surveys of a few interior areas, incidental sightings, and the summer-to-winter population ratio of the mainland coast applied to the islands. These findings suggest that the majority of the plovers west of the Rocky Mountains winter on the Gulf of California and the west coast of Baja California, where our surveys of a few sites, and two Christmas Bird Counts, turned up about 657 plovers. The most important sites in coastal California were spits and dune-backed beaches, particularly at river and creek mouths, although many areas of wide sand beach were used. There is some evidence of a decline in the size of the southern California wintering population since 1961.

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