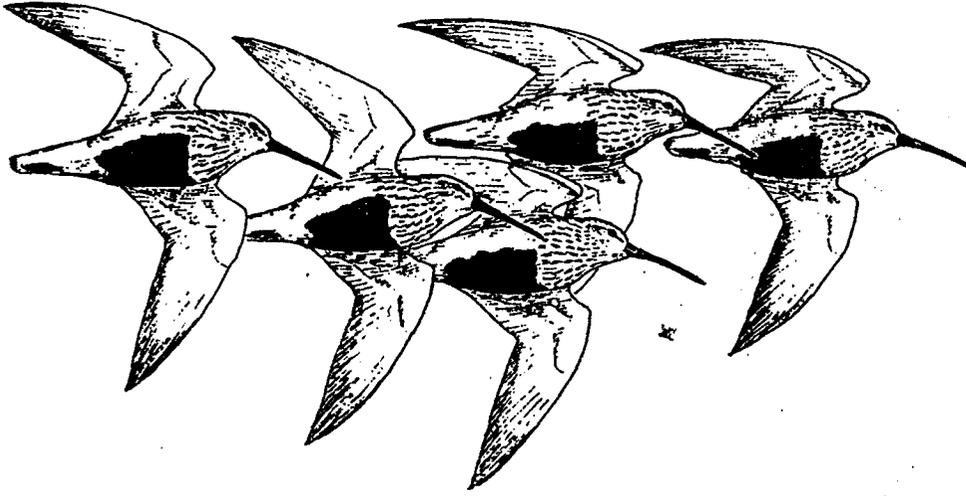


PACIFIC FLYWAY PROJECT



DISTRIBUTION, ABUNDANCE, AND HABITAT USE OF SHOREBIRDS IN CALIFORNIA'S CENTRAL VALLEY IN WINTER 1992-93

W. David Shuford, Gary W. Page, and Janet E. Kjelson

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Point Reyes Bird Observatory
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Stinson Beach, CA 94970**

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The data reported herein are part of an ongoing study
of shorebird use of wetlands in the Pacific Flyway.
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ABSTRACT

Despite extensive wetland loss, the Central Valley still supports one of the largest concentrations of wintering waterfowl in North America. Because population trends and habitat needs of waterfowl have been well studied, government agencies and private organizations were able to respond to recent waterfowl declines with the North American Waterfowl Management Plan. Although this plan will benefit other wetland-dependent birds, management efforts for species other than waterfowl will be greatly hampered because the status, population trends, and habitat needs of these species are poorly known.

In 1988 the Pacific Flyway Project was initiated to document the importance of wetlands throughout the West to shorebirds and to promote the wise management of the wetlands upon which they depend. Since 1990 the Flyway Project has been devoting special attention to the Central Valley because of its great importance to both migrating and wintering shorebirds. In the winter of 1992-93 we successfully conducted the first ever comprehensive survey of wintering shorebirds in the Central Valley. Over 270,000 shorebirds were counted, thereby documenting in this region one of the largest wintering concentrations of shorebirds in western North America. We recorded 22 species of shorebirds in the Central Valley in winter, but 10 of them accounted for 99.7% of the total individuals. The ten key species in order of abundance were Dunlin, Long-billed Dowitcher, Least Sandpiper, Western Sandpiper, Killdeer, Black-necked Stilt, Black-bellied Plover, Long-billed Curlew, Greater Yellowlegs, and American Avocet.

Of the total shorebirds in the Central Valley, the Sacramento Valley held about 140,000, the San Joaquin Valley 92,000, and the Delta and Suisun Marsh 40,000. The abundance of different species varied greatly among regions of the Central Valley. Although overall it held smaller numbers than the Sacramento Valley, the San Joaquin Valley supported more species (15 vs. 12) and the largest populations of Snowy Plovers, Black-necked Stilts, American Avocets, Willets, Marbled Godwits, and Western Sandpipers. The Sacramento Valley notably held 67% of the Dunlin, the most numerous species of shorebird in the Central Valley. For the Central Valley as a whole (excluding Suisun Marsh), agricultural croplands (especially ricelands) held 45% of the shorebirds, managed wetlands 40%, agricultural evaporation ponds 7%, sewage ponds 6%, and miscellaneous habitats 2%. Shorebird use of these habitats also varied greatly among species.

Additional research is needed to determine if the patterns observed in 1992-93 are predictable and to see how these patterns compare with those in other seasons. Research also is needed to better determine the habitat needs of wintering and migrating shorebirds and the relative importance of various habitat types to their survival. These data are crucial for the effective integration of the management needs of waterfowl, shorebirds, and other wetland-dependent species.

INTRODUCTION

Since 1988 the Pacific Flyway Project has collected data on the importance of wetlands in the West to shorebirds to increase public awareness of the need to protect shorebirds by developing sound conservation and management strategies for their wetland habitats. Details of the goals and flywaywide accomplishments of the project to date recently have been summarized by Page et al. (1992). Because California's Central Valley is so important to populations of migrant and wintering shorebirds, this report focuses on our recently completed surveys in that region during winter 1992-93.

Historically, California's Central Valley hosted one of the world's largest concentrations of wintering waterfowl (ducks, geese, and swans) and other waterbirds (herons and egrets, rails, cranes, and shorebirds). Although 95% of its historic wetlands have been lost, the Central Valley still supports about 60% of the total population of waterfowl wintering in the Pacific Flyway and about 20% of those wintering in the entire United States (Heitmeyer et al. 1989). Loss of wetlands and other factors have led to continentwide declines of 30% in fall flights of waterfowl between the late 1970s to mid-1980s. To reverse these declines, government and private organizations formed a coalition that formulated the North American Waterfowl Management Plan (NAWMP). One of the plan's priority areas for habitat improvement is the Central Valley, and the Central Valley Habitat Joint Venture (CVHJV) is charged with implementing the NAWMP in that area. Although both the NAWMP and the CVHJV recognize that other species, including shorebirds, will benefit from habitat improvement in the Central Valley, there is, in contrast to waterfowl, very little information on the population sizes, population trends, or habitat needs of other species using Central Valley wetlands.

Jurek (1973, 1974) reported on shorebird surveys taken throughout California, including various sites in the Central Valley, and Manolis and Tangren (1975) described the general seasonal use patterns and habitat needs of shorebirds in the Sacramento Valley. Neither of these studies, or previous ones, have surveyed the entire Central Valley for shorebirds. Beginning in 1990, the Pacific Flyway Project began to conduct shorebird censuses in major wetland complexes in the Central Valley, particularly in the San Joaquin Valley at (1) the Grasslands near Los Banos, Merced County, and (2) at agricultural evaporation ponds, and (3) in the Sacramento Valley at federal wildlife refuges. By 1992 we had expanded our surveys to include all of the important wetlands in the Central Valley. Page et al. (1992) summarized preliminary results of valleywide surveys of shorebirds in spring 1992. Here we report on the first comprehensive winter (1992-93) surveys of shorebirds in the Central Valley, including data on abundance, distribution, and habitat use.

STUDY AREA AND METHODS

The Central Valley -- surrounded clockwise from north to west by the Klamath Mountains, the Sierra Nevada, the Tehachapi Mountains, and the Coast Range -- extends 400 miles north to south through the heartland of California and averages about 40 miles wide. The Valley is divided into three major regions: (1) the Sacramento Valley, draining southward; (2) the San Joaquin Valley, draining northward; and (3) the Sacramento-San Joaquin River Delta and Suisun Marsh where the aforementioned rivers converge before entering San Francisco Bay (see Figure 1). The Sacramento Valley is further divided into five drainage basins: the Colusa, Butte, Sutter, American, and Yolo basins. The San Joaquin Valley is divided into the San Joaquin Basin to the north and the usually closed Tulare Basin to the south. Our shorebird census data reported below were summarized by regions and drainage basins according to the maps for the Central Valley Habitat Joint Venture (USFWS 1990), with the exception that we included Mendota Wildlife Area in the San Joaquin Basin rather than the Tulare Basin.

The six year drought that had gripped California since the winter of 1986-87 finally broke in 1992-93, and by the time of our counts extensive areas of the Sacramento Valley were flooded, particularly in the Yolo and Sutter bypasses and the vast area of ricelands, mostly north of the Yolo Basin. This flooding provided much more habitat for wintering shorebirds -- particularly in agricultural lands -- than had been available in the Valley for many years.

From late January to early March, we conducted shorebird surveys of almost all the managed wetland habitat, flooded agricultural fields, agricultural evaporation ponds, and sewage ponds in the Central Valley. These surveys used a combination of aerial and ground counts, varying by region as logistical constraints allowed. The aerial counts were conducted primarily from a Cessna 172 airplane by Flyway Project Staff (Page and Shuford). Ground counts were organized and conducted by a large network of skilled volunteers and agency personnel (see Acknowledgments), assisted by Flyway Project Staff.

In the Tulare Basin, ground counts were conducted at Kern National Wildlife Refuge (NWR), most sewage and evaporation ponds, and irrigation district reservoirs from 23-30 January; aerial counts of private duck clubs and the South Wilbur Flood Area were conducted on 2 March. In the San Joaquin Basin, ground counts at the large wetland complex of the Grasslands near Los Banos were taken mostly from 29 January to 2 February; a ground count of the Faith/Mapes Ranches and San Joaquin River NWR was conducted on 1 March. In the Delta, Suisun Marsh, and the Sacramento Valley, aerial counts were the primary method used to cover most wetlands and flooded agricultural habitats. An important supplement to the aerial counts were ground counts at a number of areas where large shorebird concentrations were located from the air. These ground counts were used to refine the aerial counts at these sites, particularly by obtaining ratios of the small sandpipers which could not be identified to species from the air. Additional ground counts were taken at federal and state refuges and private wildlife management areas in the

Sacramento Valley (Colusa, Butte, and Sutter basins) and at selected wetlands, agricultural lands, and sewage ponds in the American, Yolo, and Sutter basins and the Delta. In the Suisun Marsh, an aerial count on 24 February was followed by a ground count on 27 February. In the Delta, aerial counts were conducted from 26 January to 3 February; ground counts were taken from 24 January to 2 February. In the Sacramento Valley, aerial counts were conducted from 3 to 10 February; ground counts spanned from 16 January to 17 February (most 23 Jan-13 Feb).

Besides tallying our survey data by subregions and basins within the Central Valley, we also recorded the habitat type(s) where the shorebirds were found; ground counters were able to make finer habitat distinctions than were aerial counters. Most agricultural habitats that we surveyed were flooded to some degree, either intentionally or naturally. For purposes of this report, habitat data were lumped into these broad habitat categories:

(1) *agricultural croplands* -- a combination of (a) fallow agricultural lands, crop unknown; (b) harvested croplands with extensive standing stubble; (c) harvested rice fields with distinctions among no stubble, low stubble, or heavy stubble; and (d) alfalfa fields.

(2) *managed wetlands* -- these are largely seasonally flooded or semipermanent wetlands created on wildlife refuges and private duck clubs; some are created from effluent from agricultural processing plants.

(3) *agricultural evaporation ponds* -- these hold hypersaline agricultural drain waters from highly alkaline soils in the southern San Joaquin Valley.

(4) *sewage ponds* -- includes typical diked sewage ponds and wetlands or agricultural lands flooded with treated sewage effluent.

(5) *miscellaneous habitats* -- these include pastureland ("native" or irrigated); ditches, sloughs, or streams; irrigation district reservoirs; and farm ponds or reservoirs.

RESULTS AND DISCUSSION

Our surveys of the entire Central Valley recorded an estimated 272,784 shorebirds (Figure 1). Of the 22 shorebird species detected, 10 species accounted for 99.7% of the total number of individuals. The ten key species of shorebirds wintering in Central Valley wetlands were Dunlin (132,663 individuals), Long-billed Dowitcher (73,665), Least Sandpiper (15,563), Western Sandpiper (15,096), Killdeer (11,235), Black-necked Stilt (7318), Black-bellied Plover (6203), Long-billed Curlew (3801), yellowlegs spp. -- mostly Greater Yellowlegs (3573), and American Avocet (2906) (Table 1).

We feel these population estimates are bare minimums, primarily because of the difficulties of counting shorebirds from the air. The accuracy of our counts clearly varied among species. We counted only 316 Common Snipe, although this species probably occurred in the thousands. With their cryptic coloration, their tendency to inhabit muddy areas of marshy low vegetation, and their habit of not flushing until almost underfoot, snipe are the most difficult shorebird species to detect on the ground, let alone from airplanes. Because we focused on documenting the importance of *wetlands* to shorebirds, we underestimated (to an unknown degree) the numbers of species that prefer upland habitats or a combination

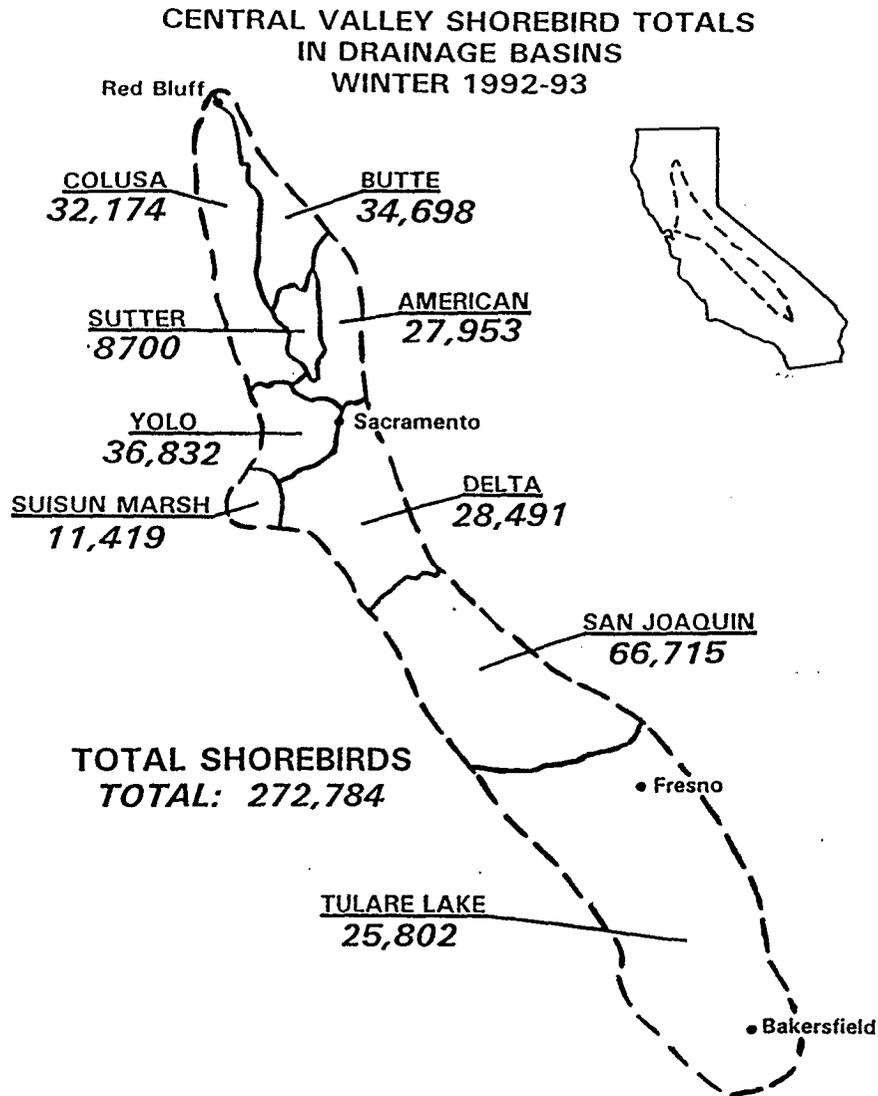


Figure 1. Total numbers of shorebirds recorded in the Central Valley and its various drainage basins on surveys in winter 1992-93.

of upland and wetland habitats. The Mountain Plover went almost unrecorded on our surveys because the species prefers relatively dry uplands. Counts of the Black-bellied Plover, Killdeer, and Long-billed Curlew were low because they spend much of their time foraging in upland pastures or agricultural fields, habitats we did not survey unless they were shallowly flooded. The Long-billed Curlew presented further problems because it (1) also used flooded rice fields with tall stubble, most of which we did not survey because this habitat is quite extensive and usually holds few if any other shorebirds, and (2) curlews tend to fly when the plane is still at great distances, making them almost impossible to survey from the air despite their large size. The Spotted Sandpiper does frequent aquatic habitats, but prefers the gravelly edges of slow-moving streams, deeper ponds, and reservoirs, habitats we infrequently survey because of their limited use to most shorebirds.

Table 1. Numbers of shorebirds counted on surveys of the entire Central Valley in winter 1992-93. Yellowlegs spp. are primarily Greater Yellowlegs although this category also includes a small but undetermined proportion of Lesser Yellowlegs (see text).

	San Joaquin Valley	Delta	Suisun Marsh	Sacramento Valley	TOTAL
Black-bellied Plover	2795	1068	105	2235	6203
Snowy Plover	174	0	0	0	174
Killdeer	2517	3229	34	5455	11,235
Black-necked Stilt	6179	203	262	674	7318
American Avocet	2050	25	633	198	2906
Yellowlegs spp.	1270	387	142	1774	3573
Willet	40	0	88	0	128
Long-billed Curlew	1012	247	0	2542	3801
Marbled Godwit	121	0	0	0	121
Western Sandpiper	9841	729	3438	1088	15,096
Least Sandpiper	9584	724	159	5096	15,563
Dunlin	26,824	14,493	2007	89,339	132,663
Long-billed Dowitcher	29,922	7344	4545	31,854	73,665
Common Snipe	175	42	4	95	316
Other species	13	0	2	7	22
TOTAL	92,517	28,491	11,419	140,357	272,784

Regional Patterns of Distribution

Of the total number of shorebirds counted in the Central Valley, the Sacramento Valley held 140,357, the San Joaquin Valley 92,517, and the Delta and Suisun Marsh 39,910 (Table 1, Figure 1). Because the various subregions or basins of the Central Valley vary greatly in size and in wetland habitat extent and diversity, it is difficult to compare numbers of shorebirds among these areas. Comparisons are further complicated by the fact that the same extent of wetland can vary greatly in its suitability for shorebirds depending on water depth at the time of the census or the length of time the wetland has been flooded. Nevertheless, some patterns were readily apparent.

Although the San Joaquin Valley held fewer total shorebirds than the Sacramento Valley, it supported 15 regularly wintering species versus 12 in the Sacramento Valley. The San Joaquin Valley also held very high proportions of the total Central Valley population of several species (Figures 2 and 3). The San Joaquin Valley held 100% of the Central Valley's small populations of Snowy Plovers, Willets (excluding those in the Suisun Marsh using tidal habitat), and Marbled Godwits. It also held 84% of the Black-necked Stilts, 70% of the American Avocets, and 84% of the Western Sandpipers (excluding Suisun Marsh birds using tidal habitat). The Sacramento Valley supported the highest number of total shorebirds primarily because it held 67% of the Dunlin, the most numerous species wintering in the Central Valley. The Sacramento Valley and Delta together held 78% of all the Dunlin in the Central Valley. Although the Sacramento Valley held large numbers of Black-bellied Plovers, numbers declined dramatically north of the Yolo Basin (Figure 2), and most of the plovers in the Butte and Colusa basins were in the southern portions of these areas. Many of these patterns seem to be explained by regional differences in climate or habitat availability, or both, and are discussed further in the habitat use and species accounts sections that follow.

Habitat Use

Taking the Central Valley as a whole, agricultural croplands held 45% of the shorebirds we surveyed this winter, managed wetlands 40%, agricultural evaporation ponds 7%, sewage ponds 6%, and miscellaneous habitats 2% (Table 2). If we are able at a later date to calculate densities of shorebirds per acre of available habitat, it would be quite clear that managed wetlands held many more shorebirds per acre than did agricultural lands, because the extent of flooded agricultural lands in midwinter 1992-93 was far greater than that of managed wetlands. The importance of the various habitats varied greatly among species. Agricultural croplands supported 40% of the Black-bellied Plovers recorded on our surveys, 71% of the Killdeers, 45% of the yellowlegs, and 50% of the Dunlins. The proportion of Killdeers using agricultural croplands would have been higher if we had surveyed fallow croplands that were not flooded. The proportion of Black-bellied Plovers recorded on agricultural lands on our surveys underestimates their use of this habitat for foraging because many of the plovers recorded in managed wetlands and at sewage ponds use those habitats for roosting after foraging in agricultural fields. That 82% of the Black-necked Stilts were found in managed wetlands indicates that this species has a strong preference for this habitat in winter. Managed wetlands also held 36% of the American Avocets, 41% of the Western Sandpipers, 58% of the Least Sandpipers, 38% of the Dunlin, and 66% of the Long-billed Dowitchers. Agricultural evaporation ponds supported 100% of the Snowy Plovers wintering in the Central Valley, 98% of the Willets, 53% of the American Avocets, and 42% of the Western Sandpipers. Because these evaporation ponds are of small extent compared with agricultural and managed wetland habitats, it is clear that they hold high densities of shorebirds. Although sewage ponds did not hold a very high proportion of any species' wintering population, they held relatively high densities of shorebirds and are of local importance to many species.

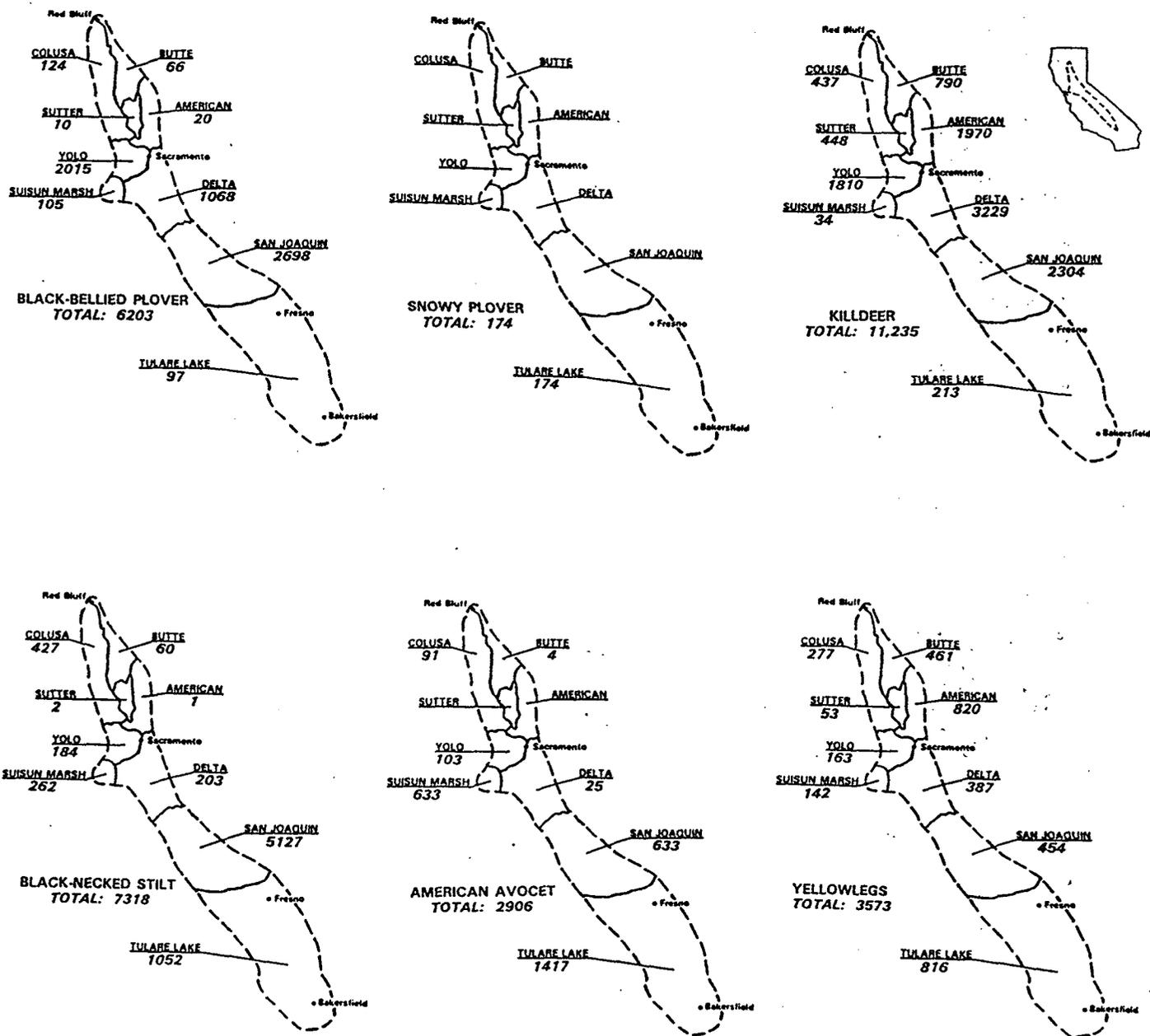


Figure 2. Total numbers of Black-bellied Plovers, Snowy Plovers, Killdeers, Black-necked Stilts, American Avocets, and yellowlegs recorded in the Central Valley and its various drainage basins on surveys in winter 1992-93.

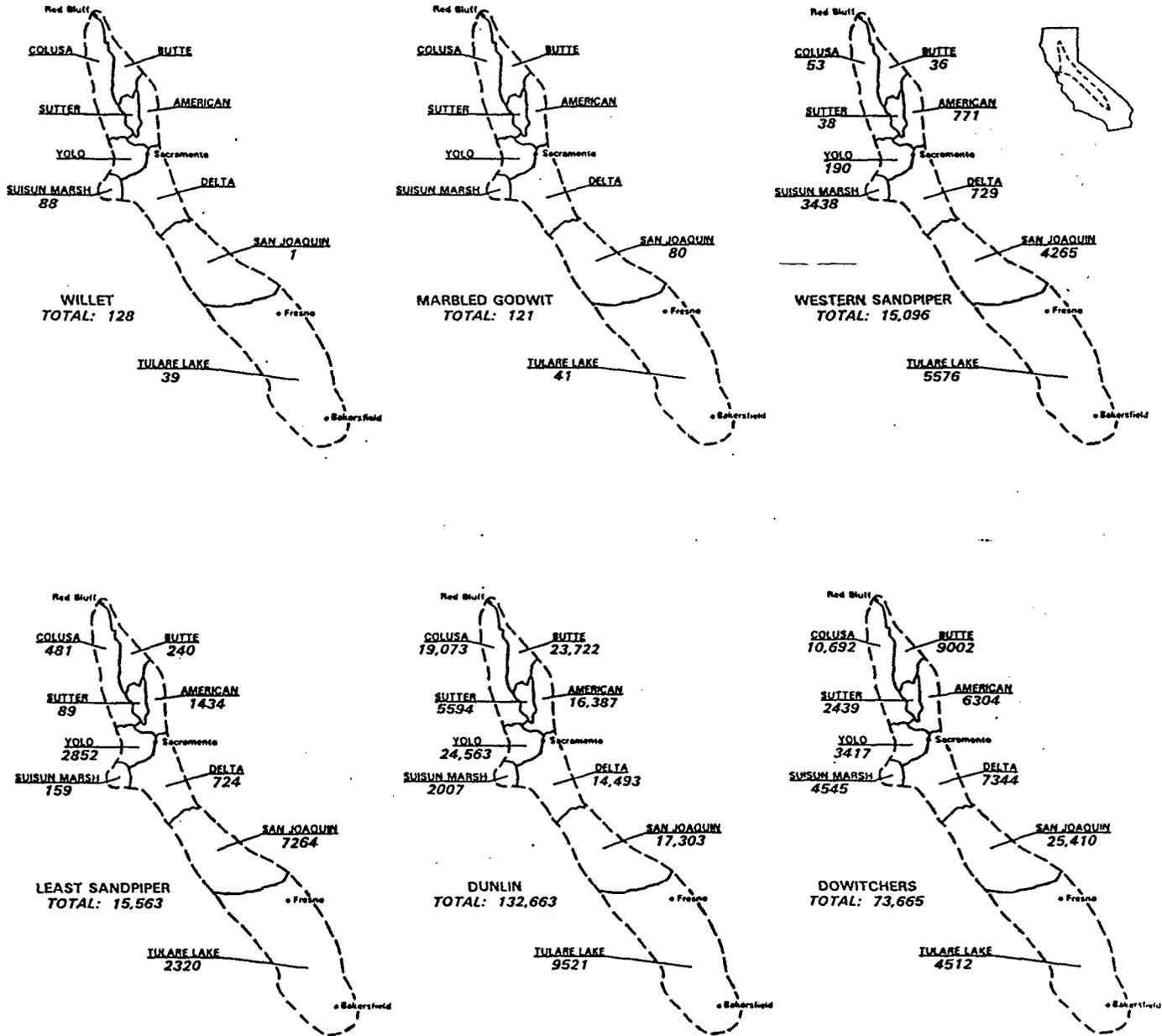


Figure 3. Total numbers of Willets, Marbled Godwits, Western Sandpipers, Least Sandpipers, Dunlins, and Long-billed Dowitchers recorded in the Central Valley and its various drainage basins on surveys in winter 1992-93.

Table 2. Percent use by selected shorebird species of various habitat types in the Central Valley (excluding Suisun Marsh) on winter 1992-93 surveys. AGLA = agricultural croplands, MGWE = managed wetlands, EVAP = agricultural evaporation ponds, SEPO = sewage ponds, and MISC = miscellaneous habitats (see Methods).

SPECIES	AGLA	MGWE	EVAP	SEPO	MISC
Black-bellied Plover	40	33	-	20	7
Killdeer	71	7	1	14	7
Black-necked Stilt	1	82	8	2	7
American Avocet	1	36	53	7	3
Yellowlegs spp.	45	20	20	2	13
Western Sandpiper	12	41	42	2	3
Least Sandpiper	25	58	6	4	6
Dunlin	50	38	6	5	1
Long-billed Dowitcher	28	66	1	2	3
TOTAL	45	40	7	6	2

Species Accounts

Black-bellied Plover (*Pluvialis squatarola*)

This species prefers disced and plowed fields, pastures, and wetland mudflats for foraging. Although birds may roost in foraging areas, many roost at sewage ponds or managed wetlands after foraging in nearby agricultural lands. This is represented by counts of 718 Black-bellied Plovers at the Woodland sewage ponds, Yolo County, on 22 January 1993 and 500 at the Modesto sewage ponds, Stanislaus County, on 29 January 1993 and 1500 there on 25 January 1992. The vast extent of agricultural croplands and pasturelands throughout the Central Valley suggests that a scarcity of Black-bellied Plovers north of the Yolo Basin in winter probably reflects the effect of the cooler and wetter climate in the northern Sacramento Valley on the food supply of this species.

Lesser Golden-Plover (*Pluvialis dominica*)

The only Lesser Golden-Plovers recorded on our winter 1992-93 surveys were 2 at the Modesto sewage ponds in the San Joaquin Basin on 29 January 1993. These birds were of the race *P. d. fulva*, which is the only race known to winter in California; some authorities consider *P. d. fulva* a separate species from *P. d. dominica*. Most wintering records of golden-plovers in the Central Valley are from the Delta and the San Joaquin Basin. Wintering birds are usually found within large flocks of Black-bellied Plovers, and the golden-plovers have the same general habitat preferences as the former species.

Snowy Plover (*Charadrius alexandrinus*)

All of the Snowy Plovers found on our surveys were at agricultural evaporation ponds in the Tulare Basin; these ponds mimic conditions at alkaline playa lakes where the species breeds throughout the interior of the West. These evaporation ponds are currently the only places where Snowy Plovers regularly winter in the Central Valley. Snowy Plovers occasionally winter at alkaline ponds in the Grasslands near Los Banos, Merced County. Five Snowy Plovers at the Grasslands in January 1991 were the only ones recorded on comprehensive winter censuses of that area in three consecutive winters.

Semipalmated Plover (*Charadrius semipalmatus*)

The only Semipalmated Plovers recorded on our winter surveys were two at the Grasslands, Merced County, on 30 January 1993. This plover is extremely rare anywhere in the Central Valley in winter. Wintering birds are most likely to be seen on the moist mudflats of receding ponds.

Killdeer (*Charadrius vociferus*)

The Killdeer may be the most widespread wintering shorebird in the Central Valley because of its broad habitat preferences. Killdeer are especially numerous in muddy fallow agricultural fields with a sheen of surface water. One muddy agricultural field in the Delta on 2 February 1993 held 1200 Killdeer, although most flocks are much smaller. Other important habitats are pastures, muddy pond edges, sewage ponds, and even lawns. The relatively low numbers recorded in the Tulare Basin probably reflects the limited amount of flooded agricultural land there at the time of our surveys.

Mountain Plover (*Charadrius montanus*)

The only Mountain Plovers recorded on our surveys were seven in fallow fields on the Conaway Ranch, Yolo County, on 23 January 1993. This species prefers relatively dry upland habitats of short-grass native pasture and relatively smooth-textured fallow, disced, or plowed fields. Because our surveys focus on wetland habitats, they were inadequate for surveying this species.

Black-necked Stilt (*Himantopus mexicanus*)

The Black-necked Stilt uses a variety of shallow-water habitats, including managed wetlands, agricultural evaporation ponds, ephemeral pools in pastures, and sewage ponds. The predominate use by stilts of managed wetlands in winter and the concentration then of most of the population in the San Joaquin Valley, despite large amounts of managed wetland habitat in the Sacramento Valley, suggests that stilts are limited at the northern end of their range in the Central Valley by climate rather than habitat. Presumably the stilts need an invertebrate supply in the water column, which is more easily found in habitats such as managed wetlands that have had a longstanding water supply, and presumably also invertebrate growth rates are higher in winter in the San Joaquin than in the Sacramento Valley.

American Avocet (*Recurvirostra americana*)

American Avocets prefer the same general suite of habitats as do Black-necked Stilts, though they tend to prefer more alkaline waters. This may explain the concentration of wintering avocets in evaporation ponds in the Tulare Basin and in managed wetlands in the San Joaquin Basin, which tend to have alkaline soils. Although the Suisun Marsh has saline soils, avocets there also probably feed on tidal mudflats as they do in San Francisco Bay. The scarcity of avocets in the northern Sacramento Valley is probably related to that region's low invertebrate production (in the water column or mud's surface) in midwinter and the lack of alkaline conditions resulting from relatively high rainfall.

Greater Yellowlegs (*Tringa melanoleuca*) and Lesser Yellowlegs (*Tringa flavipes*)

The vast majority of yellowlegs wintering in the Central Valley are Greater Yellowlegs. In the San Joaquin Valley, where most counts were taken from the ground only about 1% of the yellowlegs were Lessers. Most yellowlegs in the Suisun Marsh, Delta, and Sacramento Valley were counted from the air, consequently we were not able to distinguish between these species on these flights. Ground counts in these areas found mostly Greater Yellowlegs, except for one flock of 30 Lessers in the Delta on 24 January 1993. Both yellowlegs appear to frequent the same range of habitats which includes managed wetlands, flooded agricultural fields, ephemeral ponds in pastures, agricultural evaporation ponds, and sewage ponds. The Greater Yellowlegs was the most far ranging of any large shorebird wintering in the Central Valley. Greater Yellowlegs were even found in small pockets of open water in harvested rice fields with tall stubble, a habitat most shorebirds other than Long-billed Curlews avoided. There were no obvious distributional trends of wintering yellowlegs in the Central Valley.

Willet (*Catoptrophorus semipalmatus*)

Disregarding the 88 Willets using tidal habitats in the Suisun Marsh, only 40 Willets were found on our winter surveys. Of the 40, 39 were using agricultural evaporation ponds in the Tulare Basin and 1 was using managed wetland habitat in the Grasslands of the San Joaquin Basin. The evaporation ponds, available since only the late 1970s, seem to be the only places where Willets regularly winter in the Central Valley. The salinity and relatively mild climate (or resulting food supply) at these ponds may be attractive to Willets. Large numbers of these birds winter in saline coastal habitats and hundreds winter inland at the Salton Sea, another interior saline habitat with a mild climate.

Spotted Sandpiper (*Actitis macularia*)

The only Spotted Sandpipers recorded on our surveys were four at the Modesto Sewage ponds in the San Joaquin Basin on 29 January 1993. Spotted Sandpipers also are likely to be found in winter on the gravelly edges of lowland streams and reservoirs, habitats we did not survey.

Long-billed Curlew (*Numenius americanus*)

As noted above, our counts of Long-billed Curlews were greatly compromised by their extensive use of upland areas and their tendency to fly well before the close approach

of an airplane, no matter what the habitat. Although we counted 3801 curlews, we feel our surveys missed many thousands of birds. For example, on 8 January 1993, before our surveys, one ground-based observer counted a flock of 3000 curlew at one site in the lower American Basin. Most Long-billed Curlews forage in grasslands, agricultural fields, and alfalfa fields; smaller numbers use managed wetlands and flooded rice stubble fields, where they feed on crayfish. Considering the vast extent of nonflooded agricultural land in the Central Valley, good estimates of the size of the Long-billed Curlew population wintering there will have to await surveys designed specifically for that species.

Marbled Godwit (*Limosa fedoa*)

The few Marbled Godwits found on our winter surveys were restricted to the San Joaquin Valley. Eighty were in managed wetlands of the Grasslands in the San Joaquin Basin; of the remainder in the Tulare Basin, 21 were at the Corcoran sewage ponds and 20 were at Kern NWR. Most godwits in California winter at coastal estuaries and beaches, though hundreds are also found then at the Salton Sea. Unlike other Central Valley wintering shorebirds that are restricted to the San Joaquin Valley (such as the Snowy Plover and Willet), the Marbled Godwit tends to prefer fresher water habitats, although they may find the alkaline soils of the San Joaquin Valley attractive.

Sanderling (*Calidris alba*)

The only Sanderlings that were recorded on our winter surveys were two at the Tulare Lake Drainage District Hacienda evaporation ponds on 29 January 1993. This species is primarily an inhabitant of coastal estuaries and beaches and is extremely rare in winter inland in California away from the Salton Sea.

Western Sandpiper (*Calidris mauri*)

The Western Sandpiper has long been thought to be rare to very uncommon in the Central Valley in winter (McCaskie et al. 1979), but our surveys of the entire Central Valley in winter 1992-93 and of the San Joaquin Valley in the winters of 1990-91 and 1991-92 have dispelled that misconception. Ignoring the birds using tidal habitats in the Suisun Marsh, over 84% of the 11,658 Western Sandpipers in the Central Valley on our winter 1992-93 surveys were in the San Joaquin Valley. Most of these were concentrated in two areas: the Grasslands wetland complex in the San Joaquin Basin and the agricultural evaporation ponds in the Tulare Basin. Neither of these areas had previously been thoroughly explored for shorebirds. The evaporation ponds in the Tulare Basin began to be operated only in the late 1970s and all of them are on private land. Although some of the wetlands in the Grasslands are on public land, areas where Western Sandpipers concentrate are mostly on private lands, and only limited portions of these lands are visible from public roads. Furthermore, Westerns tend to be patchily distributed and consequently it is possible to assess their status only by covering most of the available habitat, something that had not been done prior to our surveys. Our winter 1992-93 surveys found Western Sandpipers becoming increasingly scarce from the Delta north through the Sacramento Valley. Again, they were patchily distributed, tending to congregate with large flocks of Dunlin, and their true status can only be ascertained by covering large amounts of suitable habitat. After

locating large flocks of small shorebirds from the air in the Delta and Sacramento Valley, we visited these sites on the ground to determine the ratios of the various small sandpipers. Often in flocks of 1000 to 10,000 Dunlin we saw few, if any, Westerns, but on several occasions we found 100 or more Westerns and on one occasion 450.

Very large numbers of Western Sandpipers winter in California's coastal estuaries and smaller numbers at the Salton Sea. This suggests that the concentrations of Western Sandpipers in the San Joaquin Valley are attracted to the saline/alkaline conditions found at evaporation ponds and at some areas of the Grasslands. Wintering Westerns Sandpipers are also found at flooded agricultural fields, pasture ponds, and sewage ponds.

Least Sandpiper (*Calidris minutilla*)

Least Sandpipers were probably undercounted on our surveys relative to Western Sandpipers and Dunlins. Least tend to inhabit the same general range of habitats that Westerns and Dunlins do, but compared to those species they tend to forage in shallower water, higher on the mudflats, and in areas with more vegetation. We also noticed that Least were more likely than the other small sandpipers to occur in small flocks and to crouch close to the ground when aerial predators flew overhead. Taken together, their size, habitat preferences, and habits made them more difficult to detect than the other sandpipers. Because of their preference for freshwater and vegetated habitats they were widespread throughout the Central Valley and were most numerous on managed wetlands.

Dunlin (*Calidris alpina*)

As noted above, the Dunlin was by far the most numerous species recorded on our winter surveys and was also very widespread throughout the Central Valley. The concentration of over three-fourths of the population in the Delta and Sacramento Valley can be attributed to the vast extent of flooded agricultural habitat in that region. Most Dunlin use flooded agricultural fields, managed wetlands, evaporation ponds, and sewage ponds, but smaller numbers use irrigated pastures and farm ponds and reservoirs. Most of the Dunlin that we found were in very large flocks, ranging up to 20,000 birds. These birds may have been congregating to take advantage of favorable food supplies or to minimize predation.

Many of the Dunlin on our midwinter surveys probably were inhabiting coastal estuaries earlier in the winter. In the winter of 1991-92, a study of radio-tagged and color-marked Dunlin showed that birds from Bolinas Lagoon on the central California coast moved inland to the Delta and lower Sacramento Valley after an extended period of winter rains (Nils Warnock and PRBO unpubl. data). We hope to further document the coast-to-inland shift of Dunlin next winter by conducting valleywide surveys in November and again in January to February.

Ruff (*Philomachus pugnax*)

The only Ruffs recorded on our winter surveys were single individuals at two different sets of evaporation ponds in the Tulare Basin on 29 January 1993. This Eurasian shorebird has been seen in California in increasing, though small, numbers in recent years.

Although also found on the coast, most wintering records for the state are of birds found in the San Joaquin Valley at managed wetlands or evaporation ponds.

Long-billed Dowitcher (*Limnodromus scolopaceus*)

Although large numbers were recorded as dowitcher species, we feel confident that most, if not all, of the wintering birds were Long-billed rather than the similar Short-billed Dowitcher. We know of no documented records of Short-billed Dowitchers for the interior of California in midwinter.

The Long-billed Dowitcher was the second most numerous species on our winter surveys. Long-billed Dowitchers prefer managed freshwater wetlands, flooded agricultural fields, irrigated pastures and vernal pools, sewage ponds, farm ponds and reservoirs, and large streams and channels. Highest numbers were found in managed wetlands and flooded agricultural fields.

Common Snipe (*Gallinago gallinago*)

As noted above, the Common Snipe is the most difficult wintering shorebird to survey and also is probably one of the most numerous. Our surveys were inadequate for assessing wintering numbers in the Central Valley. The Common Snipe frequents muddy, low-vegetation wetlands; flooded agricultural fields; wet pastures and vernal pools; sewage ponds; and stream, slough, and ditch banks.

Wilson's Phalarope (*Phalaropus tricolor*)

The only Wilson's Phalarope we found on our winter surveys was at the Westlake Farms South evaporation ponds in the Tulare Basin on 28 January 1993. The Wilson's Phalarope is extremely rare anywhere in California in winter, when most records are from salt evaporation ponds on the coast.

OVERVIEW AND RESEARCH NEEDS

Although our winter surveys of the Central Valley documented that this region holds one of the largest wintering concentrations of shorebirds in western North America, much still needs to be learned. Such surveys should be conducted over more years, and more frequently in single years, to determine (1) if the patterns observed in 1992-93 are predictable, (2) if numbers of shorebirds using the Central Valley increase from early to midwinter, as we predict from studies of marked Dunlin, and (3) how the winter patterns observed compare to those at other seasons. While our surveys suggest that general habitat conditions and climate seem to explain many of the between-region and latitudinal trends of wintering shorebirds in the Central Valley, more specific research is needed on habitat needs, food resources, and the relative importance of various habitat types to their survival. Our initial studies indicate that managed wetlands are of great importance because of their relatively large extent and their ability to support high densities of wintering shorebirds. Flooded agricultural fields, particularly ricelands, also are extremely important to the Central Valley's wintering shorebirds because of their vast extent, particularly in wet winters. Although managed wetlands and flooded agricultural fields supported the most

wintering shorebirds, the other habitats currently available to shorebirds also increase the number and variety of shorebirds wintering in the Central Valley. While mitigation is needed for the toxic effects of the concentration of selenium and other heavy metals at evaporation ponds (CH2M Hill et al. 1993), there also is a need to maintain similar, toxic-free playa-like habitats in the San Joaquin Valley because such habitats support high densities of shorebirds and are particularly important to certain species. Continued research on the abundance, distribution, and habitat needs of shorebirds is needed to effectively integrate the management needs of waterfowl, shorebirds, and other wetland-dependent species of birds.

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Project Staff: Janet Kjelmlyr, Gary Page, Dave Shuford, and Lynne Stenzel.

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