SHOREBIRD NUMBERS IN WETLANDS OF THE PACIFIC FLYWAY: A SUMMARY OF SPRING, FALL, & WINTER COUNTS IN 1988, 1989, AND 1990

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KEY TO NUMBERED SITES

1 SMITH RIVER MOUTH
2 POINT ST. GEORGE
3 EEL RIVER MOUTH
4 POINT REYES/BODEGA BAY WETLANDS
  BODEGA HARBOR
  ESTERO AMERICANO
  TOMALES BAY
  DRAKES ESTERO
  LIMANTOUR ESTERO
  BOLINAS LAGOON
5 MONTEREY BAY AREA
    PAJARO RIVER/WATSONVILLE SLOUGH
    ELKHORN SLOUGH
    SALINAS RIVER MOUTH
    SALINAS SEWAGE PONDS
6 LOS ANGELES RIVER
7 SEAL BEACH NWR
8 BOLSA CHICA
9 BATIQUITOS LAGOON & SAN ELIJO LAGOON
10 SAN DIEGO BAY AREA
    MISSION BAY
    SAN DIEGO BAY
    TIJUANA RIVER MOUTH
11 HARNEY LAKE
12 MUD LAKE
13 CAMPBELL LAKE
14 HART LAKE
15 GOOSE LAKE
16 UPPER ALKALI LAKE
17 SACRAMENTO NWR
18 DELEVAN NWR
19 COLUSA NWR
20 BUTTE SINK NWR
21 GRAY LODGE WA
22 SUTTER NWR
23 WOODLAND SUGAR PONDS
24 NATOMAS ROAD
25 UPPER BEACH LAKE
26 MODESTO SEWAGE PONDS
27 GRASSLAND RESOURCE CONSERVATION DISTRICT
28 BARBIZON FARMS & WESTLAKE FARMS NORTH EVAPORATION PONDS
29 HANFORD SEWAGE PONDS
30 DINUBA SEWAGE PONDS
31 CROWLEY LAKE
32 CORCORAN SEWAGE PONDS
33 TULARE SEWAGE PONDS
34 VISALIA SEWAGE PONDS
35 WESTLAKE FARMS SOUTH EVAPORATION PONDS
36 TLDD HACIENDA RANCH & J&W FARMS EVAPORATION PONDS
37 MARTIN FARMS EVAPORATION PONDS
38 TULARE LAKE DRAINAGE DISTRICT SOUTH EVAPORATION PONDS
39 CARMEL RANCH EVAPORATION PONDS
40 BAKERSFIELD SEWAGE PONDS
41 EDWARDS AIR FORCE BASE
    PIUTE PONDS
    SEWAGE PONDS
42 HARPER LAKE


PACIFIC FLYWAY SITES:
MORE THAN 1000 BIRDS
BRITISH COLUMBIA
TOFINO MUDFLATS
FRASER RIVER DELTA
WASHINGTON
OREGON
IDAHO
SILETZ BAY
ALSEA BAY
COOS BAY
BANDON MARSH
SUMMER LAKE
ABERT LAKE
LAKE LOWELL
MALHEUR LAKE
LAKES TALAWA & EARL
LOWER KLAMATH NWR
HUMBOLDT BAY
AMERICAN FALLS RESERVOIR
CALIFORNIA
NEVADA
HONEY LAKE
HUMBOLDT WMA
STILLWATER WMA
CARSON LAKE
GREAT SALT LAKE
SAN FRANCISCO BAY
MONO LAKE
OWENS LAKE
UTAH
MORRO BAY
ARIZONA
NEW MEXICO
MUGU LAGOON
UPPER NEWPORT BAY
SALTON SEA
ESTERO DE PUNTA BANDA
BAHIA DE SAN QUINTIN
BAJA CALIFORNIA
LAGUNA DE GUERRERO NEGRO
LAGUNA DE OJO LIEBRE

TABLE 1. COASTAL WETLANDS SURVEYED FOR SHOREBIRDS IN 1988, 1989, OR 1990.

SITE	AREA	MAXIMUM	SEASON	# CENSUSES
BRITISH COLUMBIA	TOFINO MUDFLATS	15081	S	2
	FRASER RIVER DELTA	100000	S	3
OREGON				
CLATSOP COUNTY	COLUMBIA RIVER MOUTH	419	F	1
	NECANICUM RIVER ESTUARY	790	F	1
TILLAMOOK COUNTY	NETARTS BAY	110	F	1
	SAND LAKE	307	F	1
LINCOLN COUNTY	SILETZ BAY	1411	F	1
	YAQUINA BAY	52	F	1
	ALSEA BAY	1592	F	1
COOS COUNTY	COOS BAY	7484	F	1
	BANDON MARSH	1041	F	1
CALIFORNIA				
DEL NORTE COUNTY	SMITH RIVER MOUTH	3340	F	6
	LAKES TALAWA AND EARL	13310	F	6
	POINT ST. GEORGE	1528	F	6
	CRESCENT CITY HARBOR	675	F	6
HUMBOLDT COUNTY	HUMBOLDT BAY	79353	W	7
	EEL RIVER MOUTH	1911	S	2
	MATTOLE RIVER MOUTH	144	F	1
MENDOCINO COUNTY	PUDDING CREEK MOUTH	185	F	1
	GARCIA RIVER MOUTH	511	W	3
	GUALALA RIVER MOUTH	7	F	3
SONOMA COUNTY	SHELL BEACH/SEA RANCH	31	S	2
	BODEGA HARBOR	12901	W	7
	ESTERO AMERICANO	2855	F	5
MARIN COUNTY	TOMALES BAY	14914	W	7
	ABBOTTS LAGOON	652	F	7
	DRAKES ESTERO	10217	W	7
	LIMANTOUR ESTERO	5527	W	7
	BOLINAS LAGOON	12287	S	7
	BOLINAS SEWAGE PONDS	40	F	5
*	SAN FRANCISCO BAY	931561	S	8
SAN MATEO COUNTY	PESCADERO MARSH	496	F	4
	ANO NUEVO & WADDELL BEACH	691	F	5
SANTA CRUZ COUNTY	CORCORAN LAGOON	46	W	4
	PAJARO RIVER/WATSONVILLE SLOUGH	1832	F	6
MONTEREY CO.	ELKHORN SLOUGH	32109	F	7
	SALINAS RIVER MOUTH	1084	S	6
	SALINAS SEWAGE PONDS	2991	F	2
	OUTER COASTAL BEACHES	4869	F	6
SAN LUIS OBISPO CO.	MORRO BAY	12946	W	8
	SANTA MARIA RIVER MOUTH	422	W	2
SANTA BARBARA CO.	DEVEREUX	345	F	5
	GOLETA SLOUGH	97	W	5
	SANTA BARBARA BIRD REFUGE	442	F	1
VENTURA COUNTY	SANTA CLARA RIVER MOUTH	341	S	2
	MUGU LAGOON	32949	S	7
LOS ANGELES CO.	MALIBU LAGOON	270	W	5
	CABRILLO BEACH	5	F	1
	LOS ANGELES RIVER	5812	F	2
	SAN GABRIEL RIVER	706	S	2
ORANGE COUNTY	SEAL BEACH NWR	5042	W	5
	BOLSA CHICA	5406	F	4
	SANTA ANA RIVER MOUTH	34	F	2
	UPPER NEWPORT BAY	14825	W	5
SAN DIEGO COUNTY	SANTA MARGARITA RIVER MOUTH	705	F	5
	SAN LUIS REY RIVER MOUTH	79	F	4
	BUENA VISTA LAGOON	80	S	2
	AGUA HEDIONDA	431	S	3
	BATIQUITOS LAGOON	2624	F	5
	SAN ELIJO LAGOON	2228	F	5
	SAN DIEGUITO LAGOON	368	W	5
	PENASQUITOS LAGOON	276	F	5
	MISSION BAY & FCC	5173	S	5
	SAN DIEGO BAY	17986	F	5
	TIJUANA RIVER MOUTH	1837	W	5
BAJA CALIFORNIA				
	ESTERO DE PUNTA BANDA	6010	F	5
	BAHIA DE SAN QUINTIN	24016	W	3
	LAGUNA GUERRERO NEGRO	21787	F	1
	LAGUNA DE OJO LIEBRE	43913	F	1
	NORTHERN GULF OF CA	486	S	1

TABLE 2. INTERIOR WETLANDS SURVEYED FOR SHOREBIRDS IN 1988, 1989, OR 1990.

SITE	AREA	MAXIMUM	SEASON	# CENSUSES
OREGON				
LAKE COUNTY	ALKALI LAKE	64	F	1
	SUMMER LAKE	10604	F	2
	ABERT LAKE	23276	F	2
	CAMPBELL LAKE	1593	S	1
	LOWER CAMPBELL LAKE	19	S	1
	FLAGSTAFF LAKE	173	S	1
	MUGWUMP LAKE	8	S	1
	SWAMP LAKE	40	S	1
	ANDERSON LAKE	28	S	1
	BTWN ANDERSON & HART LAKES	452	S	1
	HART LAKE	8104	F	2
	CRUMP LAKE	454	F	1
	PELICAN LAKE	50	F	2
	GREASER LAKE	118	S	1
	HWY 140 EAST OF ADEL	6	S	1
	MC RANCH	32	S	2
	COLEMAN LAKE	40	S	1
HARNEY COUNTY	STINKING LAKE	600	S	2
	HARNEY LAKE	1262	F	2
	MUD LAKE	1360	F	2
	MALHEUR LAKE	6615	F	2
IDAHO				
CANYON COUNTY	LAKE LOWELL	11457	F	1
**	AMERICAN FALLS RESERVOIR	5780	F	1
NEVADA				
WASHOE COUNTY	MOSQUITO LAKE	41	S	1
	ALKALI LAKE	452	S	1
	MASSACRE LAKE	511	S	1
	SOUTH WASHOE	67	S	1
	FORTYNINE LAKE	36	S	1
WASHOE/PERSHING CO.	WINNEMUCCA LAKE	46	S	1
PERSHING/CHURCILL	HUMBOLDT WMA	23740	F	2
LYON COUNTY	WABUSKA MARSHES	30	S	1
	ARTESIA LAKE	254	S	1
	FERNLEY WMA	802	F	3
	MASON VALLEY	760	S	1
CHURCHILL COUNTY	STILLWATER WMA	76988	S	4
	SODA LAKES	850	F	4
	CARSON LAKE	81933	S	4
	MAHALA SLOUGH	145	F	3
	MASSIE SLOUGH	109	S	1
	SHECKLER RESERVOIR	572	F	2
	HARMON RESERVOIR	104	F	2
	LETER RESERVOIR	165	S	1
	S-LINE RESERVOIR	71	S	2
	OLD RIVER RESERVOIR	61	F	1
UTAH				
***	GREAT SALT LAKE	113703	F	4
JUAB COUNTY	FISH SPRINGS NWR	269	F	1
CACHE COUNTY	THE BARRENS	163	F	1
CALIFORNIA				
NORTHEASTERN CA				
SISKIYOU COUNTY	BUTTE VALLEY WA	30	F	1
	LOWER KLAMATH NWR	10592	S	2
	TULE LAKE NWR	170	F	2
MODOC COUNTY	CLEAR LAKE	228	S	2
	BIG SAGE RESERVOIR	13	S	1
	GOOSE LAKE	3073	F	2
	MUD LAKE	6	S	1
	UPPER ALKALI LAKE	3475	S	1
	MIDDLE ALKALI LAKE	29	S	1
	LOWER ALKALI LAKE	753	S	1
	MODOC NWR	294	F	2
	WEST VALLEY RESERVOIR	32	S	1
	JESS VALLEY MARSHES	13	S	1
LASSEN COUNTY	ASH CREEK WA	25	S	2
	SILVA FLAT RESERVOIR	69	S	1
	DILLON LAKE	19	S	1
	SAID VALLEY RESERVOIR	33	S	1

TABLE 2 (CONTINUED)

SITE	AREA	MAXIMUM	SEASON	# CENSUSES
NORTHEASTERN CA (CONTINUED)				
LASSEN COUNTY	MADELINE PLAINS	111	S	1
	HONEY LAKE	17884	S	3
PLUMAS/SIERRA CO.	SIERRA VALLEY	521	S	3
SACRAMENTO VALLEY				
TEHAMA COUNTY	CAPAY	180	S	1
BUTTE COUNTY	CHICO OXIDATION PONDS	104	S	1
	WEST BUTTE ROAD	170	S	1
	GRAY LODGE WA	3649	S	2
SUTTER COUNTY	BUTTE SINK NWR	10	F	2
	SUTTER NWR	7199	S	1
GLENN COUNTY	SACRAMENTO NWR	10547	S	2
COLUSA COUNTY	DELEVAN NWR	16092	S	2
	COLUSA NWR	12832	S	2
YOLO COUNTY	WOODLAND SUGAR PONDS	1985	F	2
	OLD WOODLAND SUGAR PLANT	30	S	1
	MAGGOT PONDS	46	S	1
	TRESSLE PONDS	401	S	1
	DAVIS SEWER PONDS	688	F	2
	DAVIS LANDFILL WETLANDS	10	S	1
	YOLO BYPASS	14	S	1
	WEST DAVIS PONDS (F STREET)	22	F	1
	LAKE WASHINGTON	0	S	1
	ROAD 25	21	S	1
	CHANEY LAKE	25	S	1
SACRAMENTO COUNTY	NATOMAS ROAD	2708	F	1
	UPPER BEACH LAKE	4090	S	1
SAN JOAQUIN VALLEY				
MERCED COUNTY	NORTH GRASSLANDS	86678	S	2
	EAST GRASSLANDS	2104	F	1
	KESTERSON NWR	795	S	1
	SAN LUIS NWR	2364	S	2
	MERCED NWR	3220	S	1
	VOLTA WA	11008	S	2
	LOS BANOS WA	922	S	1
	SOUTH GRASSLANDS	35788	S	2
FRESNO COUNTY	MENDOTA WA	13198	S	2
SAN JOAQUIN COUNTY	LODI SEWAGE PONDS	575	S	1
	STOCKTON SEWAGE PONDS	173	S	1
	TRACY SEWAGE PONDS	148	S	1
STANISLAUS COUNTY	MODESTO SEWAGE PONDS	2561	S	1
FRESNO COUNTY	ORANGE COVE SEWAGE PONDS	26	S	1
KINGS COUNTY	HANFORD SEWAGE PONDS	1452	S	2
	CORCORAN SEWAGE PONDS	11993	S	2
TULARE COUNTY	DINUBA SEWAGE PONDS	2233	S	1
	VISALIA SEWAGE PONDS	6224	S	1
	WOODLAKE SEWAGE PONDS	200	S	1
	BRAVO LAKE	40	S	1
	EXETER SEWAGE PONDS	178	S	1
	TULARE SEWAGE PONDS	1175	S	1
	LINDSAY SEWAGE PONDS	434	S	1
KERN COUNTY	KERN NWR	562	S	1
	BUENA VISTA LAKE	23	S	1
	BAKERSFIELD SEWAGE PONDS	2396	S	2
EVAPORATION PONDS				
FRESNO COUNTY	TRANQUILITY PONDS	20	F	1
	SUMNER PECK	17	S	2
	BRITZ FIVE POINTS	19	S	1
KINGS COUNTY	JACK STONE LAND CO.	617	S	2
	WESTLAKE FARMS (N)	1691	S	2
	MEYERS RANCH	715	S	2
	BARBIZON FARMS	3358	S	2
	TULARE LAKE DRAINAGE DISTRICT (N)	677	S	2
	WESTLAKE FARMS (S)	7437	S	2
	J & W FARMS	5183	S	2
	TULARE LAKE DD HACIENDA RANCH	11050	S	2
	4J CORPORATION	27	S	1
TULARE COUNTY	PRYSE FARMS	637	S	2
	BOMAN FARMS	571	F	2
	MORRIS FARMS	304	F	2

TABLE 2 (CONTINUED)

SITE	AREA	MAXIMUM	SEASON	# CENSUSES
EVAPORATION PONDS (CONTINUED)				
TULARE COUNTY	MARTIN FARMS	1896	F	2
KINGS/KERN COUNTY	TULARE LAKE DRAINAGE DISTRICT (S)	30020	F	2
KERN COUNTY	WESTFARMERS	670	F	2
	CARMEL RANCH	1440	F	2
	LOST HILLS RANCH	840	F	2
EASTERN & SOUTHERN CA				
MONO COUNTY	MONO LAKE	36338	F	4
	CROWLEY LAKE	1963	F	2
INYO COUNTY	OWENS LAKE	8497	S	4
	TINEMAHA RESERVOIR	994	F	2
KERN COUNTY	ISABELLA LAKE	389	F	2
KERN/SAN BERNADINO	CHINA LAKE	617	F	4
SAN BERNADINO CO.	HARPER LAKE	2114	S	3
LOS ANGELES COUNTY	EAFB SEWAGE PONDS	1247	F	2
	PIUTE PONDS, EAFB	8985	S	4
	LANCASTER SEWAGE PONDS	375	F	1
	RIO HONDO SPREADING BASIN	997	S	1
RIVERSIDE/IMPERIAL	SALTON SEA	105570	F	4

KEY TO TABLES 1 & 2

S = SPRING
F = FALL
W = WINTER

* SAN FRANCISCO BAY -- SONOMA/SOLANO/MARIN/SAN FRANCISCO/CONTRA COSTA/ALAMEDA/SAN MATEO/ SANTA CLARA COUNTIES

** AMERICAN FALLS RESERVOIR -- BINGHAM/POWER/BANNOCK COUNTIES

*** GREAT SALT LAKE -- BOX ELDER/TOOELE/DAVIS/WEBER COUNTIES

PROJECT GOALS

The diking, draining, and filling of wetlands for agricultural, industrial, and residential development, and the diversion of fresh water for municipal and agricultural use are responsible for the destruction or degradation of much of the wetland habitat in the Pacific Flyway. Aquatic bird populations have declined because of this destruction. For some, such as the Clapper Rail, populations have shrunk to the extent that expensive recovery plans must be undertaken by government agencies to save the species from extinction. The decline in waterfowl, particularly ducks, has been so significant that federal, state, and private agencies have pooled their conservation efforts into the North American Waterfowl Management Plan (NAWMP), with the goals of restoring critical wetland habitat and significantly increasing waterfowl populations. The NAWMP recognizes that other wetland-dependent species, including shorebirds, should also benefit, but critical information on the status, population trends, and key areas of concentration of most shorebirds is lacking. Since shorebird conservation should be based on factual information similar to that underlying the NAWMP for waterfowl, Point Reyes Bird Observatory initiated the Pacific Flyway Project in 1988 with six major objectives:

To identify wetlands of regional, national, and international significance for shorebirds, based on the numbers of shorebirds using them.

To identify the threats to these wetlands.

To synthesize the threat and bird data into a comprehensive picture of the future prospects for shorebirds on the Pacific Flyway.

To use these data for developing sound conservation and management strategies for shorebirds and their wetland habitats.

To provide a data base on which a program for monitoring shorebird populations on the Pacific Flyway can be based.

To increase public awareness and understanding of the need for the protection of shorebirds and their wetland habitats.

The Pacific Flyway

For our study we define the Pacific Flyway as the portion of the United States and Canada west of the Rocky Mountains. Included are Alaska, British Columbia, Washington, Idaho, Oregon, Utah, Nevada, California, Arizona, New Mexico, and Baja California.

Shorebird Counts

The Pacific Flyway Project organizes hundreds of volunteers to conduct shorebird censuses in wetlands during periods of peak shorebird use in spring, fall, and winter. Over 125 counters participate on each census of San Francisco Bay alone. About 1000 counters have participated in the project since its inception in April 1988.

Small wetlands are covered by teams of one or more observers, while larger ones are divided into sub-areas that are covered by a team in each sub-area. Adjacent sub-areas are covered as close to simultaneously as possible to minimize the chances of counting the same birds more than once. Aerial censuses are used for areas that are inaccessible by foot or vehicle, or are too extensive to be covered by ground-based counters. We have been able to obtain census data for a number of distant wetlands through the generous assistance of volunteers cooperating with PRBO: they use their familiarity with the wetlands to design a method of coverage and organize the surveys of those sites.

Census participants tally each species of shorebird separately when possible. If counters are unable to determine the number or proportion of the different species in mixed-species flocks, they are asked to record the size of the flock and which species comprise it. For each census site where the proportion and number of identified individuals are sufficiently high, we assume the composition of mixed-species flocks to be similar to flocks comprised of the identified species, and we incorporate the numbers of unallocated birds into those of identified species (Stenzel and Page 1988).

The spring counts are timed to coincide with the peak occurrence of arctic-nesting shorebirds as they concentrate at staging areas south of their breeding grounds. Counts have centered around the weekends of 16-17 April 1988 (Stenzel and Page 1988), 22-23 April 1989 (Page et al. 1989), and 14-15 April 1990. Peak numbers in fall are more difficult to obtain through a single census than in spring, because fall migration is more protracted. There may be several peaks for some species, as females, males, and young birds return from the breeding grounds in successive waves. Fall counts have centered around the weekends of 10-11 September 1988 (Stenzel et al. 1989), 19-20 August 1989 (Page et al. 1989), and 8-9 and 15-16 September 1990. In winter, when shorebirds generally remain in residence at wetlands, counts have occurred from November through February in 1989 and 1990. Although we would like to obtain more censuses of each wetland annually, larger wetlands (generally the ones that hold the most shorebirds) require too much organizational effort for this to be possible.

For some sites included in our study, other researchers have collected data on numbers of shorebirds in past years. These data help characterize shorebird use of wetlands, and we have incorporated them into our data base whenever possible.

PROJECT EXPANSION

The Pacific Flyway Project has expanded significantly since its inception in 1988. Stages in this progression are as follows:

Spring 1988: First ever comprehensive census of shorebirds in San Francisco Bay.

Fall 1988: Coverage increased to include all major coastal wetlands in California from the Oregon border to Morro Bay.

Spring and Fall 1989: Coverage increased to include all major coastal wetlands in California. Surveys also were initiated along the coast of northern Baja California and in the interior of California at several sites including the Salton Sea, Mono Lake, and Owens Lake. Counts from coastal British Columbia, from Utah, and from several sites in western Nevada were contributed by federal, state, or provincial (British Columbia) wildlife protection agencies.

Winter 1989: First winter counts were attempted at all major coastal California wetlands from Humboldt to Morro bays.

Spring 1990: Area of coverage expanded to include alkaline lakes and fresh water reservoirs in northeastern California. Many wetlands in the San Joaquin and Sacramento valleys were covered for the first time. Expansion into the San Joaquin Valley and northeastern California was accomplished through expeditions of Project staff who worked with residents of the areas to conduct the censuses. Several sites in the interior of Oregon were covered for the first time.

Fall 1990: Project staff attended the annual shorebird festival of local conservation organizations at Charleston, Oregon, and helped organize censuses of many of the largest wetlands along the Oregon coast. Two important wetlands in Idaho, American Falls Reservoir and Lake Lowell, were surveyed for the first time. Project staff made an expedition to San Quintin Bay in Baja California and, working with both Mexican and U. S. citizens, developed a method of cooperatively surveying this largely pristine wetland.

Winter 1990: The winter survey effort was expanded to include all major wetlands on the California coast.

PROJECT FINDINGS

Below, we report the cumulative results of these censuses as an important step toward the identification of key wetlands for shorebirds in the Pacific Flyway.

Number of Wetlands Covered

The 70 coastal and 147 interior wetlands surveyed to date in either spring, fall, or winter are listed in Tables 1 and 2, along with the maximum total count at each wetland, the season in which the maximum number occurred, and the number of censuses for each site. Data from all the surveys are reported in Figures 1-5, using the highest count for each species at each wetland. Shorebird numbers in each wetland are represented using abundance values of six orders of magnitude, from 1-10 up to 100,000-1,000,000. The larger the dot, the greater the number of shorebirds in the area.

Whenever possible we covered all shorebird habitat in each wetland. Coverage at the Columbia River mouth in Oregon; at Goose Lake, Upper Alkali Lake, Clear Lake, and Honey Lake in California; at the Great Salt Lake in Utah; and at American Falls Reservoir and Lake Lowell in Idaho has so far been incomplete, causing totals for these sites to be underestimated.

Shorebird Use of Coastal Sites

Between southern British Columbia and Baja California we have identified at least 21 coastal sites that peak at 1,000 or more shorebirds in spring; 34 such sites in fall; and 18 such sites in winter (Figs. 1, 3, and 5). Of these, 9 wetlands support over 10,000 shorebirds in spring, 10 in fall, and 10 in winter. The importance of San Francisco Bay to shorebirds remains clear. It can hold nearly 1,000,000 shorebirds in spring and hundreds of thousands in fall and winter. The only other location currently documented to hold up to a million shorebirds along the coast south of Alaska is Grays Harbor in Washington state (Herman and Bulger 1981). Both San Francisco Bay and Grays Harbor are designated to be of hemispheric importance to shorebirds by the Western Hemisphere Shorebird Reserve Network.

Rob Butler has provided data from the Fraser River delta area and Tofino mudflats on the British Columbia coast. The Fraser River delta hosts peaks of up to 100,000 shorebirds in spring and 55,000 in fall. In addition to these large numbers of migrants, it also supports the highest densities of shorebirds in Canada in winter (Butler and Campbell 1987).

Our data for the coastal wetlands of Washington and Oregon are still fragmentary. Along the Washington coast, in addition to Grays Harbor, Willapa Bay is likely to hold large numbers of shorebirds (perhaps up to 100,000 in spring; Steve Herman and Joe Buchanan pers. comm.). The wetlands of Puget Sound are likely also very important; surveys are currently being organized there by Joe Buchanan of Cascadia Research Collective. No site along the Oregon coast held 10,000 shorebirds, but we have so far obtained only fall coverage and only partial coverage of the Columbia River mouth, a site likely to hold large numbers of shorebirds. Also, the 1990 counts occurred in mid-September, and observers report that August is a better time for peak numbers along the Oregon coast.

Our coverage for the coast is most complete for California. By the end of 1990 we had at least two spring, two fall, and one winter census for each major site. Humboldt Bay, with peaks of 44,000 shorebirds in fall, 80,000 in winter, and 31,000 in spring, is second only to San Francisco Bay in numbers of shorebirds at a California coastal site. Up to 32,000 shorebirds can be found in Elkhorn Slough in fall and winter, and 32,000 in Mugu Lagoon in spring. Other California coastal sites held peaks of less than 20,000 birds at all times of the year.

Although we still have relatively little information from Baja California, it is already clear that Bahia de San Quintin supports up to 24,000 shorebirds in fall and winter. Partial censuses of Laguna Guerrero Negro and Laguna de Ojo Liebre revealed 21,000 and 44,000 shorebirds, respectively, in the fall of 1990. All three areas are apparently major sites for shorebirds on the Baja California coast.

The Western Sandpiper was the most abundant species overall in spring, fall, and winter at coastal sites (Figs. 1, 3, and 5). Hundreds of thousands were counted in San Francisco Bay, and tens of thousands at the Tofino mudflats, the Fraser River delta, Lakes Talawa and Earl, Humboldt Bay, Bolinas Lagoon, Elkhorn Slough, Mugu Lagoon, Upper Newport Bay, and Laguna Guerrero Negro. Spring numbers of Dunlin also exceeded 100,000 birds at San Francisco Bay in spring and winter, and tens of thousands were counted at the Fraser River delta, Humboldt Bay, and Tomales Bay (Figs. 1 and 5).

The only other species in concentrations in excess of 10,000 birds in spring, fall, or winter were Black-bellied Plovers, American Avocets, Willets, Marbled Godwits, Least Sandpipers, dowitchers, and Red-necked Phalaropes. These concentrations occurred predominately at San Francisco Bay -- further documenting the importance of San Francisco Bay to shorebirds.

Species of large shorebirds were a minor component of the estuarine fauna north of California. Most large shorebirds are not arctic breeders and apparently do not use the more northerly coastal sites. Black-bellied Plovers were the main large shorebird species at coastal sites north of California.

Shorebird Use of Interior Sites

We identified 42 interior sites capable of supporting at least 1,000 shorebirds in spring, and 37 sites in fall (Figs. 2 and 4). Sixteen of these supported over 10,000 shorebirds in spring, and 10 in fall.

Washington and Oregon

We did not cover any inland sites in Washington but received counts from 21 sites in Oregon in either spring and/or fall. In fall, Abert and Summer lakes, with 23,000 and

10,600 shorebirds respectively, topped all other surveyed areas in Oregon. Fall numbers at Malheur and Hart lakes were between 5,000 and 10,000 birds. Spring numbers at interior Oregon sites were generally much lower than those in fall. For example, spring numbers at Abert, Summer, and Malheur lakes were 1,150, 3,400, and 1,800 birds, respectively.

Idaho

We received our first fall counts from Idaho in 1990. Counts at Lake Lowell and American Falls Reservoir revealed the occurrence of at least 11,500 and 5,800 shorebirds, respectively. Much remains to be learned about shorebird abundance during migration in this state. There are about 1500 reservoirs in Idaho, and little is known about shorebird use of most of them (Dan Taylor and Charles Trost pers. comm.).

Nevada and Utah

Four sites in these states -- Great Salt Lake, Stillwater Wildlife Management Area (WMA), Carson Lake, and Humboldt WMA -- stand out as major concentration sites for shorebirds. Shorebird numbers at Great Salt Lake peak in the hundreds of thousands during fall migration, mainly because of the passage of Wilson's Phalaropes (Jehl 1988). At least tens of thousands of shorebirds can be found at Great Salt Lake in the spring (Fig. 2). Counts from two years at the Stillwater WMA have yielded up to 77,000 shorebirds in spring and 62,000 in fall. Western Sandpipers, Least Sandpipers, dowitchers, and avocets are the most abundant species here as well as at Carson Lake, where up to 20,000 shorebirds were counted in fall and 82,000 in spring. Humboldt WMA, also in Nevada, had nearly 24,000 shorebirds on the 1989 fall count. Shorebird numbers have been much smaller at the other 20 sites covered in these two states.

California

San Joaquin Valley -- The first counts from the San Joaquin Valley revealed large numbers of shorebirds in the 110,000-acre Grassland Resource Conservation District near Los Banos. The area includes over 100 private duck clubs and 7 state and federal wildlife refuges. The 150,000 shorebirds counted in this area during the spring is the second largest concentration recorded for California. Fall numbers were much lower, mostly because much of the habitat dries out during late spring and summer. Conservationists and wildlife managers are concerned for the future of this wetland complex because of a paucity of uncontaminated water, urban encroachment, and the conversion of wetland habitat to agriculture.

Approximately 7000 acres of agricultural evaporation waste water ponds dot the southwest side of the San Joaquin Valley. Irrigation practices inadvertently contaminate many ponds with selenium, a naturally occurring but toxic trace element that is rinsed from the soil and washed into the shallow ponds. Levels of selenium that cause

reproductive failures and deformities in the young of nesting shorebirds have been reported at several of the pond systems (CH2M Hill et al. 1991). Collectively these ponds support large numbers of migratory shorebirds. We had counts of 50,000 in fall and 35,000 in spring.

We obtained counts from 14 sewage disposal ponds scattered throughout the San Joaquin Valley. Most were from spring. While numbers at only two pond systems exceeded 5000 shorebirds (Corcoran 12,000 and Visalia 6,200), collectively the ponds accounted for 30,000 shorebirds during the 1990 spring census.

Sacramento Valley -- Our coverage of the Sacramento Valley is less complete than for the San Joaquin Valley. Between 10,000 and 16,000 shorebirds were counted at the Sacramento, Delevan, and Colusa National Wildlife Refuges in spring. Numbers were lower at all these areas in fall. Overall we obtained census coverage of six wildlife refuges and 16 other Sacramento Valley sites in either spring and/or fall. With the exception of the Woodland Sugar Ponds and Natomas Road in fall and Upper Beach Lake in spring, all sites that were not wildlife refuges held fewer than 1000 birds.

Northeastern California -- Of the 20 sites covered in northeastern California, the largest concentrations of shorebirds reported came from Honey Lake in spring (17,900), Lower Klamath NWR in spring (10,600), Upper Alkali Lake in spring (3,500), Honey Lake in fall (3,200), and Goose Lake in fall (3,100).

Eastern & Southern California -- Of the 13 sites covered in this region, the Salton Sea and Mono Lake stand out as holding the most shorebirds. Numbers at the Salton Sea reach up to 105,000 birds in fall and 68,000 in spring. At Mono Lake we received counts of up to 36,000 shorebirds in fall and 25,600 in spring. In summer, up to 60,000 Wilson's Phalaropes have been reported at Mono Lake (Jehl 1988). Almost 9,000 shorebirds were recorded at the Piute ponds on Edwards Air Force Base in spring. Spring numbers at Owens Lake reached almost 8,500 birds; these occurred primarily at freshwater springs and seeps around the lakebed.

Overall the Western Sandpiper was the most abundant species in spring and fall at interior sites. Tens of thousands of Western Sandpipers were counted in the Grassland Resources Conservation District in the San Joaquin Valley, at Mono Lake, the Salton Sea, Stillwater WMA, Carson Lake, and Lake Lowell. Other species that occurred in concentrations exceeding 10,000 birds were the Black-necked Stilt, American Avocet, Least Sandpiper, Dunlin, dowitchers, Wilson's Phalarope, and Red-necked Phalarope. Detailed information on the relative abundance of different species in the interior is depicted in Figures 2 and 4.

PROJECT CONTINUANCE AND EXPANSION

Single censuses during any period of the year provide limited information on the number of birds a wetland is likely to support. Counts of shorebirds over a series of years are necessary to confirm the consistent use of an area and to establish a data base against which future numbers can be compared. Our goal is to obtain one census in each wetland during the peak of spring migration, one during the peak of fall migration, and one during the non-migratory winter period, annually for 3 to 5 years.

In 1991 we would like to expand our coverage to include most Pacific Flyway wetlands. We are particularly interested in wetlands with the potential of supporting at least 1,000 shorebirds during peak periods of spring or fall migration, or during winter. We feel confident we can obtain data from almost all major coastal wetlands from southern British Columbia to northern Baja California by spring 1991. We also plan on expanded coverage of interior wetlands including those in Arizona and New Mexico, which have never been covered for the project before.

Because shorebirds probably concentrate in wetlands of the western United States and British Columbia before they concentrate in the more northerly wetlands of Alaska, we plan to compare the total number of shorebirds on counts south of Alaska in late April with numbers at Alaskan staging areas in May. This comparison may provide the first gross estimate of the size of some Pacific Flyway shorebird populations.

We have also begun to gather more extensive data on threats to wetlands. We plan to send questionnaires to managers of wildlife agencies and persons familiar with specific wetlands, requesting information on the nature and seriousness of threats to wetlands.

The success of the Pacific Flyway Project to date encourages us to believe it possible to use voluntary census efforts along with data contributed by federal, state, and provincial (British Columbia) wildlife agencies to characterize shorebird use of wetlands in the Pacific Flyway. We thank everyone who has helped make this project possible and encourage anyone interested in assisting in this effort to contact us at PRBO.

Figure 1: Spring shorebird abundance in coastal wetlands; more than 1000 birds.

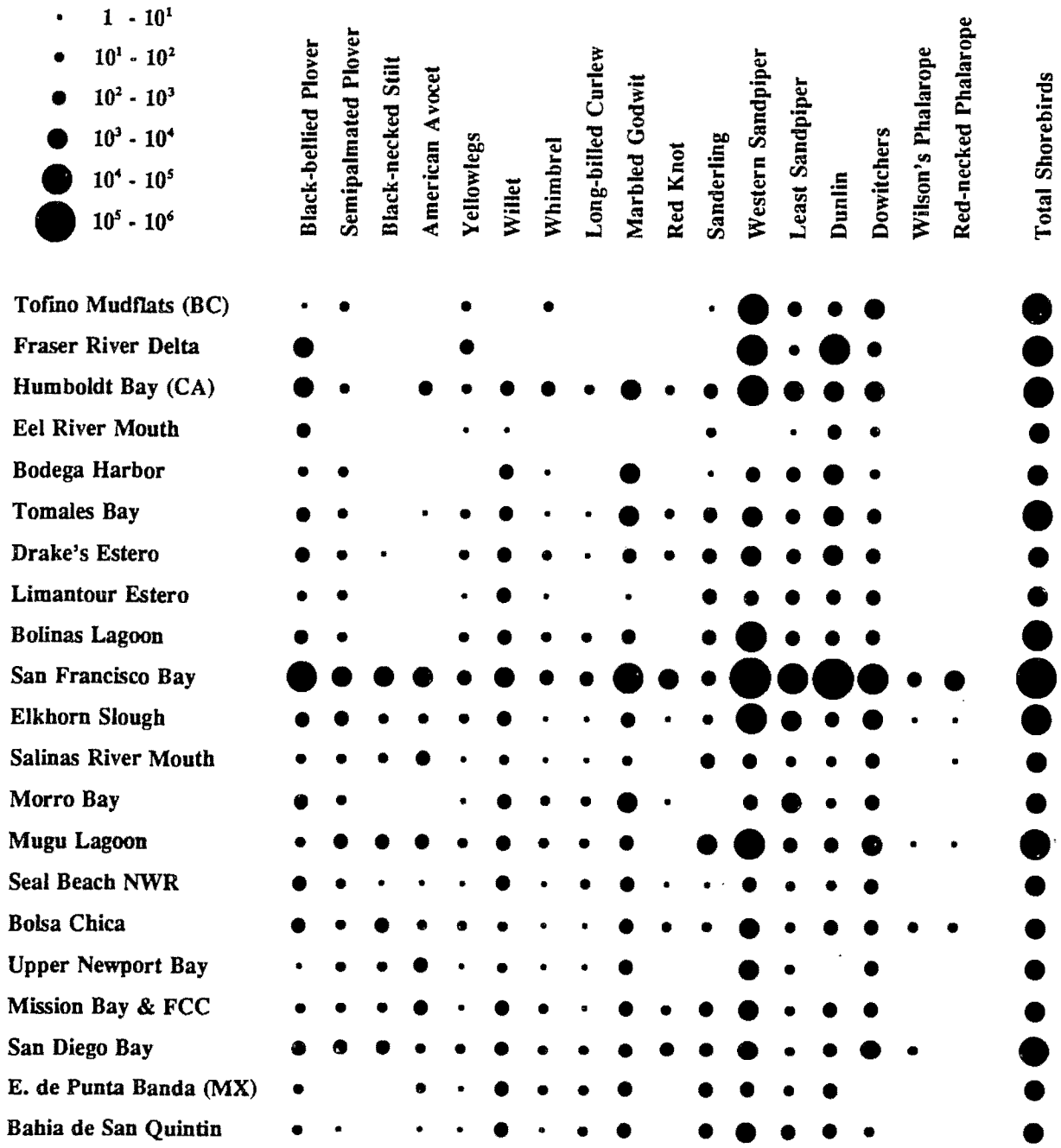


Figure 2: Spring shorebird abundance in interior wetlands; more than 1000 birds.

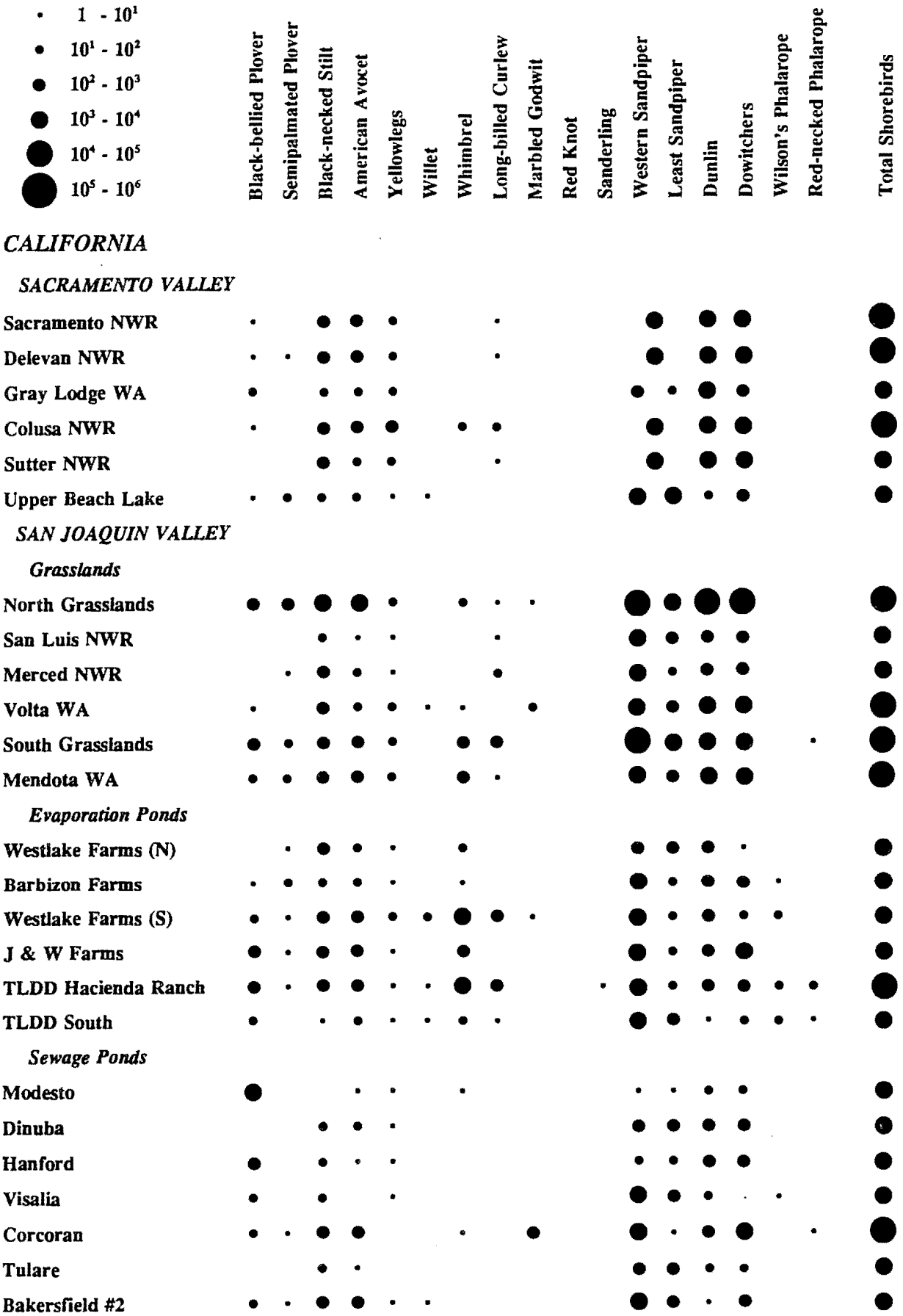


Figure 2 (Continued): Spring shorebird abundance in interior wetlands; more than 1000 birds.

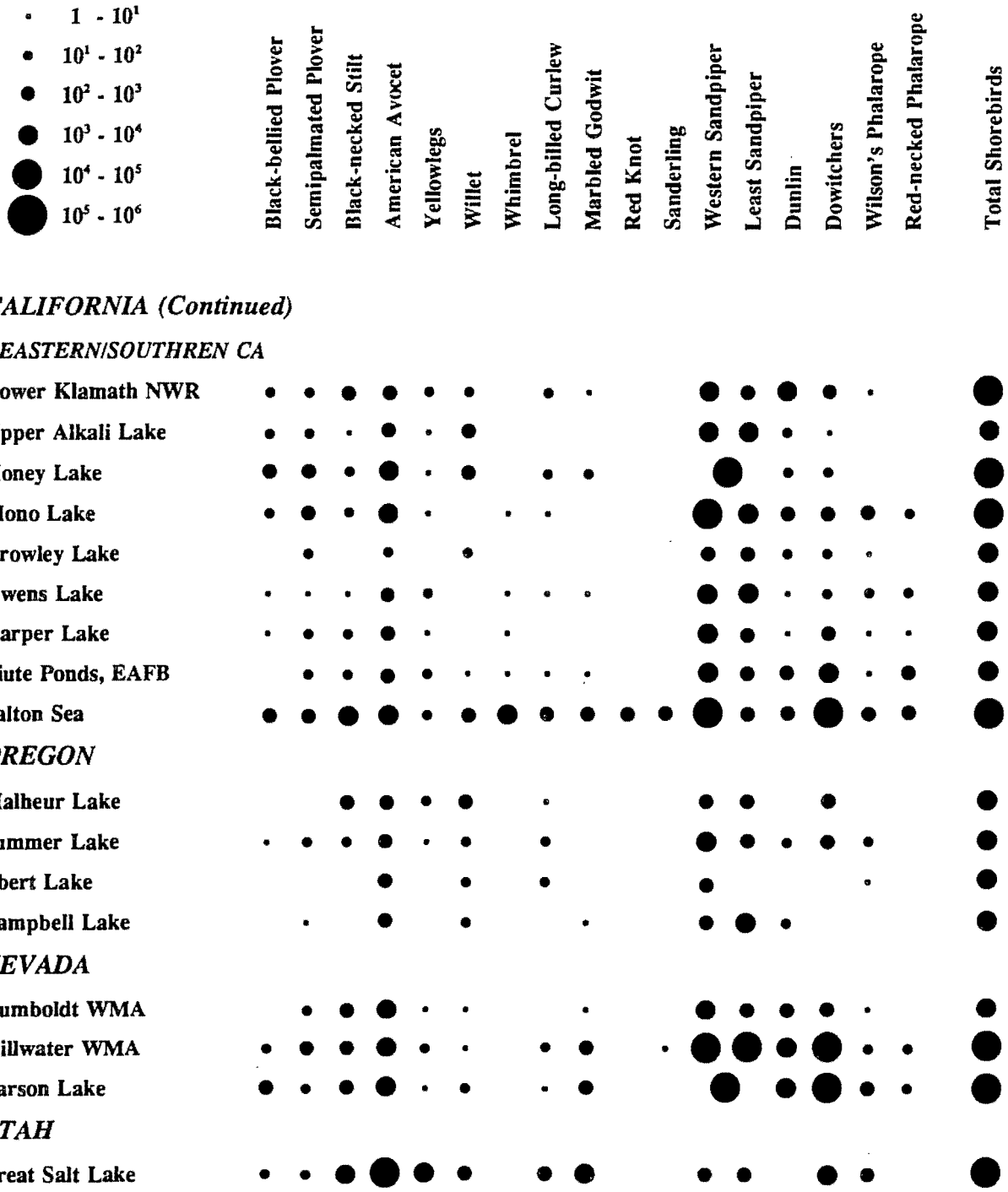


Figure 3: Fall shorebird abundance in coastal wetlands; more than 1000 birds.

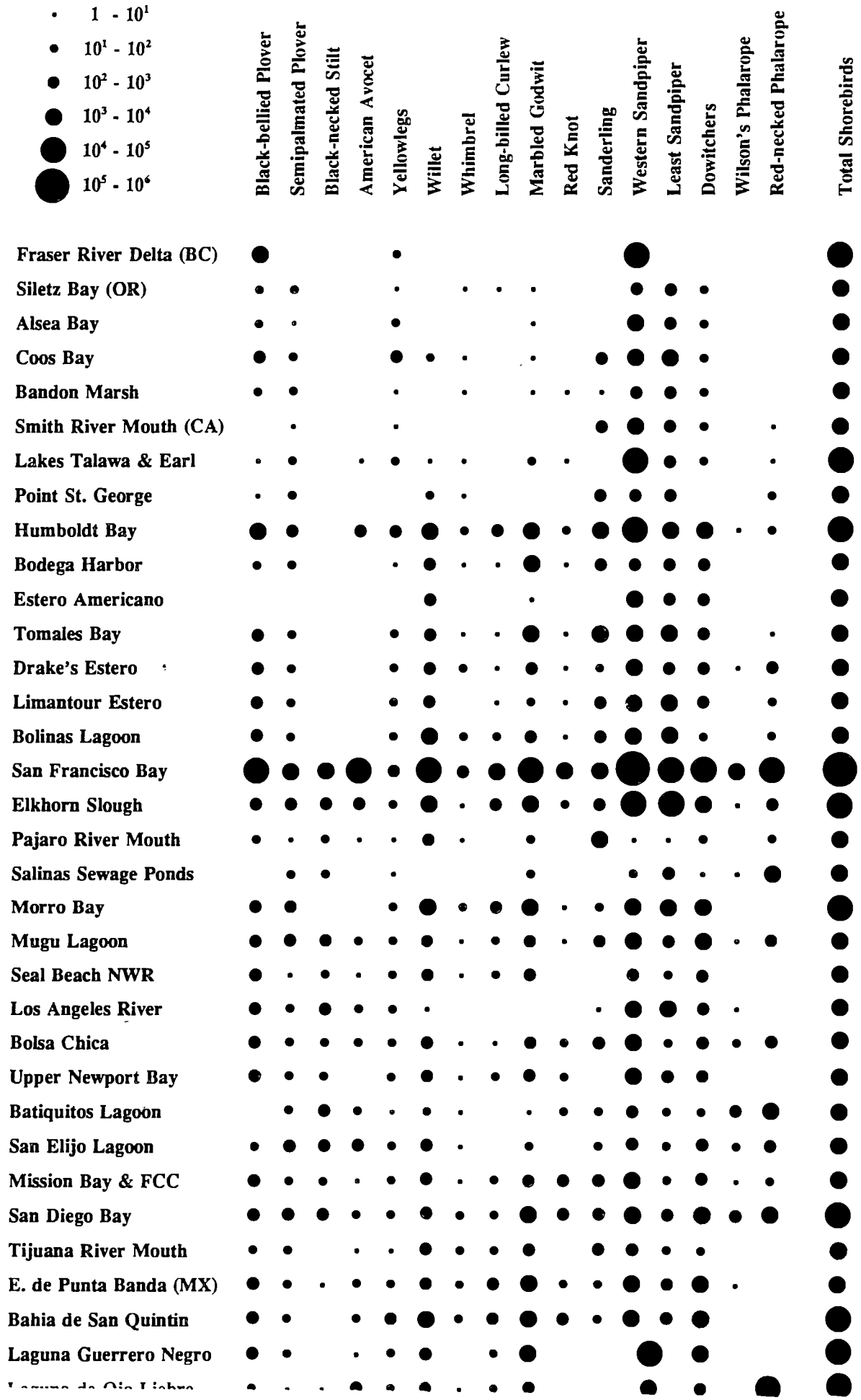


Figure 4: Fall shorebird abundance in interior wetlands; more than 1000 birds.

Figure 4 (Continued): Fall shorebird abundance in interior wetlands; more than 1000 birds.

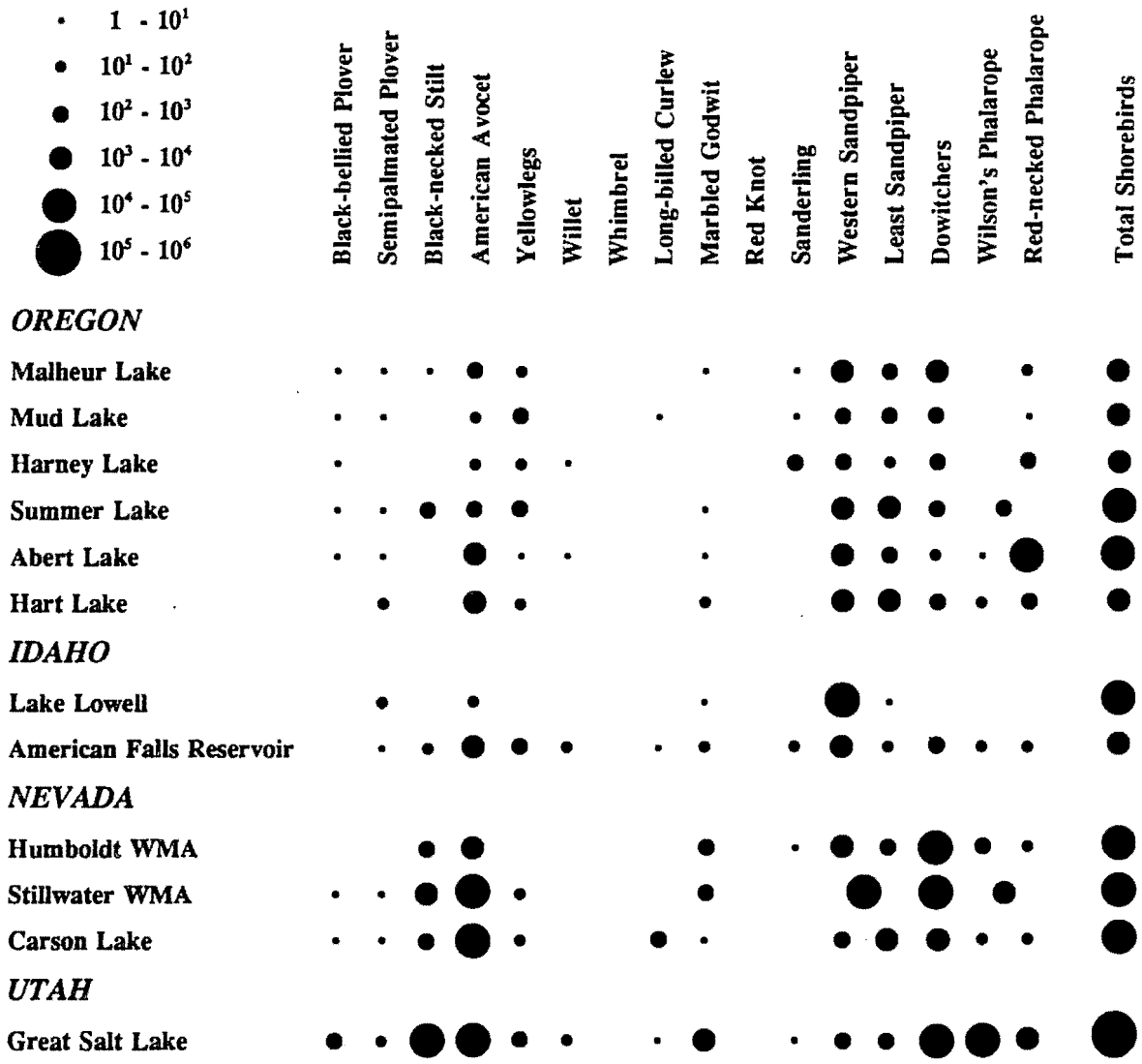
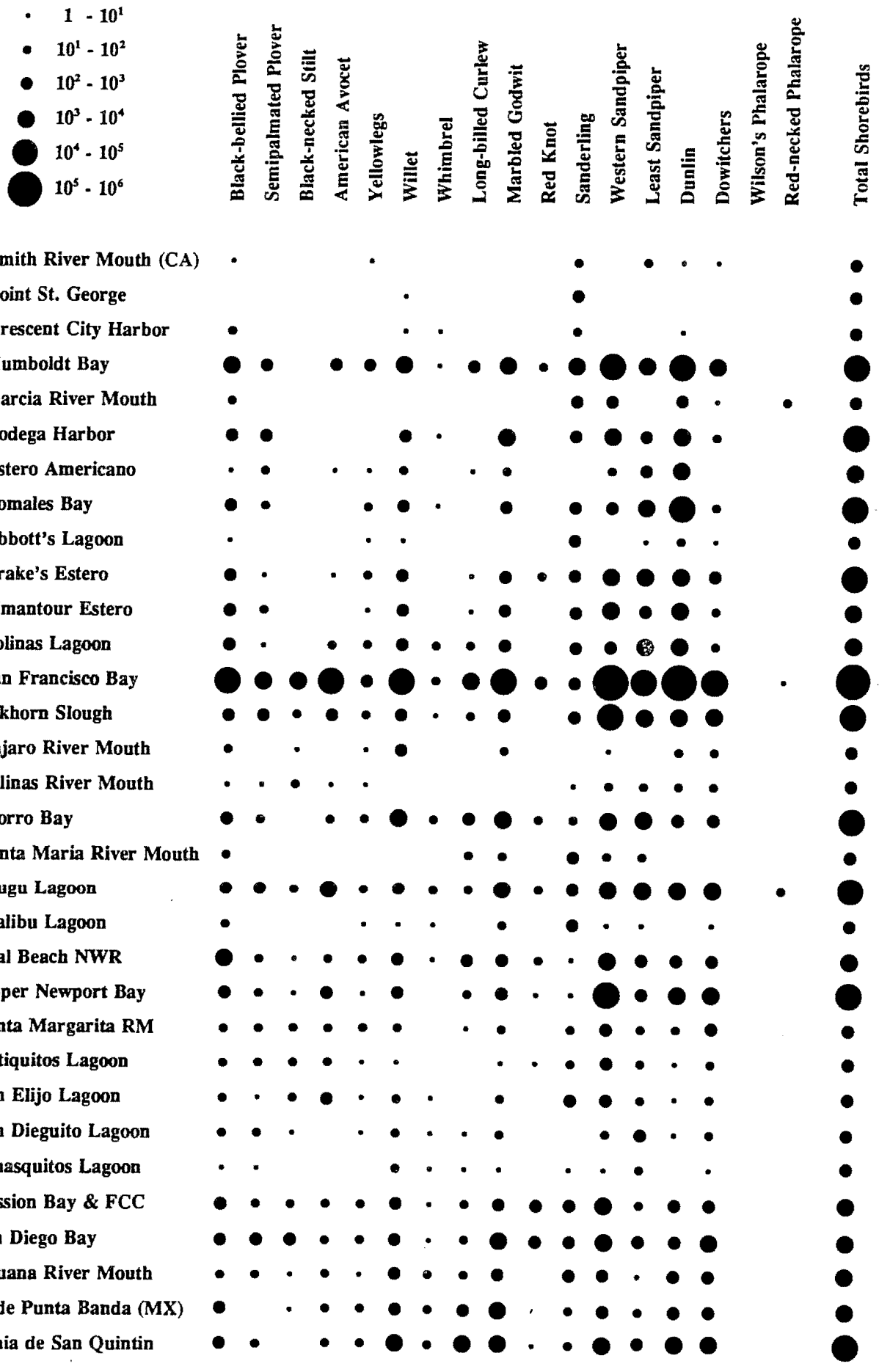


Figure 5: Winter shorebird abundance in coastal wetlands; more than 100 birds.



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