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NON-BREEDING WATERBIRDS OF THE DELTA OF THE RÍO COLORADO, MÉXICO

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Abstract.—The delta of the Río Colorado was a very important area for water birds until early in the century, after which damming and upstreams diversion caused significant habitat modifications in the area. Although recent information suggested the area was still important to many birds, detailed data on such use was lacking. Between the fall of 1993 and the summer of 1994 we made 14 surveys and two aerial flights over the area. The largest numbers of birds occured during the winter, when we counted over 100,000 birds. Shorebirds dominated the bird community, with Western Sandpipers accounting for the majority of the individuals. The areas most used by shorebirds were the extensive mudflats at the mouth of the delta. Interior habitats were important mostly to herons and ducks.

AVES ACUÁTICAS NO REPRODUCTIVAS EN EL DELTA DEL RÍO COLORADO, MÉXICO

Sinopsis.—El delta del Río Colorado fue importante para aves acuáticas hasta principios de este siglo, cuando la construcción de presas y división del agua modificaron sustancialmente los habitats del área. Información reciente sugería que el área era aún importante para aves, pero no había información detallada sobre su uso a lo largo del año. Entre el otoño de 1993 y el verano de 1994 realizamos 14 muestreos y dos vuelos aéreos sobre el área. Encontramos que las mayores congregaciones de aves ocurren durante el invierno, cuando contamos más de 100,000 aves. Los playeros fueron el grupo dominante, y *Calidris mauri* la especie más abundante. Las áreas más usadas por las aves fueron las extensas planicies lodosas en la boca del delta. Los habitats interiores fueron importantes especialmente para garzas y patos.

Before experiencing "the most striking changes in Baja California habitat" (Wilbur 1987), the delta of the Río Colorado was important for waterbirds. Aldo Leopold (1949; Leopold 1953) praised the "wealth of fowl" observed during a trip made in 1922. However, only a few surveys were carried out before extensive water development projects were made (Bancroft 1922, Price 1899, Stone and Rhoads 1905). The lists of birds they reported are the products of limited work. Indeed, the lists by Price (1899) and Stone and Rhoads (1905) were strongly criticized by Grinnell (1928). Grinnell (1928) and Van Rossem (1945) summarized the data available at their time, but in neither case had extensive surveys been made. Moreover, the most important habitat transformations in the area took place after their results had been published.

Conditions in the area were dramatically modified early in the century when the Río Colorado was dammed to provide water for agricultural development. As a result, several workers consider the area to be of moderate to poor quality, although still offering some habitat for wintering waterfowl (Carrera 1992, Knoder et al. 1980, Kramer and Migoya 1989); in a January 1952 aerial survey, 4500 ducks were counted (Leopold 1959).

The situation seems to be different for birds other than waterfowl, although no comparative data exist to assess the effects of restricted river

flow. Because of the importance of the delta for shorebirds, it was one of the first two Mexican sites incorporated into the Western Hemisphere Shorebird Reserve Network (WHSRN; Massey and Palacios 1994). A January 1992 aerial survey (Morrison et al. 1992) detected 163,744 shorebirds in the area. The vast majority (80%) were small sandpipers (mainly Western Sandpipers, *Calidris mauri*), but included over 9000 American Avocets and nearly 8000 Willets. The small shorebirds were found mainly on mudflats at the southern end of Islas Montague and Pelícano. The medium and large shorebirds were found mainly on the western margin of the delta on somewhat harder mudflats.

Away from the seashore, the Ciénega de Santa Clara developed as a result of brine water discharge from the Welton Mohawk Irrigation District (Glenn et al. 1992). The northern third of the wetland consists of a dense community of tall emergent vegetation and harbors important populations of the Yuma Clapper Rail (*Rallus longimembris yumanensis*) and several waterbirds (Eddleman 1989). The southern two thirds are composed of open evaporative saltflats, which have been reported to harbor some breeding shorebirds and Least Terns (*Sterna antillarum*) during the summer (Eddleman 1989; Mellink et al. 1996).

Most modern surveys of waterbirds of the area have been winter aerial surveys, with no ground counts, conducted once or twice a year. Ducks Unlimited de México has performed ground surveys of waterfowl in the Valle de Mexicali. Most work is not formally published and if available only in research reports. In this paper we present data we have recorded on the seabirds, herons, and shorebirds of the delta of the Río Colorado and the Valle de Mexicali during the fall and winter of 1993–1994 and the spring and summer of 1994. We also include notes on some other birds associated with aquatic habitats.

METHODS

The delta's seashore was divided in four different areas (Fig. 1). Ground surveys on the Ciénega de Santa Clara concentrated on the less-studied saltflats (Fig. 1). Two localities were selected for observation: "El Doctor" and "La Flor del Desierto," about 3 km southwest of the towns of the same names, along the San Luis Río Colorado-Golfo de Santa Clara Highway. The Bordo Lerma (Fig. 1) is one of the levees build to prevent flooding of agricultural land in the Valle de Mexicali, on those exceptional years when large amounts of water are discharged through the Río Colorado. Two deep ponds exist at the dumping site of water pumps, and backwaters form shallow ponds in some places. Additional sporadic observations were made at agricultural drains of the Valle de Mexicali, including some in the peripheral areas of the city of Mexicali. Most work was carried out on the Delta's seashore.

We visited the area on 14 occasions, between the fall of 1993 and the summer of 1994, although not all localities were surveyed every time (Table 1). On several occasions the weather did not allow for navigation, or allowed only a direct trip to Isla Montague, bypassing Boca de Sonora

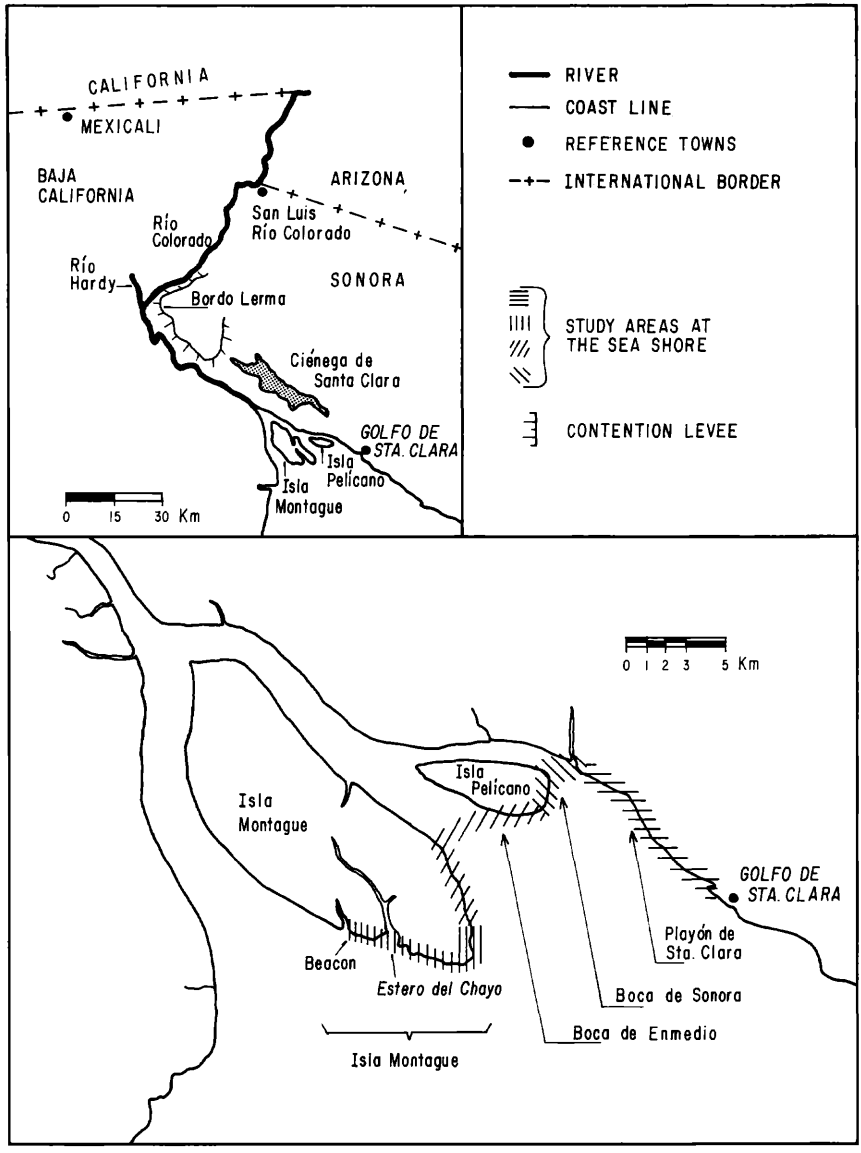

FIGURE 1. Delta of the Río Colorado and study areas for water birds, 1993–1994.

and Boca de Enmedio. Muddy conditions and time constraints also prevented us from visiting the Ciénega de Santa Clara saltflats and Bordo Lerma on all trips. Bird counts at sea were done from small fishing boats (pangas) and, on one occasion, from a zodiac; ground surveys were done on foot. Additionally, on 3 Dec. 1993 and 15 Mar. 1994 we conducted

TABLE 1. Dates on which the different localities were visited. Playón = Playón de Santa Clara, B S = Boca de Sonora, B E = Boca de Enmedio, I M = Isla Montague, Ciénega = Ciénega de Santa Clara, Lerma = Bordo Lerma (see Fig. 1).

Season	Date	Playón	B S	B E	I M	B B	Ciénega	Lerma
Fall	8 Sep. 1993	X			X		X	X
	12 Oct. 1993	X			X			
	2 Nov. 1993	X			X			X
	5–6 Dec. 1993	X	X	X	X			X
Winter	11 Jan. 1994	X		X	X		X	X
	8 Feb. 1994	X	X	X	X			X
	9 Feb. 1994	X	X	X	X			X
	9 Mar. 1994	X					X	
Spring	22 Mar. 1994	X	X	X	X	X	X	X
	6 Apr. 1994		X	X	X		X	X
	10 May 1994	X			X			
Summer	22 Jun. 1994				X			
Fall	3 Nov. 1994	X					X	
	24 Nov. 1994		X	X				

aerial surveys along the delta's seashore and the Río Colorado. These were done from a Cessna 182 fixed-wing aircraft, flying at 35 m above the ground. Three observers recorded the birds, in the front right, and in both rear seats.

On each trip we recorded all waterbirds seen at one of the sites, either standing on it or clearly flying to or from it. Birds flying high with no obvious association with one of the sites were not included. Although birds nesting in the area could be counted if visible in our counts, we did not survey the breeding colonies directly; information on them is available elsewhere (Mellink and Palacios 1993; Palacios and Mellink 1992, 1993; Persbarbosa 1995; Peresbarbosa and Mellink 1994).

Because counts varied noticeably among censuses within a given season, we used maximum counts as the best estimator of bird abundance. To interpret the seasonal variation in waterbirds, we added data from all the seashore sites, and for each species selected the highest count in the season as the best estimator of bird abundance (Appendix 1). To compare the different seasons we tallied the highest values of any single visit (Table

TABLE 2. Seasonal abundance and species richness of waterbirds at the seashore of the delta of the Río Colorado, 1993–1994. Numbers of individuals represent the sum of the highest counts for each of the species, during a given season. Numbers of species are in parentheses. 1993–1994.

	Fall 1993	Winter	Spring	Summer	Fall 1994
Seabirds	2507 (15)	6556 (16)	5160 (17)	135 (5)	1662 (8)
Herons and ibises	74 (6)	49 (4)	75 (5)	25 (2)	25 (3)
Shorebirds	5135 (17)	98,070 (16)	45,586 (15)	380 (8)	1647 (12)
Total	7716 (38)	104,675 (36)	50,821 (37)	540 (15)	3334 (23)

TABLE 3. Number of individuals and species recorded at six areas of the delta of the Río Colorado (Fig. 1), 1993–1994. Numbers of individuals represent the sum of the highest count of each species, during each season. Numbers of species are in parentheses. See text for complete area names. 1993–1994.

Area	Seabirds	Herons and Ibises	Shorebirds
Playón	4687 (15)	10 (1)	6556 (16)
B. Sonora	1660 (15)	19 (3)	59,499 (14)
B. Enmedio	2497 (7)	11 (1)	79,356 (7)
I. Montague	8133 (19)	205 (6)	12,497 (16)
Ciénega	31 (4)	10 (5)	12,814 (8)
B. Lerma	63 (8)	154 (6)	845 (6)

2) and, to compare sites, at each site we added the highest tally for each species per season into a single value (Table 3). Data from the aerial surveys were not considered in Tables 2 and 3. All species names follow the American Ornithologists' Union (1983).

RESULTS AND DISCUSSION

Seabirds.—Summing the highest counts per species per season, we recorded 16,374 individuals of 21 species of seabirds on the delta (Table 2, Appendix 1). Seabirds were most abundant in winter and spring. This pattern was strongly influenced by Brown Pelicans (*Pelecanus occidentalis*), by far the most common seabird observed during early winter, and Double-crested Cormorants (*Phalacrocorax auritus*), which were abundant during both the winter and spring. These two species of birds accounted for 27 and 23% of all seabirds, respectively. They were especially common on a large mud bar that became exposed at low tide on the southeast end of Isla Montague. The number of species was substantially lower during the summer, as many species congregated on their breeding grounds, away from the delta. The closest known breeding site for Brown Pelicans is Isla San Luis, 190 km south of the delta (Everett and Anderson 1991) and for Double-crested Cormorants, Isla San Jorge, 155 km southeast from the delta (Mellink and Palacios 1993).

The delta supports only moderate numbers of American White Pelicans (*Pelecanus erythrorhynchos*), but open water within the Ciénega de Santa Clara's vegetated portion revealed 800 individuals on the aerial survey of 3 Dec. 1993. Two White Pelicans were observed in Laguna Xochimilco outside Mexicali on 18 Dec. 1992.

Gulls accounted for 23% of the seabirds, the most common species being the Ring-billed Gull (*Larus delawarensis*; 9%). On Montague, Ring-billed Gulls were found only during the winter. Ring-billed Gulls were found in channels within the agricultural area during the fall. Laughing Gulls (*Larus atricilla*), which nest on Isla Montague (Palacios and Mellink 1992), represented 4% and were present during the spring and fall. Non-detection of Laughing Gulls during the summer might be due to their concentration on their breeding grounds.

Terns and their allies comprised 16% of the total seabirds at the seashore. Of these, 5% were Black Skimmers (*Rhynchops niger*), 4% were Caspian Terns (*Sterna caspia*), and the remainder were other tern species. Terns were most common during the spring. During late spring and summer, terns and skimmers concentrate on their breeding grounds, where they remain most of the time, making them difficult to detect. During early spring, they are more conspicuous due to courtship and pair forming activities. Gull-billed (*Sterna nilotica*), Caspian, and Forster's (*Sterna forsteri*) Terns were found along watercourses of the interior valley. Black Skimmers preferred Isla Montague, where they nest (Palacios and Mellink 1993, Peresbarbosa and Mellink 1994), but are found throughout the area, even on the Ciénega de Santa Clara saltflat, as revealed on aerial surveys. The Pied-billed Grebe (*Podilymbus podiceps*) is commonly found in watercourses of the Valle de Mexicali, although always in small numbers, and Common Loons (*Gavia immer*) were often observed in feeding groups of about 30 individuals off Boca de Enmedio.

Overall, Isla Montague was the most important area for the seabirds (48% of the birds, Table 3), followed by the Playón (27%). Boca de Sonora and Boca de Enmedio had 10% and 15% of all the birds, respectivelly. The Ciénega de Santa Clara saltflat and Bordo Lerma were of only limited use to the seabirds. The area is of primary importance to seabirds from late fall to mid-spring.

Herons and ibises.—We tallied 227 individuals of 6 species of herons, using only the highest counts at the seashore (Appendix 1, Table 2). Two species, Snowy Egret (*Egretta thula*) and Great Blue Heron (*Ardea herodias*) accounted for most individuals recorded (46% and 35% of all herons and ibises recorded, respectively). The Snowy Egret is a common breeder along the northern coast of Sonora (Mellink and Palacios 1993), and is found throughout the area in winter; on 31 Dec. 1994 there were 70 individuals in an old agricultural drain in the city of Mexicali. Great Blue Herons were found in the more densely vegetated habitats throughout the Valle de Mexicali. On the 3 Dec. 1993 aerial survey we counted 853 Great Egrets (*Ardea alba*) in the vegetated portion of the Ciénega de Santa Clara. Great Blue Herons and Great Egrets were found throughout the Valle de Mexicali, occuring in agricultural drains. Large concentrations of herons and egrets during the fall occurred in an oxbow of the Río Hardy, adjacent to the Mexicali-San Felipe highway. These concentrations were mostly of Great and Snowy Egrets, with Great Blue Herons and Black-crowned Night-Herons (*Nycticorax nycticorax*) in low numbers.

Snowy Egrets were in low numbers during the winter, and began to increase in abundance in early spring for their reproductive season on Isla Montague (Palacios and Mellink 1992). The fall peak was probabily the result of the 1993 breeding season. They are found throughout the Valle de Mexicali, including in the city (70 were in an old agricultural drainage ditch inside the city of Mexicali, 1 Jan. 1995).

The Black-crowned Night-Heron was not abundant at any of the sites during the surveys, although they are present in many vegetated ditches,

agricultural drains, and natural watercourses in the Valle de Mexicali. This species breeds in low numbers on Montague Island (Peresbarbosa-Rojas 1995) and we have observed inmature individuals throughout the Valle de Mexicali. However, during early May 1996 no Black-Crowned Night-Herons could be found in this area (E. Mellink and J. Luévano, unpubl. data).

We recorded three other species only in the interior habitats of the Valle de Mexicali: Green Heron (*Butorides striatus*), White-faced Ibis (*Plegadis chihi*), and Cattle Egrets (*Bubulcus ibis*). Green Herons are commonly found on all types of waterways in the Valle de Mexicali, including some within the city of Mexicali. White-faced Ibises were restricted to interior habitats (Ciénega de Santa Clara and Bordo Lerma). Between 1630–1730 h on 30 and 31 Dec. 1994, about 10 flocks of a few hundred ibis each flew very high over Mexicali, NE to SW. They seemed to be coming from feeding areas in the Imperial Valley to roost in the Valle de Mexicali. Cattle Egrets are found in agricultural settings in the Valle de Mexicali, and breed locally (Mellink and Palacios 1993, Mora 1989).

Isla Montague was the place most used by herons (Table 3). This is not surprising as the species with highest numbers (Snowy Egret) breeds there. Bordo Lerma, second in ranking, was specially important for Gret Blue Herons and Great Egrets.

Shorebirds.—We recorded 148,285 individuals of 20 species of shorebirds at the seashore (Appendix 1). Western Sandpipers comprised 70% of all individuals. By far the largest numbers of shorebirds were found during the winter (65%, Table 2). Whereas on the 3 Dec. 1993 aerial survey over Isla Montague and Ciénega de Santa Clara we counted 60 individuals; on the 15 Mar. 1994 flight we counted 65,730 individuals at the same two sites.

The areas most used by shorebirds were the Boca de Enmedio and Boca de Sonora (46% and 35%, respectively, Table 3). Although Isla Montague had only modest use by shorebirds (7%) and the Playón de Santa Clara low use (4%), they were used by many species, as was the Boca de Sonora (Table 3). Species that had a relatively low presence in the area were Marbled Godwit (*Limosa fedoa,* 10%), dowitchers (*Limnodromus* spp., 5%), Black-bellied Plover (*Pluvialis squatarola,* 4%), and Long-billed Curlew (*Numenius americanus* 3%). Morrison *et al.* (1992) found large concentrations of medium-sized and large shorebirds on the western side of the delta. Flats in this area are firmer than those in the eastern and central portions of the delta, where most of the small shorebirds are found.

Other waterbirds.—Throughout the study we recorded several other species of waterbirds: Osprey (*Pandion haliaetus*), Bald Eagle (*Haliaeetus leucocephalus*), Northern Harrier (*Circus cyaneus*), Peregrine Falcon (*Falco peregrinus*), Canada Goose (*Branta canadensis*), Northern Pintail (*Anas acuta*), American Wigeon (*Anas americana*), Cinnamon Teal (*Anas cyanoptera*), Northern Shoveler (*Anas clypeata*), Canvasback (*Aythya valisineria*), Red-breasted Merganser (*Mergus serrator*), Ruddy Duck (*Oxyura*

jamaicensis), American Coot (*Fulica americana*), and Belted Kingfisher (*Ceryle alcyon*). The Bald Eagle was seen resting on the saltflats of the Ciénega de Santa Clara on the 3 Mar. 1994 flight, and the Peregrine Falcon was recorded only on 8 Sep. 1993 on Isla Montague. The ducks were recorded mainly in interior habitats (Ciénega de Santa Clara, Bordo Lerma, Río Hardy, and agricultural drains), although one pintail and one wigeon were observed on Montague. As reported by other workers (Kramer and Migoya 1989), Northern Pintails were the most common duck. We saw three Belted kingfishers on 6 Dec. 1993, but not on other trips, in the water pools associated with pumps along the Bordo Lerma. We found Belted Kingfishers also along the Río Hardy.

Summary.—All of our seashore censuses were done under poor conditions for counting birds: extensive tideflats prevented us from getting close to the birds, and sea conditions were often somewhat rough. Therefore, we likely underestimated the numbers of birds actually using the area.

The avifauna of the delta of the Río Colorado is dominated by Charadriiformes that congregate there to rest and feed during the winter, but the area is important also to seabirds. The greatest abundance of birds was recorded during the winter, but winter and spring had an equal number of species (16 out of 49). The area seems to be of primary importance for migrating waterbirds during the winter and, perhaps to a lesser degree, the spring. During the summer it is important to a number of breeding birds as well.

Isla Montague harbours the largest number of seabirds, although most belonged to only two species. Isla Montague also had 25% more species than the next richest sites, Boca de Sonora and Playón de Santa Clara. Montague has previously been reported as an important breeding site for many species. Our surveys of the area confirm the distribution and abundance patterns found by Morrison et al. (1992) in their aerial surveys. The areas most used by shorebirds were the extensive mudflats between the Estero de Santa Clara, and the eastern side of Isla Montague, including Isla Pelícano. Interior habitats commonly had several species, especially of herons, but were most important numerically for ducks. However, the Ciénega de Santa Clara interior water bodies were important to White Pelicans and Great Egrets, and an oxbow of the Río Hardy, to Great and Snowy Egrets.

Regionally, the delta, in its current form, shares a great part of its avifauna with the Salton Sea (McCaskie 1970), the other large wetland of the area. The two sites might actually be used by the same individuals along their migration. It is difficult to determine the effects of restricted river flow on the avifauna of this area. However, it appears that the area is currently much more important for small shorebirds, than that reported by earlier writers (Grinnell 1928, Price 1899, Stone and Rhoads 1905). This would be the result of the currently exposed mud sediments that were created formerly by Río Colorado. Our data suggests that although

the area is important for migratory water birds, it does not represent much the original delta habitats.

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APPENDIX 1. Numbers of waterbirds recorded at the seashore of the delta of the Río Colorado, 1993–1994. Numbers correspond to species' highest tallies within any one season.

	Ground surveys					Aerial flights	
Species	Fall	Winter	Spring	Summer	Fall	December	March
Seabirds							
Common Loon	1500	0	8	0	0	0	0
Eared Grebe	0	5	3	1	0	0	0
Western Grebe	5	7	2	0	379	0	0
Black Storm-Petrel	0	0	3	0	0	0	0
Brown Booby	0	30	0	0	0	0	0
American White Pelican	40	84	0	0	24	17	77
Brown Pelican	327	2820	273	12	270	0	50
Double-crested Cormorant	80	2000	1762	4	42	5	150
Laughing Gull	0	0	354	0	0	0	0
Heermann's Gull	50	300	0	0	0	0	0
Ring-billed Gull	300	753	388	0	920	9	0
California Gull	0	4	630	0	0	0	0
Herring Gull	25	330	279	0	0	0	0
Yellow-footed Gull	69	6	0	0	0	0	0
Gull-billed Tern	1	0	55	0	0	0	12
Caspian Tern	72	50	628	10	1	14	0
Royal Tern	2	0	145	0	0	0	0
Elegant Tern	3	0	148	0	0	0	0
Forster's Tern	31	3	80	0	2	5	0
Least Tern	0	0	9	10	0	0	0
Black Skimmer	20	110	534	200	24	0	552
Herons and Ibises							
Great Blue Heron	16	24	32	6	3	14	81
Great Egret	3	7	4	0	0	19	569
Snowy Egret	51	2	30	19	2	9	215
Tricolored Egret	2	0	1	0	0	0	0
Reddish Egret	1	0	0	0	0	0	0
Black-crowned Night-Heron	1	16	8	0	0	0	36
Cattle Egret	0	0	0	0	20	0	0

APPENDIX 1. Continued.

Species	Ground surveys					Aerial flights	
	Fall	Winter	Spring	Summer	Fall	December	March
Shorebirds							
Black-bellied Plover	316	4562	268	5	228	42	340
Snowy Plover	0	2	0	0	0	0	0
Wilson's Plover	4	2	1	0	2	0	0
Kildeer	2	2	2	0	0	0	0
American Oystercatcher	49	4	59	2	4	0	0
Black-necked Stilt	0	0	40	0	0	0	60
American Avocet	58	400	1340	12	29	32	7490
Yellowlegs spp.	21	3	18	0	2	0	2
Willet	713	5671	797	8	502	200	2798
Spotted Sandpiper	2	0	0	0	0	0	0
Whimbrel	284	6	350	2	0	9	0
Long-billed Curlew	1248	214	2478	303	65	360	106
Marbled Godwit	380	9105	6057	40	43	0	2050
Ruddy Turnstone	54	0	13	0	0	0	0
Red Knot	0	12	0	0	0	0	40
Sanderling	278	227	220	0	128	0	70
Western Sandpiper	1518	74,855	30,050	0	539	60	54,920
Least Sandpiper	5	0	0	0	0	0	0
Dunlin	3	93	420	0	21	0	0
Dowitcher spp.	200	2912	3475	8	84	0	6390