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Aerial surveys of Nearctic shorebirds wintering in mexico: preliminary results of surveys of the southern half of the Pacific coast, states of Chiapas to Sinaloa

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Abstract

Aerial surveys of the southern half of the Pacific coast of Mexico between the states of Chiapas and Sinaloa were carried out in February 1994 to determine the distribution and numbers of wintering Nearctic shorebirds, as the third and final year of a Mexican Shorebird Atlas project. A total of 530 595 shorebirds was observed during the surveys. Small shorebirds were the most abundant group (224 584), consisting principally of "peeps" (unidentified small shorebirds, mostly Western Sandpipers) (220 575) in areas with soft mudflats and Sanderlings (3479) on ocean beaches. Large shorebirds (203 634) were the second most numerous category and included significant numbers of American Avocets (127 599), Black-necked Stilts (47 087), Marbled Godwits (11 922), and Willets (9814). Amongst the medium-sized species (102 377), dowitchers (38 876) were most numerous; sightings of Red Knots suggest further work is needed to determine numbers wintering on the Pacific coast of Mexico.

Eight wetlands were identified as each supporting at least 20 000 shorebirds. The most important areas were the extensive wetlands associated with the Marismas Nacionales and the Laguna el Caimanero/Laguna el Huizache south of Mazatlan: each supported over 100 000 shorebirds and would qualify for inclusion in the Western Hemisphere Shorebird Reserve Network as an International site. These areas appeared to be especially important wintering areas for American Avocets. The coastal bay systems southwest of Culiacan supported significant numbers of shorebirds, especially Ensenada Pabellones (over 68 000), Bahia de Santa Maria (over 57 000), and Bahia la Guadalupana (over 20 000). Key wetland areas farther south on the coast included Mar Muerto (over 52 000) and Laguna Cuyutlan near Manzanillo (over 42 000). Laguna la Joya supported large numbers of American Avocets and Black-necked Stilts. Numbers of wintering shorebirds counted on both coasts of Mexico during the Mexican Shorebird Atlas project surveys between 1992 and 1994 totalled over 1.47 million.

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Resumen

Los censos aéreos de la mitad de la costa sur del Pacífico mexicano, entre los estados de Chiapas y Sinaloa, se llevaron a cabo en febrero de 1994 para determinar la distribución y cantidad de aves costeras neárticas que invernaban en esos predios, en el marco del tercer y último año del proyecto para la publicación del Atlas de Aves Costeras Mexicanas. Durante los censos, se observó un total de 530.595 aves costeras. El grupo más abundante estuvo compuesto por aves costeras de pequeño tamaño (224.584), y consistió primariamente en lavanderas, o aguzanieves (pequeñas aves costeras no identificadas, en su mayoría *Calidris mauris*) (220.575) en áreas de tierras bajas, inundadas por la marea alta; y *C. alba* (3.479), en playas. La segunda categoría más numerosa se componía de aves costeras grandes (203.634), y la misma incluía cantidades significativas de *Recurvirostra americana* (127.599), de *Himantopus mexicanus* (47.087), de *Limosa fedoa* (11.922) y de *Catoptrophorus semipalmatus* (9.814). Entre las especies de medio tamaño (102.377), *Limnodromus griseus* y *L. scolopaceus* (38.876) fueron las más numerosas; la observación de *Calidus canutus* sugiere la necesidad de seguir trabajando para determinar la cantidad de aves que invernan en la costa del Pacífico mexicana.

Se identificaron ocho humedales, cada uno sirviendo de habitat a por lo menos 20.000 aves costeras. Las áreas más importantes fueron los extensos humedales asociados con las Marismas Nacionales y las lagunas el Caimanero y el Huizache, al sur de Mazatlán: cada uno de estos humedales sirve de habitat a mas de 100.000 aves costeras y, asimismo, cada uno reúne los requisitos para ser clasificado como Sitio Internacional de la Red de Reservas de Aves Costeras del Hemisferio Occidental. Estas áreas parecían ser especialmente importantes como áreas de invernación para *R. americana*. Las bahías a lo largo de la costa suroccidental de Culiacán servían de habitat a cantidades significativas de aves costeras, especialmente en el caso de la Ensenada Pabellones (más de 68.000), Bahía de Santa María (más de 57.000), y Bahía la Guadalupana (más de 20.000). Areas de humedales principales, situadas más al sur de la línea costera, incluyeron el Mar Muerto (más de 52.000) y la laguna Cuyutlán, cerca de Manzanillo (más de 42.000). La laguna la Joya servía de habitat a grandes cantidades de *R. americana* y de *H. mexicanus*. La cantidad de aves costeras que invernaban en ambas costas mexicanas durante los censos realizados en el marco del proyecto del Atlas de Aves Costeras Mexicanas, entre 1992 y 1994, alcanzó un total de 1.470.000.

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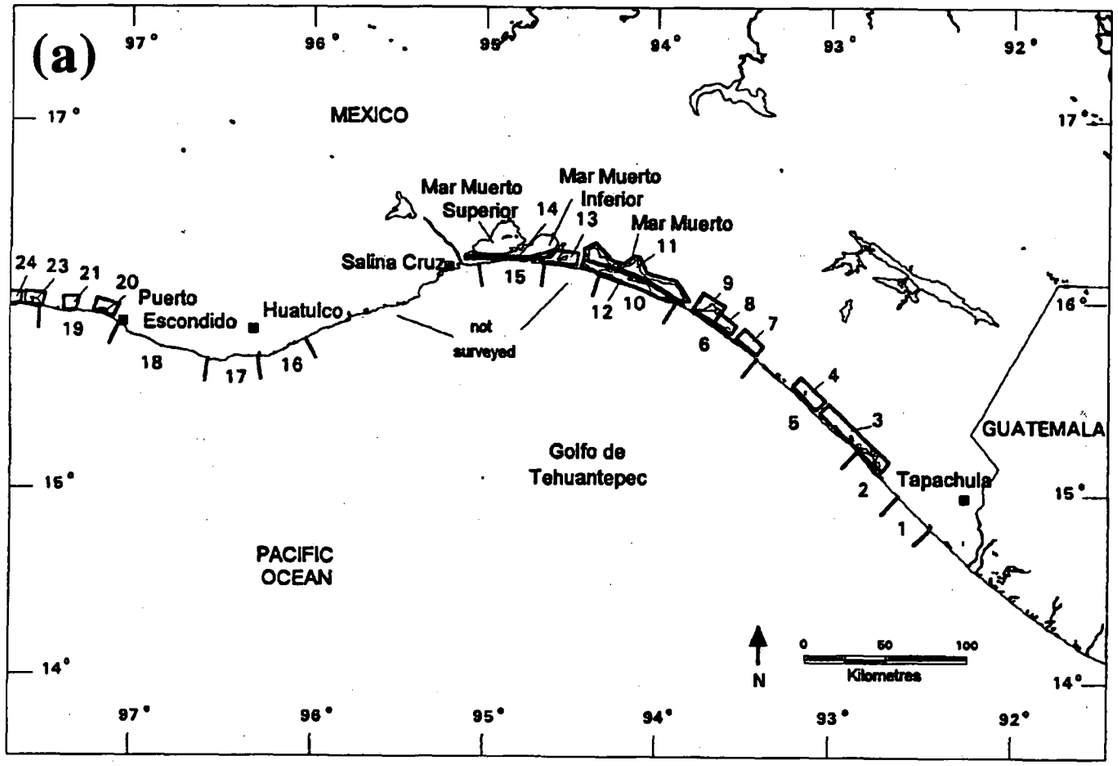
Figure 1
Survey zones and coverage during aerial surveys for shorebirds along the southern half of the Pacific coast of Mexico in February 1994: coverage is shown working northwards in Figures 1(a) through 1(d)

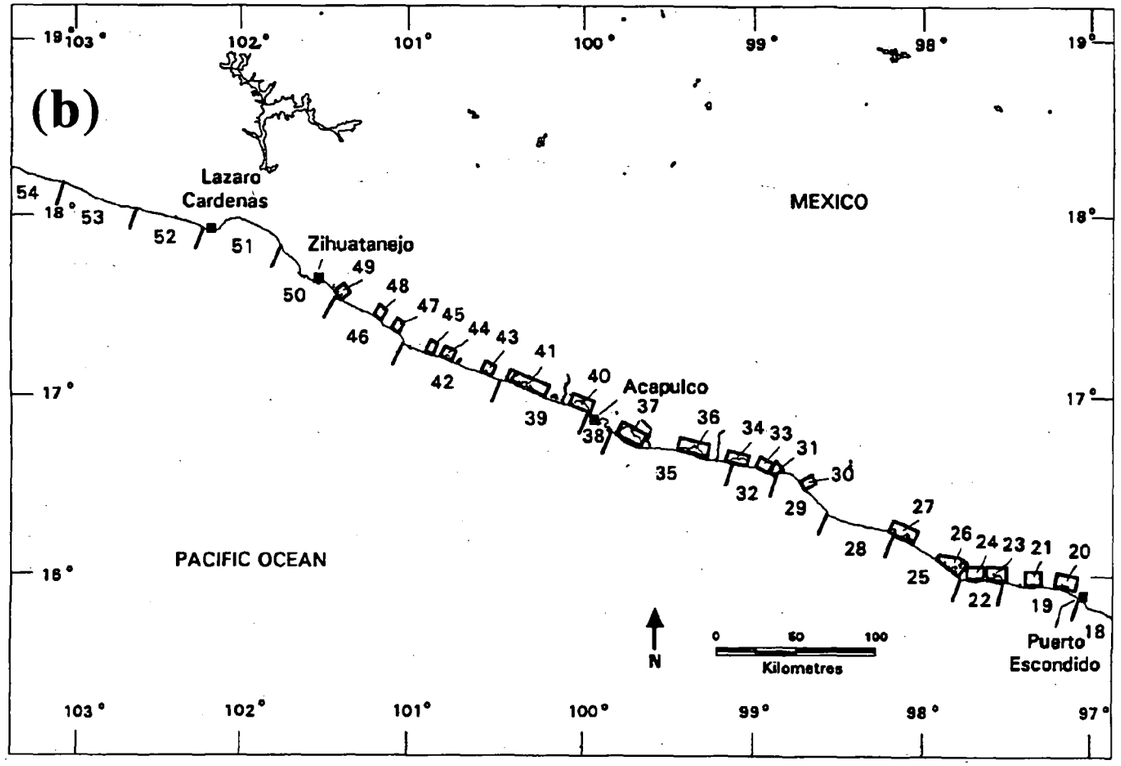


Introduction

The extensive coastal zone of Mexico contains a number of wetlands that support internationally important concentrations of waterfowl (Scott and Carbonell 1986) and shorebirds (Morrison et al. 1992, 1993). Whereas information on ducks, geese, and Neotropical water birds has been collected for many years in Mexico (see references in Scott and Carbonell 1986 and unpublished U.S. Fish and Wildlife Service reports), few data have been available until recent years on populations of Nearctic shorebirds either wintering in or migrating through these areas (Harrington 1992, 1993, 1994; Morrison et al. 1992, 1993; Page and Palacios 1993). The Mexican Shorebird Atlas project was designed as a three-year program to obtain knowledge of the wintering distribution of shorebirds on the coastline of Mexico, a key requirement for future conservational planning. The project is being carried out under the Canada/Mexico/USA Tripartite Agreement and is part of the Canadian Wildlife Service's (CWS) Latin American Program. The first two years of the study involved surveys of the Pacific northwest region of Mexico in 1992 (Morrison et al. 1992) and of the Gulf of Mexico/Caribbean coasts in 1993 (Morrison et al. 1993). This report presents preliminary results of the third and final year of the project, involving aerial surveys of the southern half of the Pacific coast from the border with Guatemala to the state of Sinaloa.

Results from the Mexican Shorebird Atlas project are intended for use in conservation planning and for the future development of the Western Hemisphere Shorebird Reserve Network. Distributional studies of shorebirds in South America (Morrison and Ross 1989) and in North America (Morrison and Myers 1989; Morrison 1992; Page et al. 1992) have shown that many species using coastal wetlands concentrate to a remarkable degree both during the winter and on migration. These studies led directly to the concept and development of the Western Hemisphere Shorebird Reserve Network, which seeks to protect all the key sites used by the birds throughout their annual cycle and thus to maintain the integrity of the system of habitats upon which the birds depend for their survival. While different conservation strategies may need to be designed for species that follow interior continental migration routes and that depend on more ephemeral habitats (Skagen and Knopf 1993), continued development of the Western Hemisphere Shorebird Reserve Network will be needed to ensure the future of populations depending on resources found at coastal locations.

Figure 1 *(cont'd)*
Survey zones and coverage during aerial surveys for shorebirds along the southern half of the Pacific coast of Mexico in February 1994: coverage is shown working northwards in Figures 1(a) through 1(d)

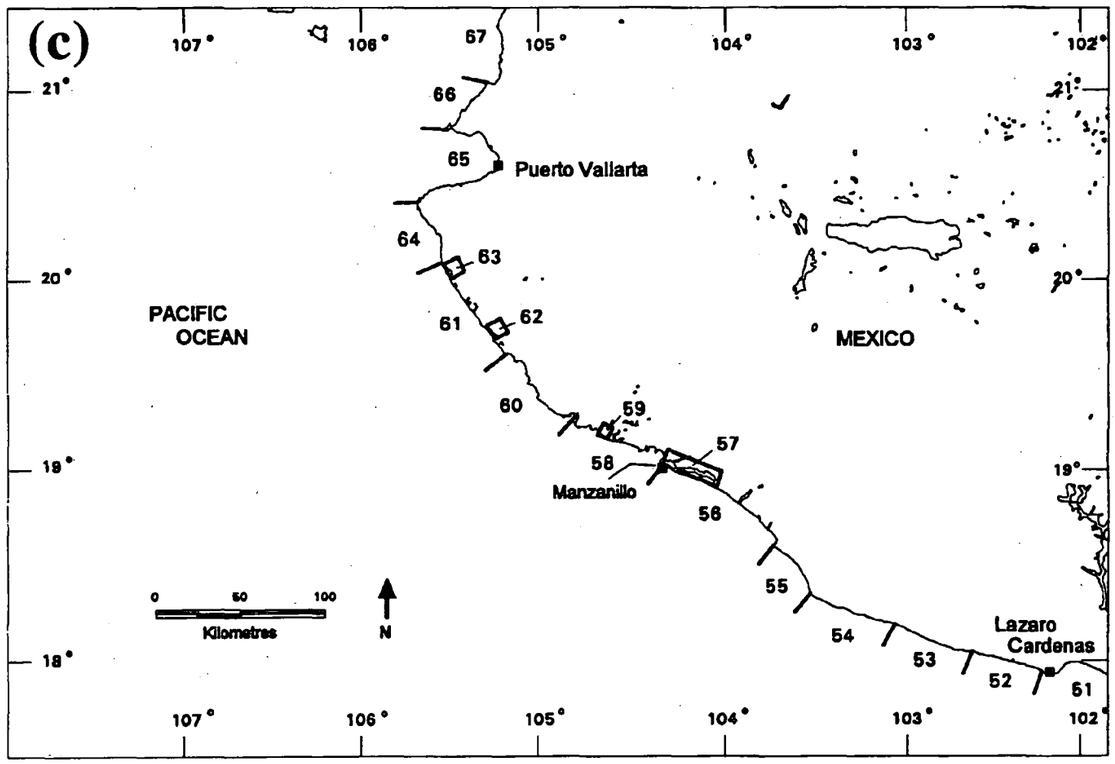


Methods

Aerial surveys of the Gulf of Mexico and Caribbean coastlines of Mexico were carried out from 12 to 19 February 1994. Flight itineraries and conditions are shown in Table 1. Survey procedures followed those used in previous surveys in South America and Mexico (Morrison and Ross 1989; Morrison et al. 1992, 1993). Surveys were conducted in a Cessna 182 fixed-wing aircraft flying at approximately 40–50 m above ground level and at an airspeed of 160–240 km/h, depending on the densities of shorebirds being encountered and the circuitousness of the flight path. The flights followed a line roughly 25 m offshore from the water's edge, with the two principal observers (RIGM and RKR) looking inland from the co-pilot's seat and the seat behind, respectively. All shorebirds seen were counted and observations recorded directly onto audio cassettes for later transcription. The third observer (JG) counted shorebirds and other species of interest, made habitat descriptions, and/or alerted the principal observers to groups of shorebirds that flushed to the left of the aircraft. Every effort was made to cover all habitats, including lagoons, that were appropriate for those shorebirds that forage on muddy substrates or in the intertidal zone. Flights were carried out between 09:15 and 17:30 local time in order to avoid glare caused by low sun angle (see Table 1).

Numbers of shorebirds were determined by direct counting when flocks were small or by visual estimation when larger concentrations were encountered. Identifications were made at the species level wherever possible, although birds had to be assigned to size categories (Table 2) when viewing conditions and/or the size and diversity of the flocks did not allow some species to be identified. The aircraft's position throughout the survey was accurately determined through onboard GPS navigation equipment and by regular time checks at and between known geographical locations. For this report, the shoreline covered was divided into 98 zones (Fig. 1, Table 3), each composed of a number of smaller sectors (total 163), to facilitate analysis. Sectors generally represent units of reasonably homogeneous habitat (e.g., sandy beach, estuarine mudflat, mangrove complex, etc.), usually bounded by obvious landmarks. Shorebird counts obtained by each principal observer were compared for each sector, and the higher counts for each species and/or size group were used in the analysis. Small, but occasionally important, differences in counts may have resulted when an observer was temporarily involved in navigation,

Figure 1 *(cont'd)*
Survey zones and coverage during aerial surveys for shorebirds along the southern half of the Pacific coast of Mexico in February 1994: coverage is shown working northwards in Figures 1(a) through 1(d)



photography, or equipment checks. Zone totals have not been rounded in tables or text in the present report.

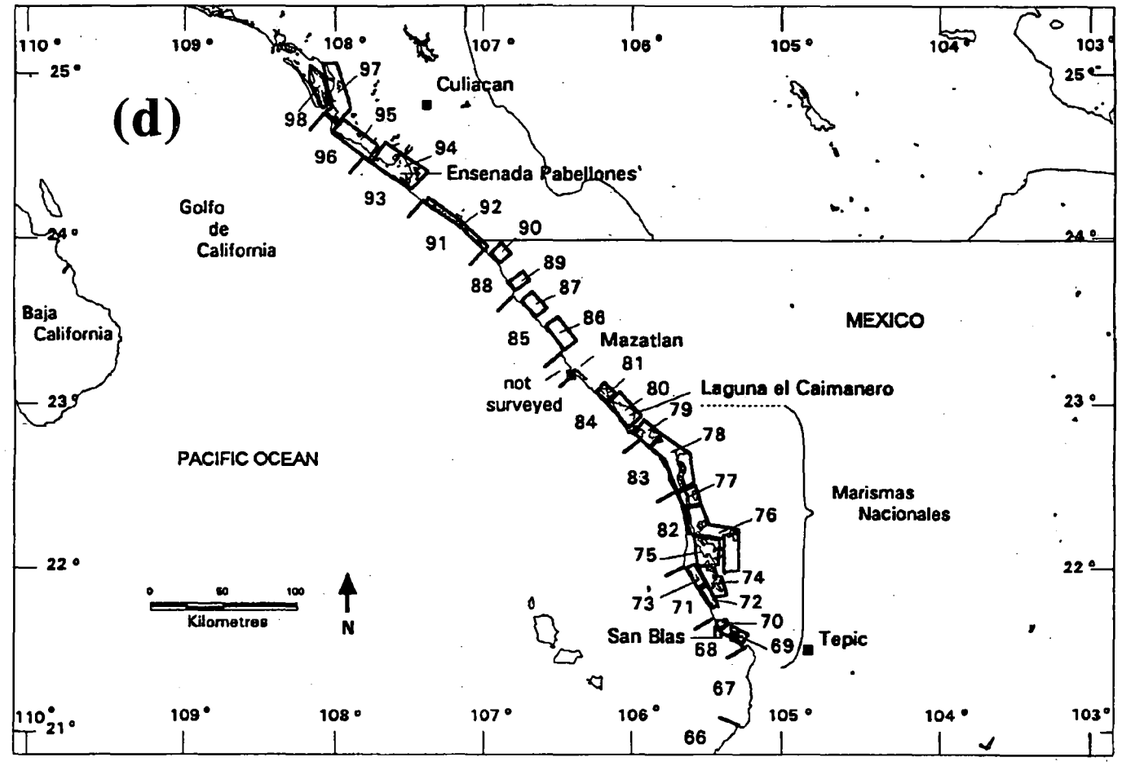
It was necessary to delay the planned survey schedule by several weeks owing to political unrest in southern Mexico. The timing, however, was still appropriate for coverage of the wintering period for shorebirds, and no indication of migration activity that might have obscured the results was observed during the surveys. Survey conditions were generally very good, with mostly clear weather and light to moderate onshore winds. The only exception occurred on 13 and 14 February in the Golfo de Tehuantepec, when high winds and extreme turbulence forced us to miss some areas, including Mar Muerto Superior, parts of Mar Muerto Inferior, and the coastline from Salina Cruz to Huatulco: this area is notorious for its windy conditions.

Results

A total of 530 595 shorebirds was observed during the surveys (Table 4), consisting of 224 584 small shorebirds (42.3%) (Table 5), 102 377 medium-sized shorebirds (19.3%) (Table 6), and 203 634 large shorebirds (38.4%) (Table 7).

Most shorebirds were concentrated in large coastal wetlands or lagoon systems, with the exception of Sanderlings (scientific names of species mentioned in the text may be found in Table 2), which were found on ocean beaches. Eight wetland areas each supported at least 20 000 shorebirds; two of these areas supported over 100 000 shorebirds (Table 8). These numbers meet the criteria for sites to qualify for inclusion in the Western Hemisphere Shorebird Reserve Network as Regional and International sites, respectively. Together, the eight areas supported a total of 469 083 or 88.4% of the shorebirds counted. When population turnover resulting from migration and other movements is taken into account, numbers of shorebirds using each site are likely to be much higher than the totals counted during the surveys. Composition of the size groups varied between the different wetlands, with large species being most numerous at four sites, small shorebirds at three sites, and medium-sized species at one site (Table 8), probably reflecting the habitat structure and food resources available in the different areas.

Figure 1 *(cont'd)*
Survey zones and coverage during aerial surveys for shorebirds along the southern half of the Pacific coast of Mexico in February 1994: coverage is shown working northwards in Figures 1(a) through 1(d)



Marismas Nacionales (zones 69–70, 72–79)
Laguna el Caimanero/Laguna el Huizache (zones 80–81)

To the south of Mazatlan are found the two lagoons of el Huizache and el Caimanero, followed by the very extensive Marismas Nacionales stretching south to approximately San Blas. Water levels in the two lagoons were fairly low during the surveys, uncovering enormous areas of mudflats around their borders. The Marismas Nacionales consist of vast complexes of lagoons, ponds, mangroves, mudpans, and other wetland habitats. These two areas together formed the most extensive tract of wetlands encountered on the southern half of the Pacific coast and held by far the largest numbers of shorebirds: 104 046 (19.6%) in the Marismas Nacionales and 100 702 (19.0%) in the lagoons, for a combined total of 204 748 (38.6% of the total). Both areas were especially important for large species, which made up the most numerous size category. Laguna el Caimanero was the single most important wintering area found for the American Avocet on the surveys (46 100, 36.1% species total), with substantial numbers also wintering in the Marismas Nacionales (32 500, 25.5%), so that the entire complex together supported 80 615 (63.2%) of the survey total of 127 599. Other prominent large species included the Marbled Godwit (5088, 42.7% in both areas) and Black-necked Stilt (7086, 15.0% in both areas). Medium-sized species were also fairly numerous: the most common category identified on the surveys involved dowitchers, with 8650 (22.3%) in the two areas. Dowitchers were also likely to have been common amongst the substantial number of unidentified medium-sized shorebirds (24 198, 47.3%) counted in the areas. The medium-sized total for these two areas also included 250 Red Knots. Large numbers of small sandpipers (peeps) were also found in both the lagoons (38 470, 17.4%) and Marismas Nacionales (35 544, 16.1%), accounting for some 33.6% (74 014) of the survey total.

Ensenada Pabellones (zone 94)

The Ensenada Pabellones is an extensive coastal inlet enclosed by the sandy Peninsula Lucenilla and contains large areas of mudflats, brackish marshes, and mangrove swamps. It is connected to the sea at the Boca la Tonina, to the north of which the Bahia Alteta forms a northern extension of the bay system. The total of 68 908 shorebirds consisted principally (69.3%) of peeps (47 765, 21.7% of peep total), the majority of which were found on the extensive mudflats on the inner parts of the bay. Amongst

the medium-sized shorebirds (11 868), dowitchers predominated (11 676, 30.0% of dowitcher total), again occurring mostly on mudflat habitats.

Bahia de Santa Maria (zones 97–98)

The Bahia de Santa Maria comprises a large, shallow saline bay enclosed by the 42-km-long Isla Altamura. It contains many islands, and there are extensive mudflats along the inner parts of the bay as well as many shallow flooded areas lying behind the bay proper. Flights in 1994 covered the southern parts of the bay that had not been surveyed in 1992 (Morrison et al. 1992), including the flats running south from La Reforma and the intertidal areas surrounding Isla Talchichitle, the largest island in the bay on the inner side of Isla Altamura. The total of 57 536 shorebirds consisted mostly of medium-sized (27 705) and small (19 883) species, most of which occurred on the large flats on the inner parts of the bay. Dowitchers were the most common medium-sized shorebird (9700, 25.0% dowitcher total), although a large number of unidentified medium-sized shorebirds were also recorded (17 670, 34.6% of category). Some 280 Red Knots were recorded in the area; although this species was not regularly identified, ground counts in 1992 (Morrison et al. 1992) suggested that knots may be dispersed amongst flocks of medium-sized shorebirds and probably are more numerous in the area than the survey totals suggest. Willets (2176, 22.2% species total) and Marbled Godwits (3438, 28.8% species total) were also fairly numerous.

Mar Muerto (zones 11–12)

The Mar Muerto is an extensive shallow lagoon enclosed by a low sandy peninsula with an opening to the sea at its eastern end. Large areas of open muddy habitat also occur at its western end towards Lago Cerritos. The area supported 52 749 shorebirds, most of which were small species (40 984). Extensive mudflats occur along the southern side of Mar Muerto, especially in the southwest corner, and most of the 40 895 peeps (18.5% peep total) were encountered in this area near Isla Potrerito and Isla Berlin. Mar Muerto was the most important area identified on the surveys for yellowlegs (7230, 74.2% yellowlegs total, mostly Lesser Yellowlegs).

Owing to extremely windy conditions, it was not possible to survey the nearby Mar Muerto Superior and parts of the Mar Muerto Inferior lagoons.

Laguna Cuyutlan, Manzanillo wetlands (zone 57)

Laguna Cuyutlan consists of a brackish coastal lagoon with large areas of open mud and mangrove swamps, lying between Manzanillo and Cuyutlan, separated from the sea by the barrier beach Playa Campos. Large shorebirds (22 920) were the most prominent group amongst the 42 029 shorebirds counted in the area, consisting principally of Black-necked Stilts (12 127, 25.8% species total) and American Avocets (10 440, 8.2% species total). Substantial numbers of peeps (15 370, 7.0% peep total) occurred on the open muddy areas of the lagoon.

Laguna la Joya (zone 9)

Laguna la Joya lies just to the east of Mar Muerto and consists of a shallow, slightly brackish lagoon with extensive mangrove stands on its southern side. Water levels vary considerably depending on local rainfall, and many areas of very shallow water were noted during surveys conducted under extremely windy conditions in February 1994. Large shorebirds (21 385) made up the bulk of the total of 22 586, with notable numbers of both American Avocets (11 800, 9.2% avocet total) and Black-necked Stilts (9580, 20.3% stilt total).

Bahia la Guadalupana (zone 92)

Bahia la Guadalupana consists of a narrow coastal estuary enclosed by the barrier beach Peninsula Quevedo just south of Ensenada Pabellones. The area supported 20 527 shorebirds, the most numerous of which were peeps (8500, 3.9% peep total), American Avocets (6401, 5.0% avocet total), and dowitchers (2975, 7.7% dowitcher total).

Small shorebirds (Table 5)

Small shorebirds were the most abundant group of shorebirds observed during the surveys, making up 224 584 (42.3%) of the total of 530 595. It was usually possible to distinguish Sanderlings from other small shorebirds during the surveys, as well as Spotted Sandpipers when encountered in small numbers away from large flocks of other shorebirds. Small plovers (likely species listed in Table 2) could be distinguished from small sandpipers on beach habitats where numbers encountered were small; however, in other habitats and where large concentrations of small shorebirds occurred, small plovers are likely to have been included in the general category of peeps.

Peeps. The most abundant peep occurring in large flocks in coastal wetlands and open or intertidal muddy habitats was probably the Western Sandpiper, although no ground checks were carried out during the present surveys. Least Sandpipers occur throughout the area, Dunlin may occur along coastlines bordering the Golfo de California in the northern part of the region, and Semipalmated Sandpipers may occur on the southern parts of the coast (Blake 1953; Edwards 1972; Hayman et al. 1986). Peeps may therefore have included some of these and other species listed in Table 2, although normally in considerably lower numbers than Western Sandpipers.

A total of 220 575 peeps was counted on the surveys, most occurring in coastal embayments or wetlands with extensive areas of open mud. The large bay systems near Culiacan in the state of Sinaloa (Ensenada Pabellones/Bahia Alteta, zones 94–95; Bahia de Santa Maria, zones 97–98; Bahia la Guadalupana, zone 92), the Marismas Nacionales (zones 69–70, 72–79)/Lagunas el Caimanero and el Huizache (zones 80–81), and parts of Mar Muerto (zones 11–12) held the largest numbers on the surveys, these areas supporting some 193 444 (87.7%) of the total.

Sanderling. A total of 3479 Sanderlings was observed during the surveys, considerably fewer than found on the Gulf of Mexico/Caribbean coasts (12 743) or in the Pacific northwest (6646) during previous Atlas surveys (Morrison et al. 1992, 1993). The species was widely distributed throughout the survey area, with few major concentrations. Sanderlings were found almost exclusively on ocean beaches and were most numerous along the coastline fronting the Marismas Nacionales (zones 68, 71, 82–84: 467, 13.4%), on the coast east of Puerto Escondido (zone 18: 421, 12.1%), and near Lazaro Cardenas (zones 51–52: 393, 11.3%).

Medium-sized shorebirds (Table 6)

A total of 102 377 medium-sized shorebirds was observed on the surveys, the least abundant (19.3% of overall total) of the three size categories. Medium-sized species were often difficult to identify from the air during the surveys, as they were in many cases encountered amongst large concentrations of other small and/or large shorebirds, resulting in a high proportion (51 139, 50.0%) being assigned to a general "unidentified medium-sized" category. Relatively few medium-sized species were found in wetlands in the southern parts of the area surveyed in 1994, with the majority occurring in the Marismas Nacionales (zones 69–70, 72–79: 22 963, 22.4%)/Lagunas el Caimanero and el Huizache (zones 80–81: 10 870, 10.6%) and bay systems south and west of Culiacan (zones 92, 94, 97–98: 43 474, 42.5%), especially Bahia de Santa Maria (zones 97–98: 27 705, 27.1%).

Black-bellied Plover. During the surveys, 1991 Black-bellied Plovers were identified. The species was widely distributed, occurring throughout the survey area. It was found in small numbers along ocean beaches, as well as in larger concentrations in wetlands and lagoons with firm muddy substrates. The highest numbers identified were in the Mar Muerto (zones 11–12: 520, 26.1%) and nearby Mar Muerto Inferior (zone 14: 305, 15.3%). The Marismas Nacionales (zones 69–70, 72–79) held a total of 371 (18.6%); Lago Nuxco (zone 44) was the only other wetland where over 200 Black-bellied Plovers were counted (220, 11.0%).

Yellowlegs. In total, 9748 yellowlegs were counted during the surveys; the total included both Greater and Lesser yellowlegs, although most yellowlegs seen were thought to be Lesser Yellowlegs. They occurred throughout the area surveyed, mainly in wetlands and lagoons lying behind the outer coast. By far the largest concentrations were observed in Mar Muerto (zones 11–12), where 7230 (74.2% of the total) occurred.

Red Knot. Discrete flocks of Red Knots were identified in two areas, Bahia de Santa Maria (zones 97–98: 280) and Marismas Nacionales (zone 77: 250). Observations in 1992 in the Bahia de Santa Maria indicated that Red Knots may be dispersed through flocks of dowitchers and other medium-sized shorebirds (Morrison et al. 1992), and it is possible, therefore, that totals of Red Knots were considerably higher than survey results indicated.

Dowitchers. Dowitchers were the most numerous of the medium-sized species, making up 38 876 (38.0%) of this category, and it is likely that many of the 51 139 unidentified medium-sized shorebirds were also dowitchers. Although small numbers were found on many of the smaller lagoons with muddy borders throughout the survey area, the largest numbers were encountered in extensive wetland complexes such as the Marismas Nacionales and associated Lagunas el Caimanero/el Huizache (zones 69–70, 72–79, 80–81: 8650, 22.3%) and Laguna Cuyutlan near Manzanillo (zone 57: 2570, 6.6%) and in the large coastal embayments south and west of Culiacan, including Ensenada Pabellones (zone 94: 11 676, 30.0%), Bahia de Santa Maria (zones 97–98: 9700, 25.0%), and Bahia la Guadalupana (zone 92: 2975, 7.7%).

Large shorebirds (Table 7)

Large shorebirds made up the second most numerous category found on the surveys, with a total of 203 634 (38.4% of overall total). Large shorebirds were a prominent component of many of the coastal lagoons and wetlands, sometimes outnumbering peeps. American Avocets, Black-necked Stilts, Marbled Godwits, and Willets were the most common large shorebirds found in lagoons, and Willets and Whimbrels were also recorded regularly along ocean beaches. The size and relatively distinct appearance of many of the large species resulted in only a small proportion (5732, 2.8%) being recorded as unidentified; most instances occurred where large numbers of other shorebirds were encountered, making specific identification of all observed birds difficult.

American Oystercatcher. American Oystercatchers were quite widely distributed throughout the survey area, although they were recorded irregularly and only in small numbers (total 38). Most were seen along ocean beaches.

Black-necked Stilt. Black-necked Stilts (total 47 087) were common in brackish or freshwater wetlands throughout the entire area surveyed; some were also recorded in intertidal habitats around the Golfo de California. The most important areas supporting the species were Laguna Cuyutlan east of Manzanillo (zone 57: 12 127, 25.8%), Laguna la Joya east of Mar Muerto (zone 9: 9580, 20.3%), and the Marismas Nacionales and lagoons south of Mazatlan (zones 69–70, 72–81: 7086, 15.0%).

American Avocet. American Avocets were the most numerous species (127 599) identified amongst the large shorebirds. Avocets were found in open pans in wetlands some distance from the shore as well as in brackish coastal

habitats. Major concentrations occurred in the Lagunas el Caimanero and el Huizache (zones 80–81: 48 115, 37.7%) and Marismas Nacionales (zones 69–70, 72–79: 32 500, 25.5%) (combined total 80 615, 63.2%), and the wetlands of the Pacific northwest coast of Mexico would appear to be a major wintering area for the species. Avocets were widely distributed, however, with other significant concentrations in Laguna la Joya east of Mar Muerto (zone 9: 11 800, 9.2%) and Laguna Cuyutlan (zone 57: 10 440, 8.2%) near Manzanillo.

Marbled Godwit. The most important areas identified for the 11 922 Marbled Godwits counted on the surveys were the Marismas Nacionales/Lagunas el Caimanero and el Huizache (zones 69–70, 72–81: 5088, 42.7%) and the intertidal habitats in Bahia de Santa Maria (zones 97–98: 3438, 28.8%) and Ensenada Pabellones (zone 94: 1201, 10.1%). Although recorded throughout the area surveyed, the species was much less numerous south of Marismas Nacionales.

Whimbrel. Whimbrels (total 1408) were seen regularly throughout the area, mostly in small flocks along ocean beaches, although some occurred in coastal lagoons and bay systems. The largest concentrations were in the Marismas Nacionales (zones 69–70, 72–79: 244, 17.3%) and adjacent coastline (zones 68, 71, 82–84: 238, 16.9%).

Long-billed Curlew. Small numbers (total 34) of Long-billed Curlews were counted during the surveys. Most were seen in the bay systems southwest of Culiacan, with only two being recorded south of Laguna el Caimanero (zone 80).

Willet. The species (total 9814) was regularly observed in small numbers along ocean beaches throughout the survey area, with larger concentrations occurring in coastal lagoons and bay systems, usually in habitats with firm substrates. Areas with highest recorded numbers included Bahia de Santa Maria (zones 97–98: 2176, 22.2%) and Ensenada Pabellones (zone 94: 1261, 12.8%) in the northwest, Marismas Nacionales and lagoons south of Mazatlan (zones 69–70, 72–81: 1467, 14.9%), Laguna Tecomate (zone 36: 1410, 14.4%), and Mar Muerto/Lago Cerritos (zones 11–13: 1107, 11.3%) in the south.

Discussion

The present surveys have identified additional wetlands of international importance for shorebirds in Mexico. The most significant areas were the Marismas Nacionales and the two lagoons Laguna el Caimanero/Laguna el Huizache south of Mazatlan, both of which held over 100 000 shorebirds. The overall shorebird totals for these areas are broadly similar to totals counted on surveys by Lock (1990b) in 1990 and Harrington (1992) in 1992 and somewhat lower than those obtained by Harrington (1994) in 1994. These wetlands were especially significant as wintering areas for American Avocets, together holding over 80 000 avocets, with the Laguna el Caimanero alone supporting some 46 100. The areas were important for a variety of other species, including Marbled Godwits, Black-necked Stilts, Willets, dowitchers, and peeps. The bay systems southwest of Culiacan were also very important wintering areas for shorebirds, especially the Ensenada Pabellones and Bahia de Santa Maria, with over 68 000 and 57 000 shorebirds, respectively. Further ground studies would be valuable in Bahia de Santa Maria to assess further the species composition of the large numbers of unidentified medium-sized shorebirds counted on the surveys, especially as this category may be found to contain significant numbers of Red Knots (see above). It would also be useful to know the extent of wintering population movements between these bays and those found north to Los Mochis, which are also known to contain very substantial numbers of shorebirds (Morrison et al. 1992; Harrington 1992, 1993, 1994).

Shorebird concentrations were generally lower south of Marismas Nacionales, with the most important areas being the Mar Muerto, with over 52 000 shorebirds, and the wetland complexes of Laguna Cuyutlan near Manzanillo, with over 42 000 shorebirds. Surveys could not be conducted over all areas of Mar Muerto and the two adjacent areas Mar Muerto Inferior and Mar Muerto Superior owing to the persistent strong and very turbulent winds, a problem often encountered during aerial surveys in the area (Lock 1990a; D. Benning, pers. commun.). It is clear that Mar Muerto contains extensive habitat suitable for a wide variety of shorebird species, and further surveys in the area would be useful to complete documentation of shorebird usage. Many of the other smaller coastal lagoons found along the coast support moderate totals of shorebirds. Some, such as the Laguna la Joya, just east of Mar Muerto, hold substantial numbers of particular species, in this case American Avocets and Black-necked Stilts. In general, few shorebirds were found along the ocean beaches of the southern half of the Pacific coast: numbers of Sanderlings, for instance, were considerably lower than along beaches in the Pacific northwest or on the Gulf of Mexico/Caribbean coasts.

All of the wetlands listed in Table 8 would qualify for inclusion in the Western Hemisphere Shorebird Reserve Network, as either International or Regional reserves, where the criteria are that the area should support over 100 000 and 20 000 shorebirds — or 15% and 5% of a species' flyway population — respectively (Morrison et al. 1991). The numbers found on the present surveys represent minimum estimates of the numbers of shorebirds using an area, as many more birds will pass through the area during migration or as winter movements between areas occur. Aerial surveys also tend to underestimate the number of birds present. Further information on population turnover and on population sizes for different species would be needed to assess whether some sites might qualify as Western Hemisphere Shorebird Reserve Network Hemispheric sites, where the criteria are that the site should support at least 500 000 shorebirds or 30% of a flyway population.

Preliminary totals from the three years of Mexican Shorebird Atlas project surveys are shown in Table 9. Over 1.47 million shorebirds were counted on the surveys, of which a substantial majority were found on the Pacific coast (1.35 million, 91.5%), compared with the Gulf of Mexico/Caribbean coasts (125 000, 8.5%). The wintering population of 1.47 million shorebirds may be compared with those of 2.92 million for South America (Morrison and Ross 1989), 254 854 for Panama (R.I.G. Morrison, R.K. Ross, R.W. Butler, and F. Delgado, unpubl. data), 700 000 for coastal wetlands of the west coast of the United States and Canada (Page et al. 1992), and 119 000 for the central valley of California (Page et al. 1992). The surveys have demonstrated that Mexico contains wetlands of major international importance for wintering populations of shorebirds, especially (but not exclusively) in the Pacific northwest, as outlined in this publication and in Morrison et al. (1992, 1993).

Shorebird populations wintering in Mexico clearly not only involve different species compared with those wintering in South America but also differ in their size class composition. For instance, the majority of small sandpipers (peeps) wintering in Mexico are Western Sandpipers; in South America, on the other hand, Semipalmated Sandpipers are the most common species on the north coast, and White-rumped Sandpipers *Calidris fuscicollis* and Baird's Sandpipers *C. bairdii* predominate in southern regions. It would appear likely that Mexico supports a substantial portion of the world population of Western Sandpipers. Mexico also supports a much higher proportion of large species of shorebirds amongst its wintering populations than does South America. These mostly involve relatively short-distance migrants such as the American Avocet, Black-necked Stilt, Marbled Godwit, and Willet. The coastal wetlands of the Pacific northwest appear to be especially important for the American Avocet. Continued internationally based surveys will be needed for the future development of the Western Hemisphere Shorebird Reserve Network and the preservation of the coastal habitats on which Nearctic shorebirds depend.

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Table 1
Summary of information on 1994 aerial surveys along the southern half of the Pacific coast of Mexico

Date	Time	Coverage	Weather
12 February	10:30–14:45	Huatulco–Tapachula	Light north wind, clear, 30°C+
13 February	9:15–12:30	Tapachula–Huatulco	Initially light north wind becoming very strong from the northeast (>50 km/h) near Mar Muerto, scattered cloud, 30°C+
14 February	12:50–13:30	Huatulco–Puerto Escondido	Moderate southwest wind, clear, 28°C. Surveys east of Huatulco impossible owing to very strong winds
15 February	11:15–15:00	Puerto Escodido–Acapulco	Moderate southwest wind, clear, 30°C
16 February	10:50–12:00	Acapulco–lagoons–Acapulco	Light wind, clear, some haze, 30°C
	13:50–16:15	Acapulco–Zihuantanejo	Light wind, clear, 30°C
17 February	9:30–13:00	Zihuantanejo–Manzanillo	Light wind, clear, 30°C+
	13:45–17:15	Manzanillo–Tepic	Light wind, clear, 28°C
18 February	9:50–12:15	Tepic–Mazatlan	Light wind, clear, 25°C
	14:00–17:15	Mazatlan–Marismas Nacionales–Mazatlan	Light wind to calm, clear, 25°C
19 February	9:25–13:00	Mazatlan–Culiacan	Light wind, clear, 25°C
	15:00–17:30	Culiacan–Bahia de Santa Maria–Culiacan	Light wind, scattered clouds, 25°C

Table 2
Size categories of Nearctic shorebirds observed during the 1994 aerial surveys along the southern half of the Pacific coast of Mexico

Common name	Scientific name	Code[a]
Small		
Snowy Plover	*Charadrius alexandrinus*	SNPL
Wilson's Plover	*Charadrius wilsonia*	WIPL
Semipalmated Plover	*Charadrius semipalmatus*	SEPL
Spotted Sandpiper	*Actitis macularia*	SPSA
Sanderling	*Calidris alba*	SAND
Semipalmated Sandpiper	*Calidris pusilla*	SESA
Western Sandpiper	*Calidris mauri*	WESA
Least Sandpiper	*Calidris minutilla*	LESA
Pectoral Sandpiper	*Calidris melanotos*	PESA
Dunlin	*Calidris alpina*	DUNL
Medium-sized		
Black-bellied Plover	*Pluvialis squatarola*	BBPL
Killdeer	*Charadrius vociferus*	KILL
Greater Yellowlegs	*Tringa melanoleuca*	GRYE
Lesser Yellowlegs	*Tringa flavipes*	LEYE
Wandering Tattler	*Heteroscelus incanus*	WATA
Ruddy Turnstone	*Arenaria interpres*	RUTU
Surfbird	*Aphriza virgata*	SURF
Red Knot	*Calidris canutus*	REKN
Stilt Sandpiper	*Calidris himantopus*	STSA
Short-billed Dowitcher	*Limnodromus griseus*	SBDO
Long-billed Dowitcher	*Limnodromus scolopaceus*	LBDO
Large		
American Oystercatcher	*Haematopus palliatus*	AMOY
Black-necked Stilt	*Himantopus mexicanus*	BNST
American Avocet	*Recurvirostra americana*	AMAV
Willet	*Catoptrophorus semipalmatus*	WILL
Whimbrel	*Numenius phaeopus*	WHIM
Long-billed Curlew	*Numenius americanus*	LBCU
Marbled Godwit	*Limosa fedoa*	MAGO

[a] Other codes: PEEP = small sandpipers, YELL = yellowlegs, DOW = dowitchers, PLOV = small plovers.

Table 3
Locations of zones during aerial surveys of the southern half of the Pacific coast of Mexico, February 1994

Zone No.	Area surveyed
1	Coast and coastal lagoons, Puerto Madero to Estero San Juan
2	Coast, Puerto Madero to Estero San Juan
3	Coastal wetlands and lagoons, Lago los Cerritos to Estero Castano
4	Coastal wetlands, Estero Buenavista to Estero Pereyra
5	Coast, Estero Chocohuital to Barra San Juan
6	Coast, Estero San Francisco
7	Lagunas Agua Tendida to Lago Buenavista
8	Lago Buenavista
9	Laguna la Joya
10	Coast, west of Mar Muerto
11	N. side Mar Muerto, E. end and islands
12	Estero Mar Muerto, S. side Mar Muerto
13	Lago Cerritos
14	Mar Muerto Inferior, S. shore
15	Coast, Mar Muerto Inferior
16	Coast, Santa Cruz to Playa San Agustin
17	Coast, Playa San Agustin to Punta Cometa
18	Coast, Punta Cometa to Puerto Escondido
19	Coast, Puerto Escondido to Cabo Hermoso
20	Laguna San Jose Manialtepec
21	Lago Lagartero
22	Coast, Cabo Hermoso to Rio Verde
23	Laguna Pastoria
24	Laguna Chacahija
25	Coast, Rio Verde to Laguna Corralero
26	Rio Verde/Lago Minuya
27	Laguna Corralero
28	Coast, Laguna Corralero to Punta Maldonado
29	Coast, Punta Maldonado to Punta Casa de Piedra
30	Rio Quetzala estuary
31	Estero Las Salinas
32	Coast, Punta Casa de Piedra to Laguna Chautengo
33	Estero El Icaco/Estero El Draguito
34	Laguna Chautengo
35	Coast, Laguna Chautengo to Acapulco
36	Laguna Tecomate
37	Laguna Tres Palos
38	Coast, Acapulco
39	Coast, Laguna Coyuca to Paraiso Perdido
40	Laguna Coyuca
41	Laguna Mitla
42	Coast, Paraiso Perdido to Playa Tlalcoyunque
43	Tetitlan wetlands
44	Lago Nuxco
45	San Luis estuary
46	Coast, Playa Tlalcoyunque to Punta el Potosi
47	Lago el Tular
48	Lago Salina el Cuajo
49	Lago el Potosi
50	Coast, Punta el Potosi to Punta los Organos
51	Coast, Punta los Organos to Lazaro Cardenas
52	Coast, Lazaro Cardenas to Chuquapan
53	Coast, Chuquapan to Playa Titzupan
54	Coast, Playa Titzupan to Punta Tejupan
55	Coast Punta Tejupan to Punta La Playa Corrida de San Juan
56	Coast, Punta La Playa Corrida de San Juan
57	Laguna Cuyutlan, Manzanillo wetlands
58	Coast, Manzanillo to Bahia Tenacatita
59	Punta Graham lagoons
60	Coast, Bahia Tenacatita to Punta Soledad

Continued

Table 3 (*cont'd*)
Locations of zones during aerial surveys of the southern half of the Pacific coast of Mexico, February 1994

Zone No.	Area surveyed
61	Coast, Punta Soledad to Punta las Peñitas
62	Punta Chalacatepec lagoons
63	Punta las Peñitas lagoons
64	Coast, Punta las Peñitas to Cabo Corrientes
65	Coast, Bahia de Banderas/Puerto Vallarta
66	Coast, Punta de Mita to Punta Raza
67	Coast, Punta Raza to San Blas
68	Coast, San Blas to Plaza los Corchos
69	San Blas wetlands
70	Boca Asadero estuary
71	Coast, Playa los Corchos to Santa Cruz
72	Bocas de Camichin wetlands
73	Santa Cruz wetlands
74	Mexicaltitan wetlands
75	Laguna Agua Brava
76	Lago Chamberto wetlands
77	Estero Teacapan
78	Laguna Agua Grande wetlands
79	Laguna Grande wetlands
80	Laguna el Caimanero
81	Laguna el Huizache
82	Coast, Santa Cruz to San Cayetano
83	Coast, San Cayetano to Laguna Grande
84	Coast, Laguna Grande to Mazatlan
85	Coast, Mazatlan to Punta Prieta
86	Estero el Escodama wetlands
87	Estero el Pozole wetlands
88	Coast, Punta Prieta
89	Rio Piaxtla exit
90	Rio Elota exit
91	Coast, Bahia la Guadalupana
92	Bahia la Guadalupana
93	Coast, Peninsula Quevedo to Boca la Tonina
94	Ensenada Pabellones
95	Bahia Alteta
96	Coast, Boca la Tonina to Isla Ventana
97	Bahia de Santa Maria, Isla Ventana to La Reforma
98	Isla Talchichitle

Table 4
Summary of totals of small, medium-sized, and large shorebirds counted during aerial surveys of the southern half of the Pacific coast of Mexico, February 1994[a]. For zone locations, see Table 3 and Figure 1.

	Small		Medium-sized		Large		All species	
Zone no.	Total	%	Total	%	Total	%	Total	%
1	22	0.0	50	0.0	1 378	0.7	1 450	0.3
2	2 604	1.2	753	0.7	101	0.0	3 458	0.6
3	299	0.1	323	0.2	341	0.1	963	0.1
4	351	0.2	320	0.3	3 795	1.8	4 466	0.9
5	715	0.3	96	0.0	316	0.2	1 127	0.2
6	21	0.0	6	0.0	23	0.0	50	0.0
7	2	0.0	50	0.0	1 231	0.6	1 283	0.2
8	0	0	0	0	1 502	0.7	1 502	0.3
9	251	0.1	950	0.9	21 385	10.5	22 586	4.3
10	0	0	0	0	0	0	0	0
11	558	0.3	2 876	2.8	1 277	0.7	4 711	0.9
12	40 426	18.0	7 010	6.9	602	0.3	48 038	9.1
13	405	0.2	38	0.0	1 066	0.5	1 509	0.3
14	1 743	0.8	938	0.9	243	0.1	2 924	0.6
15	0	0	0	0	0	0	0	0
16	0	0	0	0	4	0.0	4	0.0
17	0	0	0	0	0	0	0	0
18	432	0.2	28	0.0	4	0.0	464	0.1
19	202	0.1	103	0.1	112	0.1	417	0.1
20	1	0.0	0	0	0	0	1	0.0
21	0	0	0	0	0	0	0	0
22	4	0.0	61	0.1	0	0	65	0.0
23	2	0.0	0	0	200	0.1	202	0.0
24	0	0	71	0.1	2 252	1.1	2 323	0.4
25	51	0.0	63	0.0	71	0.0	185	0.0
26	2	0.0	2	0.0	1 660	0.8	1 664	0.3
27	513	0.2	1 084	1.1	4 101	2	5 698	1.1
28	166	0.0	52	0.0	160	0.0	378	0.0
29	408	0.2	3	0.0	92	0.0	503	0.1
30	6	0.0	57	0.1	330	0.2	393	0.1
31	0	0	9	0.0	200	0.1	209	0.0
32	196	0.1	24	0.0	24	0.0	244	0.0
33	190	0.1	69	0.0	29	0.0	288	0.0
34	300	0.1	41	0.0	130	0.1	471	0.1
35	906	0.4	12	0.0	70	0.0	988	0.2
36	1 020	0.5	1 605	1.6	5 281	2.6	7 906	1.5
37	25	0.0	226	0.2	84	0.0	335	0.1
38	0	0	0	0	0	0	0	0
39	240	0.1	26	0.0	46	0.0	312	0.0
40	1	0.0	0	0	0	0	1	0.0
41	39	0.0	988	1	1 421	0.7	2 448	0.5
42	275	0.0	37	0.0	58	0.0	370	0.0
43	2	0.0	20	0.0	80	0.0	102	0.0
44	245	0.1	263	0.3	61	0.0	569	0.1
45	10	0.0	11	0.0	2	0.0	23	0.0
46	25	0.0	10	0.0	35	0.0	70	0.0
47	0	0	0	0	96	0.0	96	0.0
48	400	0.2	367	0.4	298	0.1	1 065	0.2
49	0	0	0	0	326	0.2	326	0.1
50	30	0.0	2	0.0	5	0.0	37	0.0
51	241	0.1	72	0.1	552	0.2	865	0.1
52	211	0.1	4	0.0	97	0.0	312	0.1
53	16	0.0	61	0.1	336	0.2	413	0.1
54	1	0.0	0	0	176	0.1	177	0.0
55	51	0.0	20	0.0	113	0.1	184	0.0
56	185	0.1	548	0.5	1 437	0.7	2 170	0.4
57	15 371	6.8	3 738	3.7	22 920	11.3	42 029	7.9

Continued

Table 4 (*cont'd*)
Summary of totals of small, medium-sized, and large shorebirds counted during aerial surveys of the southern half of the Pacific coast of Mexico, February 1994[a]. For zone locations, see Table 3 and Figure 1.

	Small		Medium-sized		Large		All species	
Zone no.	Total	%	Total	%	Total	%	Total	%
58	0	0	0	0	50	0.0	50	0.0
59	100	0.0	101	0.1	69	0.0	270	0.1
60	2	0.0	0	0	42	0.0	44	0.0
61	232	0.1	69	0.1	345	0.2	646	0.1
62	4	0.0	70	0.1	606	0.3	680	0.1
63	2	0.0	359	0.4	468	0.2	829	0.2
64	31	0.0	30	0.0	86	0.0	147	0.0
65	0	0	0	0	1	0.0	1	0.0
66	0	0	0	0	4	0.0	4	0.0
67	58	0.0	0	0	78	0.0	136	0.0
68	446	0.2	37	0.0	84	0.0	567	0.1
69	200	0.1	37	0.0	87	0.0	324	0.0
70	147	0.1	117	0.1	150	0.1	414	0.1
71	27	0.0	23	0.0	45	0.0	95	0.0
72	928	0.4	316	0.3	598	0.3	1 842	0.3
73	5 027	2.2	3 652	3.6	2 433	1.2	11 112	2.1
74	1 124	0.5	2 187	2.1	1 397	0.7	4 708	0.9
75	15 476	6.9	11 111	10.8	21 962	10.8	48 549	9.1
76	100	0.0	51	0.0	39	0.0	190	0.0
77	6 840	3.0	3 610	3.5	3 841	1.9	14 291	2.7
78	5 220	2.4	1 497	1.5	8 824	4.3	15 541	2.9
79	550	0.2	385	0.3	6 140	3.0	7 075	1.4
80	37 400	16.7	10 470	10.2	49 192	24.2	97 062	18.3
81	1 070	0.5	400	0.4	2 170	1.1	3 640	0.7
82	390	0.2	40	0.0	148	0.1	578	0.1
83	49	0.0	1	0.0	51	0.0	101	0.0
84	301	0.1	122	0.1	93	0.0	516	0.1
85	22	0.0	2	0.0	23	0.0	47	0.0
86	352	0.2	100	0.1	353	0.2	805	0.2
87	414	0.2	82	0.1	241	0.1	737	0.1
88	38	0.0	4	0.0	19	0.0	61	0.0
89	12	0.0	0	0	32	0.0	44	0.0
90	0	0	0	0	0	0	0	0
91	44	0.0	9	0.0	53	0.0	106	0.0
92	8 503	3.8	3 901	3.8	8 123	3.9	20 527	3.8
93	65	0.0	6	0.0	14	0.0	85	0.0
94	47 765	21.3	11 868	11.6	9 275	4.6	68 908	13.0
95	2 408	1.1	907	0.9	394	0.2	3 709	0.7
96	190	0.1	21	0.0	33	0.0	244	0.0
97	17 976	8.0	16 998	16.6	4 794	2.4	39 768	7.5
98	1 907	0.8	10 707	10.5	5 154	2.5	17 768	3.3
	224 584	99.7	102 377	99.3	203 634	99.2	530 595	99.4

[a] All percentages have been rounded to the nearest 0.1%. Figures shown as 0.0% are thus actually <0.05%.

Table 5
Totals of small shorebirds counted during aerial surveys on the southern half of the Pacific coast of Mexico, February 1994. For abbreviations, see Table 2. For zone locations, see Table 3 and Figure 1.

Zone no.	PLOV	SPSA	SAND	PEEP	Total small
1	0	3	19	0	22
2	0	1	3	2 600	2 604
3	0	5	0	294	299
4	0	1	0	350	351
5	0	8	2	705	715
6	0	0	1	20	21
7	0	1	0	1	2
8	0	0	0	0	0
9	0	1	0	250	251
10	0	0	0	0	0
11	0	38	0	520	558
12	0	1	50	40 375	40 426
13	0	0	0	405	405
14	132	0	246	1 365	1 743
15	0	0	0	0	0
16	0	0	0	0	0
17	0	0	0	0	0
18	5	0	421	6	432
19	0	5	57	140	202
20	0	1	0	0	1
21	0	0	0	0	0
22	0	0	4	0	4
23	0	1	0	1	2
24	0	0	0	0	0
25	0	1	50	0	51
26	0	2	0	0	2
27	0	7	0	506	513
28	0	0	60	106	166
29	0	1	17	390	408
30	0	6	0	0	6
31	0	0	0	0	0
32	50	0	136	10	196
33	0	0	0	190	190
34	0	0	0	300	300
35	98	1	157	650	906
36	0	0	0	1 020	1 020
37	0	5	0	20	25
38	0	0	0	0	0
39	3	0	237	0	240
40	0	1	0	0	1
41	0	8	0	31	39
42	0	0	185	90	275
43	0	2	0	0	2
44	0	0	200	45	245
45	0	0	0	10	10
46	15	0	10	0	25
47	0	0	0	0	0
48	0	0	60	340	400
49	0	0	0	0	0
50	0	0	30	0	30
51	0	3	213	25	241
52	0	7	180	24	211
53	0	1	1	14	16
54	0	1	0	0	1
55	0	1	50	0	51
56	0	13	0	172	185
57	0	1	0	15 370	15 371

Continued

Table 5 (*cont'd*)
Totals of small shorebirds counted during aerial surveys on the southern half of the Pacific coast of Mexico, February 1994. For abbreviations, see Table 2. For zone locations, see Table 3 and Figure 1.

Zone no.	PLOV	SPSA	SAND	PEEP	Total small
58	0	0	0	0	0
59	0	0	0	100	100
60	0	0	2	0	2
61	1	0	130	101	232
62	0	3	0	1	4
63	0	2	0	0	2
64	16	0	0	15	31
65	0	0	0	0	0
66	0	0	0	0	0
67	0	2	55	1	58
68	0	0	46	400	446
69	0	0	0	200	200
70	0	2	45	100	147
71	0	0	27	0	27
72	0	21	0	907	928
73	0	0	0	5 027	5 027
74	0	0	0	1 124	1 124
75	0	0	0	15 476	15 476
76	0	0	0	100	100
77	0	0	0	6 840	6 840
78	0	0	0	5 220	5 220
79	0	0	0	550	550
80	0	0	0	37 400	37 400
81	0	0	0	1 070	1 070
82	47	0	190	153	390
83	0	0	49	0	49
84	0	1	155	145	301
85	0	0	22	0	22
86	0	0	2	350	352
87	0	0	0	414	414
88	0	1	36	1	38
89	0	0	12	0	12
90	0	0	0	0	0
91	0	0	44	0	44
92	0	3	0	8 500	8 503
93	0	0	65	0	65
94	0	0	0	47 765	47 765
95	0	0	20	2 388	2 408
96	0	0	190	0	190
97	0	0	0	17 976	17 976
98	0	1	0	1 906	1 907
Total	367	163	3 479	220 575	224 584

Table 6
Totals of medium-sized shorebirds counted during aerial surveys of the southern half of the Pacific coast of Mexico, February 1994. For abbreviations, see Table 2. For zone locations, see Table 3 and Figure 1.

Zone no.	BBPL	KILL	YELL	WATA	RUTU	REKN	DOWI	Unidentified medium-sized	Total medium-sized
1	0	0	50	0	0	0	0	0	50
2	0	0	131	0	0	0	90	532	753
3	2	1	75	0	0	0	0	245	323
4	0	0	102	0	0	0	0	218	320
5	55	0	0	0	0	0	0	41	96
6	1	0	5	0	0	0	0	0	6
7	0	0	0	0	0	0	0	50	50
8	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	550	400	950
10	0	0	0	0	0	0	0	0	0
11	215	0	2 085	0	5	0	0	571	2 876
12	305	0	5 145	0	0	0	0	1 560	7 010
13	4	0	0	0	0	0	0	34	38
14	305	0	0	0	9	0	0	624	938
15	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0
18	5	0	0	0	0	0	0	23	28
19	16	9	68	0	0	0	0	10	103
20	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	61	61
23	0	0	0	0	0	0	0	0	0
24	0	0	41	0	0	0	0	30	71
25	13	0	21	0	0	0	0	29	63
26	0	0	2	0	0	0	0	0	2
27	0	0	584	0	0	0	200	300	1 084
28	30	0	0	0	0	0	0	22	52
29	0	0	3	0	0	0	0	0	3
30	30	0	2	0	0	0	0	25	57
31	5	0	4	0	0	0	0	0	9
32	24	0	0	0	0	0	0	0	24
33	2	9	5	0	0	0	0	53	69
34	11	0	0	0	0	0	10	20	41
35	7	0	0	0	1	0	0	4	12
36	80	0	145	0	0	0	10	1 370	1 605
37	0	0	1	0	0	0	200	25	226
38	0	0	0	0	0	0	0	0	0
39	26	0	0	0	0	0	0	0	26
40	0	0	0	0	0	0	0	0	0
41	0	0	68	0	0	0	850	70	988
42	22	0	15	0	0	0	0	0	37
43	0	0	0	0	0	0	0	20	20
44	220	0	3	0	0	0	0	40	263
45	11	0	0	0	0	0	0	0	11
46	10	0	0	0	0	0	0	0	10
47	0	0	0	0	0	0	0	0	0
48	1	0	6	0	0	0	260	100	367
49	0	0	0	0	0	0	0	0	0
50	2	0	0	0	0	0	0	0	2
51	1	0	20	0	0	0	0	51	72
52	4	0	0	0	0	0	0	0	4
53	0	0	60	1	0	0	0	0	61
54	0	0	0	0	0	0	0	0	0
55	0	0	20	0	0	0	0	0	20
56	8	5	380	0	0	0	150	5	548
57	5	0	237	0	0	0	2 570	926	3 738

Continued

Table 6 (*cont'd*)
Totals of medium-sized shorebirds counted during aerial surveys of the southern half of the Pacific coast of Mexico, February 1994. For abbreviations, see Table 2. For zone locations, see Table 3 and Figure 1.

Zone no.	BBPL	KILL	YELL	WATA	RUTU	REKN	DOWI	Unidentified medium-sized	Total medium-sized
58	0	0	0	0	0	0	0	0	0
59	0	0	21	0	0	0	80	0	101
60	0	0	0	0	0	0	0	0	0
61	0	2	0	0	0	0	0	67	69
62	0	0	0	0	0	0	20	50	70
63	21	0	18	0	0	0	320	0	359
64	0	0	0	0	0	0	30	0	30
65	0	0	0	0	0	0	0	0	0
66	0	0	0	0	0	0	0	0	0
67	0	0	0	0	0	0	0	0	0
68	20	0	2	0	14	0	0	1	37
69	8	0	3	0	1	0	20	5	37
70	64	0	1	0	0	0	38	14	117
71	1	0	0	0	2	0	10	10	23
72	25	0	9	0	25	0	60	197	316
73	5	0	101	0	2	0	1 182	2 362	3 652
74	7	0	0	0	0	0	1 730	450	2 187
75	0	0	1	0	0	0	1 450	9 660	11 111
76	1	0	0	0	0	0	0	50	51
77	210	0	200	0	0	250	1 840	1 110	3 610
78	26	0	20	0	1	0	1 270	180	1 497
79	25	0	0	0	0	0	150	210	385
80	0	0	0	0	0	0	910	9 560	10 470
81	0	0	0	0	0	0	0	400	400
82	15	0	0	0	0	0	0	25	40
83	1	0	0	0	0	0	0	0	1
84	22	0	10	0	0	0	90	0	122
85	2	0	0	0	0	0	0	0	2
86	0	0	0	0	0	0	0	100	100
87	2	0	0	0	0	0	0	80	82
88	3	0	0	0	0	0	0	1	4
89	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0
91	9	0	0	0	0	0	0	0	9
92	20	0	6	0	0	0	2 975	900	3 901
93	0	0	0	0	6	0	0	0	6
94	10	0	62	0	0	0	11 676	120	11 868
95	32	0	0	0	0	0	420	455	907
96	3	0	0	0	0	0	15	3	21
97	33	0	15	0	0	210	5 100	11 640	16 998
98	6	0	1	0	0	70	4 600	6 030	10 707
Total	1 991	26	9 748	1	66	530	38 876	51 139	102 377

Table 7
Total of large shorebirds counted during aerial surveys of the southern half of the Pacific coast of Mexico, February 1994. For abbreviations, see Table 2. For zone locations, see Table 3 and Figure 1.

Zone no.	AMOY	BNST	AMAV	MAGO	WHIM	LBCU	WILL	Unidentified large	Total large
1	0	170	1 200	0	8	0	0	0	1 378
2	0	43	5	2	11	0	40	0	101
3	0	239	20	3	1	0	78	0	341
4	0	2 965	750	80	0	0	0	0	3 795
5	0	0	0	40	8	0	228	40	316
6	0	0	0	0	20	0	3	0	23
7	0	900	200	80	1	0	50	0	1 231
8	0	1 002	480	0	0	0	20	0	1 520
9	0	9 580	11 800	2	0	0	3	0	21 385
10	0	0	0	0	0	0	0	0	0
11	0	563	450	30	13	0	221	0	1 277
12	0	10	0	256	0	0	236	100	602
13	0	250	0	145	21	0	650	0	1 066
14	4	2	0	0	98	1	73	65	243
15	0	0	0	0	0	0	0	0	0
16	2	0	0	0	0	0	2	0	4
17	0	0	0	0	0	0	0	0	0
18	0	0	0	0	3	0	1	0	4
19	0	105	1	0	6	0	0	0	112
20	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0
23	0	192	0	0	1	0	7	0	200
24	0	955	1 292	0	0	1	4	0	2 252
25	0	54	0	0	14	0	3	0	71
26	0	135	1 515	0	10	0	0	0	1 660
27	0	3 130	470	251	0	0	250	0	4 101
28	0	0	0	0	136	0	24	0	160
29	0	64	0	0	15	0	13	0	92
30	0	289	20	0	9	0	12	0	330
31	0	114	45	30	11	0	0	0	200
32	0	0	0	0	15	0	9	0	24
33	0	18	4	0	4	0	3	0	29
34	0	63	1	0	5	0	61	0	130
35	0	25	0	0	36	0	9	0	70
36	0	1 425	2 042	301	1	0	1 410	102	5 281
37	0	84	0	0	0	0	0	0	84
38	0	0	0	0	0	0	0	0	0
39	0	1	1	0	41	0	3	0	46
40	0	0	0	0	0	0	0	0	0
41	0	801	620	0	0	0	0	0	1 421
42	0	0	0	0	56	0	2	0	58
43	0	80	0	0	0	0	0	0	80
44	0	30	0	0	5	0	24	2	61
45	0	0	0	1	0	0	1	0	2
46	0	8	0	0	14	0	13	0	35
47	0	15	80	0	1	0	0	0	96
48	0	189	60	0	2	0	47	0	298
49	0	185	50	11	0	0	80	0	326
50	0	0	0	0	3	0	2	0	5
51	0	386	20	0	27	0	109	10	552
52	0	37	0	0	31	0	29	0	97
53	3	300	0	0	7	0	26	0	336
54	4	170	0	0	1	0	1	0	176
55	4	100	0	0	3	0	6	0	113
56	0	1 386	0	0	6	0	45	0	1 437
57	0	12 127	10 440	55	0	0	98	200	22 920
58	0	50	0	0	0	0	0	0	50
59	0	12	12	35	0	0	10	0	69

Continued

Table 7 (*cont'd*)
Total of large shorebirds counted during aerial surveys of the southern half of the Pacific coast of Mexico, February 1994. For abbreviations, see Table 2. For zone locations, see Table 3 and Figure 1.

Zone no.	AMOY	BNST	AMAV	MAGO	WHIM	LBCU	WILL	Unidentified large	Total large
60	5	35	0	0	2	0	0	0	42
61	1	305	25	0	6	0	8	0	345
62	0	366	226	0	1	0	13	0	606
63	0	167	232	11	12	0	44	2	468
64	0	21	60	0	5	0	0	0	86
65	0	0	0	0	1	0	0	0	1
66	0	0	0	0	2	0	2	0	4
67	0	11	0	1	6	0	10	50	78
68	0	5	12	1	22	0	44	0	84
69	6	8	5	15	5	0	48	0	87
70	0	8	102	14	12	0	14	0	150
71	1	1	0	0	12	0	31	0	45
72	0	57	272	120	40	0	109	0	598
73	0	810	918	417	155	0	133	0	2 433
74	0	140	770	382	1	0	4	100	1 397
75	0	1 930	17 550	1 010	2	0	120	1 350	21 962
76	0	20	0	0	2	0	17	0	39
77	0	815	1 805	810	1	0	410	0	3 841
78	0	1 408	6 440	730	1	0	45	200	8 824
79	0	645	4 638	490	25	0	342	0	6 140
80	1	1 190	46 100	1 080	7	3	145	666	49 192
81	0	55	2 015	20	0	0	80	0	2 170
82	0	0	0	0	115	0	33	0	148
83	2	0	0	0	43	0	6	0	51
84	2	22	0	11	46	0	12	0	93
85	0	0	0	0	6	0	17	0	23
86	0	70	272	10	1	0	0	0	353
87	0	10	210	9	3	0	9	0	241
88	0	0	0	0	3	0	16	0	19
89	0	0	0	30	0	2	0	0	32
90	0	0	0	0	0	0	0	0	0
91	0	0	0	0	5	0	48	0	53
92	0	331	6 401	672	81	13	555	70	8 123
93	0	0	0	0	12	0	2	0	14
94	1	155	6 572	1 201	75	10	1 261	0	9 275
95	2	10	105	128	26	1	122	0	394
96	0	0	0	0	1	0	32	0	33
97	0	238	1 171	1 236	16	3	1 020	1 110	4 794
98	0	0	120	2 202	11	0	1 156	1 665	5 154
Total	38	47 087	127 599	11 922	1 408	34	9 814	5 732	203 634

Table 8
Numbers of shorebirds counted during aerial surveys of major wetlands (>20 000 shorebirds) on the southern half of the Pacific coast of Mexico, February 1994

Zone no.	Location	Small Total	Small %	Medium-sized Total	Medium-sized %	Large Total	Large %	Total, all species
9	Laguna la Joya	251	0.1	950	0.9	21 385	10.5	22 586
11–12	Mar Muerto	40 984	18.2	9 886	9.7	1 879	0.9	52 749
57	Manzanillo	15 371	6.8	3 738	3.7	22 920	11.3	42 029
69–70, 72–79	Marismas Nacionales	35 612	15.9	22 963	22.4	45 471	22.3	104 406
80–81	Lagunas el Caimanero/el Huizache	38 470	17.1	10 870	10.6	51 362	25.2	100 702
92	Bahia la Guadalupana	8 503	3.8	3 901	3.8	8 123	3.9	20 527
94	Ensenada Pabellones	47 765	21.3	11 868	11.6	9 275	4.6	68 908
97–98	Bahia de Santa Maria	19 883	8.9	27 705	27.1	9 948	4.9	57 536
Total, Above areas		206 839	92.1	91 881	89.8	170 363	83.6	469 083
Total, All zones		224 584	42.3	102 377	19.3	203 634	38.4	530 595
Total, Top 5 areas		182 714	81.4	83 202	81.3	117 935	57.9	383 941

Table 9
Totals of shorebirds counted in Mexico on aerial surveys conducted during the Canadian Wildlife Service Mexican Shorebird Atlas project, 1992–1994

Region and year of study	Size category: Small	Medium-sized	Large	Unidentified	Total
Pacific: northwest 1992[a]	563 207	68 175	117 773	66 376	815 531
Pacific: southern 1994[b]	224 584	102 377	203 634		530 595
Gulf of Mexico/Caribbean 1993[c]	63 771	48 563	12 567		124 901
	851 562	219 115	333 974	66 376	1 471 027

[a] Morrison et al. (1992).
[b] Present results.
[c] Morrison et al. (1993).

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