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NUMBERS OF WINTERING SHOREBIRDS IN COASTAL WETLANDS OF BAJA CALIFORNIA, MEXICO

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Abstract.—A paucity of information on shorebird regional population sizes and numbers in particular wetlands has precluded quantitative assessment of the effect of wetland loss on shorebirds. To address this, Point Reyes Bird Observatory organized a broad survey to quantify the importance of specific wetlands to wintering and migratory shorebirds in western North America. In wetlands along the west coast of Baja California, Mexico, 354,905 shorebirds were estimated present in winter based on ground and air surveys between January 1991 and January 1994. This compares to 500,000–575,000 for coastal California wetlands during the winters of 1990–1992. Western Sandpipers (*Calidris mauri*) made up 35.8%, Marbled Godwits (*Limosa fedoa*) 25.4%, dowitchers (*Limnodromus* spp.) 13.6%, Dunlins (*Calidris alpina*) 11.0%, Willets (*Catoptrophorus semipalmatus*) 4.7%, Black-bellied Plovers (*Pluvialis squatarola*) 3.7%, and 20 other species each less than 1.0% of the wintering shorebirds in the Baja California wetlands. The Laguna Ojo de Liebre/Guerrero Negro wetland complex held many more wintering shorebirds than any other Baja California site. When compared to other Pacific coast wetlands in the United States and Canada, it had the most wintering Marbled Godwits, was second (to San Francisco Bay) in total wintering shorebirds and Western Sandpipers, and was one of only three sites supporting several hundred wintering Red Knots (*Calidris canutus*). In comparison with coastal California, numbers of wintering American Avocets (*Recurvirostra americana*), Black-necked Stilts (*Himantopus mexicanus*), and Least Sandpipers (*Calidris minutilla*) were relatively low in western Baja California.

NUMEROS DE AVES PLAYERAS INVERNANDO EN LOS ANEGADOS COSTEROS DE BAJA CALIFORNIA, MEXICO

Sinopsis.—Una falta de información sobre los tamaños poblacionales regionales de las aves playeras en anegados particulares ha evitado analisis cuantitativos sobre la pérdida de áreas anegadas sobre estas aves. Para corregir esta situación, el "Observatorio de Aves de Point Reyes" organizó un estudio abarcador para cuantificar la importancia de anegados específicos sobre las aves playeras invernales y migratorias del oeste de Norte América. Se estimaron 354,905 aves playeras invernando en los anegados a lo largo de la costa oeste de Baja California, Mexico basándose en muestreos terrestres y en el aire entre enero del 1991 y enero del 1994. Esto es comparado con 500,000 a 575,000 en los anegados costeros de California

durante los inviernos del 1991–1992. Las aves playeras invernales en los anegados de Baja California incluyeron *Calidris mauri* con 35.8%, *Limosa fedoa* (25.4%), *Limnodromus* spp. (13.6%), *Calidris alpina* (11.0%), *Catoptrophorus semipalmatus* (4.7%), *Pluvialis squatarola* (3.7%), y otras 20 especies, cada una con menos del 1.0% del total de aves estimado. El complejo de anegados de la Laguna Ojo de Liebre/Guerrero Negro sostuvo muchas más aves playeras invernales que cualquier otra área estudiada en Baja California. Al compararlo con otros anegados costeros de la costa del Pacífico de los Estados Unidos de Norte América y del Canadá, se halló que tenía las mayor cantidad de *Limosa fedoa,* secundó a la Bahía de San Francisco en el total de aves playeras invernales y de *Calidris mauri,* y que era una de solo tres lugares sosteniendo varios cientos de individuos de *Calidris canutus.* Al compararle con la costa de California, los números de *Recurvirostra americana, Himantopus mexicanus* y *Calidris minutilla* resultaron relativamente bajos en la Baja California occidental.

Shorebirds are associated predominately with wetlands, particularly during the migrating and wintering phases of their annual cycle. When migrating and during winter, most shorebirds concentrate into much smaller areas of habitat than during the breeding season (Myers et al. 1987). Consequently, loss of wetlands at migratory staging sites and on the wintering grounds could have a pronounced affect on the size of shorebirds populations. During the past 150 years, humans have altered or destroyed a significant proportion of the native wetland in North America. However, due to a paucity of data on the relative importance of specific wetlands to migrating and wintering shorebirds, and the absence of information on regional and global shorebird population sizes, little can be deduced about the effect of these wetland losses on shorebirds (Page and Gill 1994).

A fundamental step toward the conservation and management of wetlands for the preservation of shorebird populations is an overview of how North, Central and South American wetlands function together to maintain current shorebird populations (Pitelka 1979, Senner and Howe 1984). We must identify which wetlands are important to each species of shorebird and link this knowledge with more extensive ecological studies to create a comprehensive overview of the relationship between shorebirds and their wetland environment.

In western North America the benefits of past studies of shorebird abundance in wetlands have been limited by their sporadic nature and restriction to one or a few sites (e.g., Colwell 1994, King et al. 1987, Page et al. 1979, Shuford et al. 1989, Storer 1951), or by a lack of complete coverage of individual sites when studies have extended over broader geographical areas (Jurek 1979). To overcome the limitations of previous studies, Point Reyes Bird Observatory (PRBO) initiated the Pacific Flyway Project, a broad surveying effort to identify the relative importance of specific sites within the western North American wetland system to wintering and migratory shorebirds.

Here we present the results of counts from one geographical region of the flyway, the west coast of Baja California. Except for Estero de Punta Banda (Palacios et al. 1991) and a survey of winter Sanderling numbers along the west coast (Schick et al. 1984), published information on shorebird occurrence in Baja California is limited mostly to anecdotal obser-

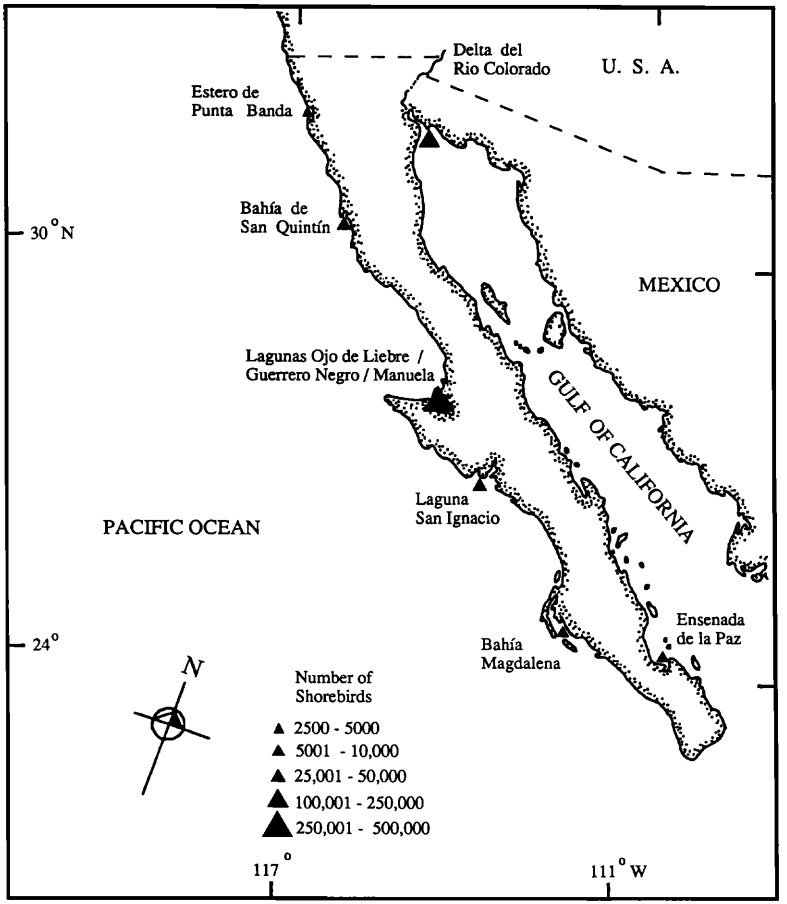

FIGURE 1. Map of Baja California with estimated numbers of wintering shorebirds during 1991–1993 for the major wetland complexes.

vations or generalized species accounts (Massey and Palacios 1994, Wilbur 1987).

STUDY AREA AND METHODS

Baja California is a 1600-km long, arid peninsula with little surface water at any season (Wilbur 1987). Our surveys were limited to the west coast where the five wetland systems of significance to shorebirds, from north to south, are: Estero de Punta Banda (2000 ha) near the city of Ensenada; Bahia San Quintin (12,000 ha), nearby salt ponds, and Laguna Figueroa; Lagunas Ojo de Liebre, Guerrero Negro, and Manuela (39,000 ha) about midway along the peninsula; the Laguna San Ignacio wetland complex (28,000 ha); and the Bahia Magdalena wetland complex (Massey and Palacios 1994, Fig. 1).

We relied heavily on aerial censuses to count shorebirds because much of the wetland habitat was inaccessible by road. Due to the high cost of aerial counts we also focused on the winter period when we were able to collect data on winter shorebird numbers by accompanying the U.S. Fish and Wildlife Service (FWS) aerial survey team during waterfowl counts. While flying with the FWS, we surveyed wintering shorebirds at the Bahia Magdalena and Laguna San Ignacio wetland complexes in January 1992, and in addition to these, at Lagunas Ojo de Liebre, Guerrero Negro and Manuela, and at Bahia San Quintin in January 1993.

Flight speed of the aerial surveys was about 190 km/h at an altitude of 50 m. Because surveys were conducted to maximize chances of observing Brant (*Branta bernicla*), the flight path was usually over water and not all suitable shallow-water habitat for shorebirds was covered. Counts of shorebirds were conducted by one observer from the right rear seat of the plane in 1992 but by observers on both sides in 1993. Consequently, shorebird numbers were likely underestimated more in 1992 than in 1993.

Ground counts of shorebirds were undertaken at four of the five wetland complexes. Following survey methods outlined by Stenzel and Page (1988), teams of volunteers covered Estero de Punta Banda from the ground on 17 Feb. 1991 and one or all of the following three locations: Bahia San Quintin (Q), associated salt ponds (P) and Laguna Figueroa (F) during 5–10 Jan. 1991 (Q), 25–27 Jan. 1992 (Q,P,F), 23–27 Nov. 1992 (Q,P), 24 Feb. 1993 (F), and 15 Dec. 1993 (F).

We conducted ground counts at the Laguna San Ignacio wetland complex from 26 Jan.–1 Feb. 1993 and at Lagunas Ojo de Liebre and Guerrero Negro from 11–22 Jan. 1994. At Laguna San Ignacio counting methods followed those of Stenzel and Page (1988), but were spread over several days due to its large size and the inaccessibility of several areas which had to be accessed by boat. The count covered potential shorebird habitat from Estero La Bocana to Estero El Datil, except for the shorelines of Islote Abaroa, Isla Ana and the southeastern 15 km of Punta Bronaugh. At Lagunas Ojo de Liebre and Guerrero Negro the ground count was focused on high tide shorebird roosts. We used boats to gain access to islands and areas of shoreline inaccessible by road. Counters estimated that they covered 80% of the shoreline and playas suitable for shorebirds. Because counts at Laguna San Ignacio or Ojo de Liebre/Guerrero Negro complexes did not include all barrier beach, species such as Snowy Plover (*Charadrius alexandrinus*) and Sanderling (*Calidris alba*) were likely under-counted.

In addition to our data, we also examined the following sources of information on shorebirds for the west coast of Baja: an aerial survey of the entire Baja coastline by Morrison et al. (1992) in January and February 1992; unpublished counts from mud flats and beaches at Estero de Punta Banda by Salvador Gonzalez in 1989 and 1990; unpublished counts supplied by Lee Tibbitts of the FWS for several sites in Lagunas Ojo de Liebre and Guerrero Negro between 16 Dec. 1992 and 21 Jan. 1993; and

unpublished sightings of R. LeValley from Bahia Magdalena in the 1970s and 1980s. We used the mean of the highest three winter observations of each species recorded by R. LeValley to estimate the relative proportion of each species by size group at Bahia Magdalena.

To compare the results of our surveys with those of others, we divided species into the same size classes (small, medium, and large) as Morrison et al. (1992). To estimate overall winter shorebird numbers for all Baja west coast wetlands, we used ground counts in preference to aerial counts even though this necessitated pooling data across more than one winter. We avoided using the less precise data from aerial counts and expected a reasonable estimate given relatively consistent numbers of wintering shorebirds at three of four sites between years (Table 1). We derived the regional totals in Table 1 from the following surveys: Estero de Punta Banda—the 17 Feb. 1991 ground census (Table 1); Bahia San Quintin wetland complex—26–27 Jan. 1992 ground surveys of Bahia San Quintin (Table 1), 27 Jan. 1992 ground survey of Laguna Figueroa (Table 2), and 26 Jan. 1992 ground survey of San Quintin Salt Ponds (Table 2); Ojo de Liebre/Guerrero Negro/Manuela wetland complex—January 1994 ground surveys of Lagunas Ojo de Liebre and Guerrero Negro (Table 1) and 22 Jan. 1993 aerial survey of Laguna Manuela (Table 2); Laguna San Ignacio wetland complex—January 1993 ground survey (Table 1); and Bahia Magdalena—January 1993 aerial survey (Table 1).

RESULTS

We estimated 354,900 wintering shorebirds in wetlands on the west coast of Baja California. Of these 79.1% were located in the Laguna Ojo de Liebre/Guerrero Negro wetland complex, 9.0% in the Bahia San Quintin complex, 8.9% in the Laguna San Ignacio complex, 2.2% in the Bahia Magdalena complex, and 0.8% in Estero de Punta Banda.

Lagunas Ojo de Liebre, Guerrero Negro, and Manuela complex.—Morrison et al. (1992) estimated 270,360 shorebirds here on a February 1992 aerial survey (Tables 1 and 2). Of these, 13.1% were large species, 7.1% medium, 67.2% small, and 12.6% species of undetermined size; however, only 33.6% of the large, 3.4% of the medium, and 0.3% of the small shorebirds were allocated to taxa.

Our January 1993, high-tide, aerial count of Lagunas Ojo de Liebre and Guerrero Negro, which excluded the extensive salt pond system and some shallow water regions of Laguna Ojo de Liebre, recorded 128,710 shorebirds (Table 1); 5,256 more were counted at Laguna Manuela (Table 2). Of these 133,966 shorebirds, 52.9% were large, 8.7% medium, and 38.4% small species. All medium, 83.6% of the large, and 1.0% of the small shorebirds, were allocated to taxa. Comparison of species composition at Lagunas Ojo de Liebre and Guerrero Negro between our January 1993 aerial survey and ground counts of L. Tibbitts and colleagues the same winter suggest counts from the air were less proficient than those from the ground at detecting the less numerous large species (Table 3). Among medium-size species, ground counts indicated higher proportions

TABLE 1. Winter shorebird numbers in major wetlands of the west coast of Baja California. See methods for definition of Regional Total.

	Punta Banda	Bahia San Quintin			Ojo de Liebra Guerrero Negro			Laguna San Ignacio				Bahia Magdalena			Regional Total
	Feb.[d] 1991	Jan. 1991	Jan.[d] 1992	Jan.[b] 1993	Feb.[a] 1992	Jan.[c] 1993	Jan.[d] 1994	Jan.[b] 1992	Feb.[a] 1992	Jan.[b] 1993	Jan.[d] 1993	Jan.[b] 1992	Feb.[a] 1992	Jan.[bd] 1993	
Black-bellied Plover	213	801	1032	73	135	170	10,762	36	48	219	709	39	41	139	13,238
Snowy Plover	57	198	272	0	0	0	664	0	0	0	419	0	0	0	1605
Wilson's Plover	0	0	0	0	0	0	87	0	0	0	83	0	0	0	170
Semipalmated Plover	0	12	6	0	0	0	673	0	0	0	409	0	0	0	1090
Killdeer	0	17	44	0	0	0	3	0	0	0	4	0	0	0	51
Mountain Plover	0	0	0	0	0	0	0	0	0	0	0	0	0	0	148
American Oystercatcher	0	0	0	0	0	15	64	0	0	0	39	0	11	0	103
Black-necked Stilt	3	0	0	0	0	0	117	0	182	0	1	0	0	0	237
American Avocet	54	92	71	44	640	0	753	0	200	0	364	0	0	0	1545
Greater Yellowlegs	50	62	116	0	1	21	334	9	1	17	1712	0	21	16	2232
Lesser Yellowlegs	18	2	5	0	0	0	0	0	0	0	0	0	0	0	40
Willet	300	3606	3513	2484	2318	13,022	9375	2378	1590	2577	1251	765	441	965	16,754
Wandering Tattler	0	0	6	0	0	0	0	0	0	0	0	0	0	0	6
Spotted Sandpiper	1	1	7	0	0	0	0	0	0	0	3	0	0	1	12
Whimbrel	97	15	83	1	11	1	141	0	2	2	35	1	25	13	370
Long-billed Curlew	179	1814	1293	252	35	544	671	1	17	29	615	0	3	62	2997
Marbled Godwit	1037	7800	7596	7306	7797	42,617	68,942	10,261	8206	7690	6419	2949	1181	4241	90,306
Ruddy Turnstone	40	48	67	0	0	0	665	0	0	0	31	12	0	0	823
Black Turnstone	0	39	22	0	0	0	5	0	0	0	0	0	0	0	27
Red Knot	0	3	29	0	170	0	1053	0	0	0	0	0	0	0	1082
Sanderling	91	37	61	0	463	0	1952	57	65	50	539	0	345	20	2880
Western Sandpiper	253	4514	7454	0	0	0	101,731	0	0	0	15,806	0	0	0	127,045
Least Sandpiper	80	479	496	0	0	0	811	0	0	0	467	0	0	0	2090
Dunlin	324	1586	1743	0	0	0	34,304	0	0	0	1855	0	0	0	38,887
Dowitcher	196	2890	3375	6775	140	10,106	42,239	20	0	2145	781	298	30	374	48,345
Red Phalarope	0	0	0	0	0	500	45	0	0	0	0	0	0	0	45
Unidentifed Small Sandpiper	0	0	0	4384	180,855	50,114	0	3437	4560	14,578	0	1727	1507	1967	2777
Medium Sandpiper	0	0	0	0	17,937	0	0	0	1531	0	0	0	613	0	0
Large Sandpiper	0	0	0	4330	23,403	11,600	0	0	0	0	0	0	300	0	0
Unidentified Shorebird	0	0	0	0	34,078	0	0	0	0	0	0	1412	0	0	0
TOTAL:	2993	24,016	27,291	25,649	267,983	128,710	275,391	16,199	16,402	27,307	31,542	7203	4518	7798	354,905

[a] Aerial censusing; source Morrison et al. 1992.
[b] Aerial census.
[c] Aerial census, coverage incomplete.
[d] Used for estimate of regional totals.

TABLE 2. Number of shorebirds in three samll wetlands on the west coast of Baja California.

	Laguna Figueroa			San Quintin Salt Ponds		Laguna Manuela	
	27 Jan.[c] 1992	15 Dec. 1993	24 Feb. 1993	26 Jan.[c] 1992	27 Nov. 1992	3 Feb.[b] 1992	22 Jan.[ac] 1993
Black-bellied Plover	280	686	35	43	80	6	60
Snowy Plover	193	192	0	0	7	—	—
Wilson's Plover	0	0	0	0	0	—	—
Semipalmated Plover	1	9	0	0	76	—	—
Killdeer	0	31	38	1	0	—	—
Mountain Plover	148	0	0	0	0	—	—
Black-necked Stilt	89	10	50	27	0	0	0
American Avocet	140	0	3	163	0	0	0
Greater Yellowlegs	4	0	0	0	1	0	0
Lesser Yellowlegs	17	0	0	0	0	0	0
Willet	181	1	105	171	0	458	998
Spotted Sandpiper	0	0	0	0	0	—	—
Whimbrel	0	0	0	1	0	15	0
Long-billed Curlew	0	1	0	120	0	46	57
Marbled Godwit	62	571	0	28	6	548	1981
Ruddy Turnstone	19	70	0	1	2	0	0
Sanderling	214	0	0	3	0	—	—
Western Sandpiper	1589	400	120	212	455	—	—
Least Sandpiper	49	40	0	187	13	—	—
Dunlin	461	7	0	200	1071	—	—
Dowitcher	28	234	0	2	21	200	1350
Unidentifed Small Sandpiper	0	0	0	0	0	450	810
Medium Sandpiper	0	0	0	0	0	630	0
Large Sandpiper	0	0	0	0	0	24	0
TOTAL	3475	2252	351	1159	1732	2377	5256

[a] Aerial census.
[b] Aerial census; source Morrison et al. 1992.
[c] Used for estimate of regional totals.

of all taxa except dowitchers, which made up 73% of the medium-size shorebirds on the ground counts and 98% on aerial counts. Ground counts showed that Western Sandpipers and Dunlins accounted for the majority (96.6%) of the small shorebirds. L. Tibbitts and colleagues also detected 640 American Avocets, 273 Black-necked Stilts and 492 Red Phalaropes (*Phalaropus fulicaria*) in the Ojo de Liebre salt ponds, which were not covered on the aerial count.

The most thorough count of Lagunas Ojo de Liebre and Guerrero Negro, conducted from the ground in January 1994, totalled 275,391 shorebirds (Table 1) with large species making up 29.1%, medium 20.0%, and small 50.9% of the total (Table 3); all were allocated to taxa. Marbled Godwits and Willets made up 97.8% of the large shorebirds, dowitchers and Black-bellied Plovers 96.2% of medium-size shorebirds, and Western Sandpipers and Dunlins 97.0% of the small species (Table 3). The January 1994 ground count of Lagunas Ojo de Liebre and Guerrero Negro

TABLE 3. Percent composition of wintering shorebirds by size class.

	Punta Banda	San Quintin complex	Ojo de Liebre/ Guerrero Negro			San Ignacio complex		Magdalena complex	
	A[a]	B	C	D	E	F	G	H	I
				LARGE					
American Oystercatcher	0.0	0.0	<0.1	0.4	0.1	0.0	0.4	0.0	0.3
Black-necked Stilt	0.2	0.9	0.0	*[b]	0.1	0.0	<0.1	0.0	0.0
American Avocet	3.2	2.8	0.0	*	0.9	0.0	4.2	0.0	0.0
Willet	18.0	28.5	23.2	19.2	11.7	25.0	14.3	18.3	24.4
Whimbrel	5.8	0.6	<0.1	0.3	0.2	<0.1	0.4	0.2	2.7
Long-billed Curlew	10.7	10.4	1.0	3.9	0.8	0.3	7.1	1.2	7.1
Marbled Godwit	62.1	56.8	75.8	76.3	86.1	74.7	73.6	80.3	65.4
				MEDIUM					
Black-bellied Plover	41.2	25.9	1.7	6.6	19.5	9.2	21.9	26.3	41.0
Mountain Plover	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Killdeer	0.0	0.9	0.0	0.0	<0.1	0.0	0.1	0.0	0.0
Greater Yellowlegs	9.7	2.3	0.2	2.6	0.6	0.7	52.9	3.0	9.9
Lesser Yellowlegs	3.5	0.4	0.0	*	0.0	0.0	0.0	0.0	0.0
Wandering Tattler	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ruddy Turnstone	7.7	1.7	0.0	1.3	1.2	0.0	1.0	0.0	12.0
Black Turnstone	0.0	0.4	0.0	0.0	<0.1	0.0	0.0	0.0	0.0
Red Knot	0.0	0.6	0.0	16.1	1.9	0.0	0.0	0.0	1.9
Dowitcher	37.9	65.0	98.1	73.3	76.7	90.1	24.1	70.7	35.1
				SMALL					
Snowy Plover	7.1	3.5	—	0.7	0.5	—	2.1	—	0.9
Wilson's Plover	0.0	0.0	—	0.3	0.1	—	0.4	—	0.3
Semipalmated Plover	0.0	0.1	—	0.6	0.5	—	2.1	—	0.4
Spotted Sandpiper	0.1	0.1	—	0.0	0.0	—	<0.1	—	0.1
Sanderling	11.3	2.1	—	0.4	1.4	—	2.8	—	7.4
Western Sandpiper	31.4	70.4	—	65.4	72.5	—	80.7	—	44.3
Least Sandpiper	9.9	5.6	—	1.4	0.6	—	2.4	—	5.9
Dunlin	40.2	18.3	—	31.2	24.5	—	9.5	—	40.6
Red Phalarope	0.0	0.0	—	0.0	<0.1	—	0.0	—	0.1

[a] Source: A, February 1991 census; B, January 1992 census of Bahia San Quintin, salt ponds and Laguna Figueroa; C, January 1993 aerial survey of Lagunas Ojo de Liebre and Guerrero Negro; D, December/January ground counts of Lagunas Ojo de Liebre and Guerrero Negro; E, January 1994 ground count of Lagunas Ojo de Liebre and Guerrero Negro; F, January 1993 aerial count of Laguna San Ignacio complex; G, January 1993 ground count of Laguna San Ignacio complex; H, January 1993 aerial count of Bahia Magdalena complex; I, derived from R. LeValley's observations (see Methods).

[b] * indicates the presence of a species in relatively small numbers in a region of the complex that was not sampled for species composition.

(Table 1) was combined with the January 1993 aerial count of Laguna Manuela (Table 2) for an overall estimate of 280,647 wintering shorebirds for this wetland complex.

Bahia San Quintin complex.—January 1992 surveys were the basis for

the 31,925 shorebirds estimated for this wetland complex. Of these, 85.5% were in Bahia San Quintin (Table 1), 3.6% in nearby salt ponds (Table 2), and 10.9% at Laguna Figueroa (Table 2). Divided by size, 42.4% of the total were large species, 16.4% medium-sized species, and 41.2% small species. Marbled Godwits, Willets, and Long-billed Curlews (*Numenius americanus*) made up 95.7% of the large species, dowitchers and Black-bellied Plovers 90.9% of medium species, and Western Sandpipers and Dunlins 88.7% of small species (Table 3). Shorebird numbers at Bahia San Quintin varied from 24,016–27,291 on three January counts (Table 1) and totalled 27,804 on one November 1992 count (PRBO, unpubl. data). Numbers at the salt ponds varied from 1159–1732 on two winter counts (Table 2) and at Laguna Figueroa from 351–3475 on three winter counts (Table 2).

Laguna Figueroa was the only location with Mountain Plovers (*Charadrius montanus*) on our surveys. The 148 we counted there on 27 Jan. 1992 and a subsequent sighting of at least 115 on 9 Jan. 1996 (S. Howell and S. Webb, unpubl. data) suggest Laguna Figueroa is one of the most important wintering locations in Baja California for this declining species.

Laguna San Ignacio complex.—The 31,542 wintering shorebirds attributed to this wetland complex were from the January 1993 ground survey (Table 1); size composition of the shorebirds was 27.7% large, 10.3% medium, and 62.1% small species. Marbled Godwit, Willet, and Long-billed Curlew accounted for 95.0% of the large shorebirds; Greater Yellowlegs (*Tringa melanoleuca*), dowitchers, and Black-bellied Plovers 98.9% of the medium ones; and Western Sandpipers and Dunlins 90.2% of the small ones. Comparison of our ground survey with our aerial survey in January 1993 suggested that Long-billed Curlews, American Avocets, Greater Yellowlegs, and Black-bellied Plovers, in particular, were undercounted on the aerial survey (Tables 1 and 3). Shorebird totals on two aerial counts of this wetland complex in January and February 1992 were 11,000–15,000 birds fewer than the two January 1993 counts (Table 1), variation possibly due to differences in counting methods. Although Red Knots were not recorded on any aerial or ground counts (Table 1), the 23–26 seen there during a reconnaissance visit on 21–22 Jan. 1992 indicate some occur there some winters.

Bahia Magdalena complex.—Total shorebirds varied from 4518–7798 on three aerial surveys (Table 1). Using the highest and probably the most complete count (January 1993, see Methods) for our regional estimate (Table 1), 67.7% of the shorebirds were large, 6.8% medium and 25.5% small species. Based on the January 1993 aerial count and earlier observations of R. LeValley (pers. comm.), large shorebirds appeared to be at least 90% Marbled Godwits and Willets, medium shorebirds at least 76% dowitchers and Black-bellied Plovers, and small species at least 85% Western Sandpipers and Dunlins (Table 3).

Estero de Punta Banda.—We estimated 2993 wintering shorebirds for Estero de Punta Banda (Table 1). Large species made up 55.8% of the total, medium ones 17.3%, and small ones 26.9%. Marbled Godwits, Wil-

lets, and Long-billed Curlews accounted for 90.8% of the large shorebirds; Black-bellied Plovers, dowitchers, and Greater Yellowlegs for 88.8% of the medium shorebirds; and Dunlins, Western Sandpipers, Sanderlings, and Least Sandpipers for 92.8% of the small shorebirds. More shorebirds likely winter here than our February 1991 survey indicated. N. Warnock (unpubl. data) reports 4000 Western Sandpipers in October and November 1994, 2000 in December 1994 and about 1500 in January and February 1995; at least 400 Least Sandpipers in November and December 1995; and 110 Snowy Plovers on 16 November 1995. Noting 47 Red Knots at this location on 22 Feb. 1992, Unitt et al. (1995) suggest this species might be a regular winter visitor at Punta Banda. Red Knots may not occur here every winter. We failed to find them on our February 1991 count and S. Gonzalez (unpubl. data) did not find them on any of 11 winter counts between 25 Nov. 1989 and 24 Feb. 1990 even though 152 had been present as late as 18 Nov. 1989 (S. Gonzalez unpubl. data). N. Warnock (pers. comm.) found them at Estero de Punta Banda during winter in 1994 and 1995, including 150–200 on 7 Jan. 1996.

Estimated winter total for west coast wetlands.—Of the estimated 354,905 wintering shorebirds in wetlands along the west coast of Baja, 35.8% were Western Sandpipers, 25.4% Marbled Godwits, 13.6% dowitchers, 11.0% Dunlins, 4.7% Willets, and 3.7% Black-bellied Plovers (Table 1). The remaining 20 species were each represented by fewer than 3000 (<1.0%) individuals. The coastal regions containing the five wetland complexes we studied accounted for 97% of the 304,529 wintering shorebirds tallied by Morrison et al. (1992) for the entire west coast of Baja California in 1992. The coastal species most overlooked by our focus on wetlands was likely the Sanderling which concentrates on sandy beaches. We estimated only 2880 for the wetlands (Table 1). For the entire shoreline of Baja's west coast Morrison et al. (1992) tallied 3974 on their February 1992 aerial survey and Schick et al. (1984) 10,260 on a December 1983 aerial survey.

DISCUSSION

The wetland complex of Lagunas Ojo de Liebre and Guerrero Negro holds far more wintering shorebirds than any other site along the west coast of Baja California (Table 1). This may be due to several factors including the large size of the wetland system, extensive intertidal flats without mangroves, and a large salt evaporation pond system. The relatively low numbers at Bahia Magdalena stand in contrast to its large size. The tidal flats at Bahia Magdalena are limited in size, invaded by mangroves, and very sandy. This restricts the quantity or quality of available foraging habitat for shorebirds. Mangroves and sandy substrates are also prominent features of the wetlands at Laguna San Ignacio, but in contrast to Bahia Magdalena, there are also extensive sandy tidal flats at low tide. Additionally, large stretches of shallowly flooded playa may attract some of the smaller shorebirds and yellowlegs. Western and Least Sandpipers made up 1867 of 2243 shorebirds on two areas of playa in the complex and 1082 yellowlegs were located on another playa near Estero El Del-

gadito during our January 1993 ground count. At Bahia San Quintin there are extensive tidal flats at low tide and no mangroves.

The wetlands on the west coast of Baja California apparently support a larger wintering population of shorebirds than those on the east Baja coast. Although up to 163,000 shorebirds have been reported from the Gulf of California in winter (Mellink et al. 1997, Morrison et al. 1992), a large portion likely were in the State of Sonora; these cannot be considered as wholly belonging to the Baja California winter population. At Ensenada de La Paz, the only other wetland along the east coast of Baja with many shorebirds (Massey and Palacios 1994), 5700–7400 shorebirds were estimated present during the winters of 1992 and 1993 (E. Arvizu, G. Bravata, and G. Fernandez, unpubl. data).

Our estimated 354,905 wintering shorebirds for the wetlands of west coast of Baja California compares to 500,000–575,000 for the wetlands of the California coast during winter from 1990–1992 (PRBO, unpubl. data). Relative to winter numbers at other Pacific coast wetlands in the United States and Canada (PRBO, unpubl. data), only San Francisco Bay had higher winter shorebird numbers than Ojo de Liebre/Guerrero Negro. The Ojo de Liebre/Guerrero Negro complex had more wintering Marbled Godwits than any other site (followed by San Francisco Bay's 13,400–19,800), was the only site other than San Francisco Bay with as many as 100,000 wintering Western Sandpipers, and was one of only three sites (others are San Francisco and San Diego bays) supporting several hundred wintering Red Knots. Laguna San Ignacio had more Greater Yellowlegs during the January 1993 winter ground count than we have recorded during winter at any other site along the Pacific coast of the United States or Baja California (PRBO unpubl. data). The wetlands of Baja California Sur also supported moderate numbers of resident Wilson's Plovers (*Charadrius wilsonius*) and American Oystercatchers (*Haematopus palliatus*), two species essentially absent in Pacific coast wetlands north of Baja California Sur.

Some shorebirds were much less numerous in the coastal wetlands of western Baja California than in other regions of the Pacific coast of North America. American Avocets and Black-necked Stilts occurred in very low numbers along the west coast of Baja California compared to the central and southern California coast (PRBO, unpubl. data) and the east coast of the Gulf of California (Morrison et al. 1992; B. Harrington, unpubl. data; PRBO, unpubl. data). Wintering Least Sandpipers were also much less numerous in the wetlands of the west coast of Baja California than along the California coast (PRBO, unpubl. data).

Although 71% of the shorebirds we estimated to be wintering in the coastal wetlands of western Baja California are included in the vast Viscaino Biosphere Reserve, encompassing Lagunas Ojo de Liebre and San Ignacio, shorebirds receive little protection through this designation and proposed developments could alter shorebird abundance inside and outside the reserve in the future. Within the reserve, current plans to develop 18,130 ha at San Ignacio Lagoon into solar salt evaporation ponds

should increase foraging habitat for some species such as stilts, avocets, and phalaropes but possibly at the expense of species on the playa such as the Snowy Plover (Palacios et al. 1994). Outside the reserve, proposed development of the undeveloped western spit of Bahia San Quintin with shops, motels, houses and two golf courses, could reduce roosting and feeding habitat for some shorebirds. Our studies indicate the wetlands of Baja California support a sizeable population of wintering shorebirds in western North America. These wetlands should be protected for shorebirds and other aquatic organisms.

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