

Discrimination of Predators by Lapwings (Charadriidae: Vanellus).

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Field observations of three species of lapwing revealed similar variation in responses to predatory birds. For each lapwing, variation existed in the distance at which a predator elicited a response and the intensity of that response. Responses included various vocalizations, distraction displays, and physical attack. Responses to a particular predatory species were consistent within each stage of the breeding cycle, but varied between predators and between stages. Variation in response to predators could not be attributed to habituation or predator morphology. Instead, variation was related to predator diet: species most likely to prey on lapwings or their young during a particular stage of the breeding cycle elicited the strongest response during that stage. For example, vultures, snail-eating kites and fish-eating species elicited little or no response. The apparently sophisticated discriminatory abilities of these species may be a result of the high cost of false alarms in their open, predator-rich habitats.

AERIAL SURVEYS OF SHOREBIRDS IN SOUTH AMERICA: SOME PRELIMINARY RESULTS

by R. I. G. Morrison

Introduction

One of the most basic requirements for conservational planning for shorebirds on an international scale is to obtain an understanding of their distribution throughout their ranges, and to identify those areas which are of critical importance during the annual cycle of the birds. Obtaining such information in South America presents considerable problems owing to the enormous distances to be covered and the remote nature of the coastline. Aerial surveys represent perhaps the only method of overcoming this logistical barrier and obtaining a wide geographical perspective on the distribution of the birds. The opportunity of undertaking such surveys has occurred under the Latin American Program of the Canadian Wildlife Service, set up in 1980 to undertake programs of conservational interest on groups of migratory birds shared between Canada and Latin American countries. Shorebirds are the most important group of birds shared between Canada and many South American countries, and a Shorebird Atlas Project has been started to determine shorebird distribution on wintering and migration areas for as much of the South American coast as possible. To date, spring surveys have been carried out in Suriname and Venezuela in 1981, and the first major set of winter surveys was completed in January/February 1982. During the latter, a large proportion of the coastline of northern South America was covered, including the coasts of Venezuela, Trinidad, Guyana, Suriname, French Guiana and Brasil to east of the mouth of the Amazon River, as well as the Rio Grande do Sul coastline of southern Brasil and nearly the entire coastline of Argentina (see Figure 1). This paper will present broad preliminary results from the 1982 set of winter surveys.

Methods

Aerial surveys of the mainland coast were carried out in single or twin engine light aircraft (Aero Commander, Norman Britten Islander, Cessna 210), and in a jet helicopter (Gazelle) for the coast of Trinidad. Surveys were flown at an altitude of approximately 40-50 metres and air speed of 160-240 kilometres per hour, depending on the densities of birds being encountered. Two observers recorded times and places of bird observations and estimates of numbers directly onto cassette tape recorders for later transcription.

Results

An estimated total of almost 2,214,300 shorebirds were counted during the aerial surveys (Table 1, see Figure 1). A number of areas of outstanding international importance for shorebirds were identified. The north coast of South America, Suriname and parts of neighbouring French Guiana are of critical importance for a wide variety of shorebird species, while on the coast of Argentina several areas hold major portions of the wintering populations of the North American race of the Red Knot *Calidris canutus rufa* and of the Hudsonian Godwit *Limosa haemastica*. Results are summarized for each country below, in geographical order starting with Venezuela. Totals in the text are rounded; those in Table 1 give the actual numbers counted.

Venezuela. For Venezuela, the most important shorebird habitats appeared to be in the Orinoco River Delta and in the coastal lagoons, especially those of the east-central coast between Caracas and Barcelona and on the Araya Peninsula, as well as those on the west-central coast and the Paraguana Peninsula. Much of the western and central coastline of Venezuela is sandy, mountainous and rocky, the only area with extensive mangrove coasts being found in the delta of the Orinoco River.

In February 1982, an estimated total of over 130,000 shorebirds were counted in Venezuela, with 65% in the Orinoco River Delta, and 19% and 8% in coastal lagoons of the east-central and west-central coasts, respectively. "Peeps", probably mostly Semipalmated Sandpipers *Calidris pusilla*, comprised 72% (94,100) of the total, and showed a similar pattern of distribution, with 74% in the Orinoco Delta, and 16% and 4% in the east-central and west-central lagoons, respectively; these represented 5% of the total for the north coast of South America (see Figure 2). Dowitchers *Limnodromus* sp. and Willets *Catotrophorus semipalmatus* (10,200 and 866 respectively) were most common in coastal lagoons with mangrove cover, and nearly 100% of Common Stilts *Himantopus himantopus* (2,150) occurred in the lagoons and at Lake Maracaibo. Sanderling *Calidris alba* (644) were recorded along the ocean beaches of western Venezuela (29%) and sandy areas of the Orinoco Delta (71%). Red Knot (520) were identified only in western Venezuela and presumably belong to the population wintering in the Caribbean.

During spring surveys in late March 1981, an estimated total of over 96,200 shorebirds were recorded in Venezuela. Some differences were observed in shorebird distribution compared with the winter surveys, suggesting a westerly shift in the birds: a much higher proportion of the birds occurred in coastal lagoons in the east-central coast (86%), and fewer were found in the Orinoco Delta (9%). Lower numbers and percentages were found on western coasts and lagoons and around Lake Maracaibo. It appears likely that these differences are related to a general westerly movement associated with spring migration towards the breeding grounds, and/or changes in availability of habitat and food resources. Apart from the greater use of coastal lagoons and westerly shift in distribution, various features of the

Table 1 - Counts of Shorebirds during aerial surveys in South America, January/February 1982

Country	"Peeps" <i>Calidris</i> spp.	White-rumped Sandpiper <i>C. fuscicollis</i>	Sanderling <i>C. alba</i>	Spotted Sandpiper <i>Actitis macularia</i>	"Medium Shorebirds"	Golden Plover <i>Pluvialis dominica</i>	Black-bellied Plover <i>P. squatarola</i>	Ruddy Turnstone <i>Arenaria interpres</i>	Yellowlegs SP. <i>Tringa</i> spp.	Dowitcher SP. <i>Limnodromus</i> sp.
Venezuela: west	9,746	-	184	9	7,513	-	213	219	1,290	-
central	15,202	-	-	-	300	-	47	-	779	7,113
east	69,166	-	460	7	10,435	-	143	42	246	3,100
Trinidad	12,337	-	5	22	81	-	173	76	489	209
Guyana	9,755	-	28	18	1,246	-	598	49	6,378	1,450
Suriname	1,342,411	-	42	9	55,837	-	3,942	621	65,639	11,270
French Guyana	395,327	-	2	5	9,444	-	20	601	5,137	1,200
Brasil northwest	24,954	-	2	2	1,674	-	477	191	125	20
Amazon	1,958	-	117	4	141	-	101	4	185	150
Amazon-east	15,496	-	408	-	7,344	1	49	127	364	-
	1,896,352	-	1,248	76	94,015	1	5,763	1,930	80,632	24,512
Brasil: Rio Grande do Sul	15,069	2,340	6,478	-	420	381	3	-	3	-
Argentina	16,000	-	1,367	-	3,219	138	6	328	649	-
	31,069	2,340	7,845	-	3,639	519	9	320	652	-
Total	1,927,421	2,340	9,093	76	97,654	520	5,772	2,250	81,284	24,512

Country	Red Knot <i>C. canutus</i>	"Large Shorebirds"	Willet <i>Catartophorus semipalmatus</i>	Whimbrel <i>Numenius phaeopus</i>	Hudsonian Godwit <i>Limosa haemastica</i>	Common Stilt <i>Himantopus himantopus</i>	American Oystercatcher <i>Haematopus palliatius</i>	Black Oystercatcher <i>H. ater</i>	Southern Lapwing <i>Vanellus chilensis</i>	GRAND TOTAL
Venezuela: west	520	165	121	92	-	1,751	47	-	-	21,870
central	-	50	464	5	-	391	1	-	-	24,352
east	-	-	281	122	-	7	-	-	-	84,009
Trinidad	-	-	190	76	-	34	-	-	-	13,692
Guyana	-	-	284	36	-	-	-	-	-	19,842
Suriname	-	2,640	15,218	3,165	-	80	-	-	-	1,500,874
French Guyana	-	650	325	380	-	20	-	-	-	413,111
Brasil northwest	120	511	25	137	-	-	-	-	-	28,238
Amazon	-	3	-	-	-	-	-	2	2	2,665
Amazon-east	-	2,681	631	460	-	-	-	-	-	27,568
	640	6,700	17,539	4,473	-	2,283	7	-	2	2,136,221
Brasil: Rio Grande do Sul	-	4	-	-	-	100	851	-	458	26,107
Argentina	14,592	59	23	5	3,494	350	11,425	345	-	51,971
	14,592	63	2	5	3,494	450	12,276	345	458	78,078
Total	15,232	6,763	17,541	4,478	3,494	2,733	12,331	345	460	2,214,299

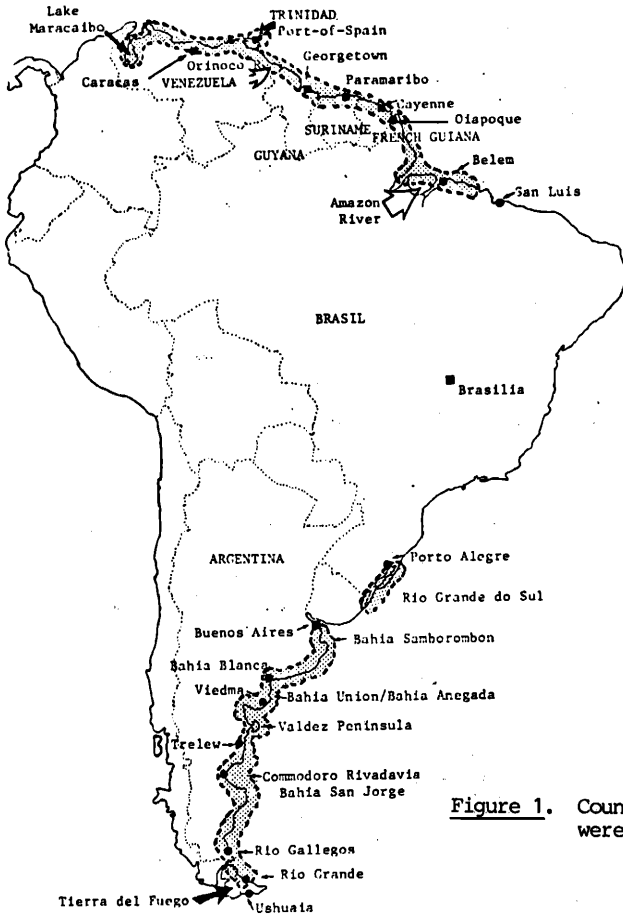


Figure 1. Countries and coastal areas in which aerial surveys were carried out, January - February 1982.



Figure 2. Distribution of small sandpipers (mostly Semipalmated Sandpipers *Calidris pusilla*) on the north coast of South America during aerial surveys in January - February 1982.

two surveys were consistent. Peeps (84,900) comprised 88% of the shorebirds recorded, and 92% of these occurred in east-central coastal lagoons. Medium-sized shorebirds, including yellowlegs *Tringa* sp. and Willets, favoured east-central coastal lagoons and over 95% of Common Stilts were in lagoons. Sanderling (404) were once more restricted to sandy beaches in western Venezuela (82%), the east-central coastline (15%) and the Orinoco Delta (4%), a more westerly distribution again being evident.

Trinidad. An estimated total of nearly 13,700 shorebirds were counted in Trinidad, of which some 90% were small sandpipers. The most important shorebird habitats occurred at a restricted number of locations on the west coast. Oil pollution was evident along many parts of the west and east coasts.

Guyana. Nearly all the estimated 19,800 shorebirds recorded in Guyana occurred in the eastern section of the country, between Georgetown and the border with Suriname. Although this area is probably heavily used during migration periods, it contained a relatively small proportion of the shorebirds on the north coast (less than 1% of the total, or 1% of the total for the three Guianas) (Figure 2). The large number of band recoveries in Guyana of Semipalmated Sandpipers marked in James Bay, Canada, suggests heavy hunting pressure on the coast in this area (unpublished results). Very few shorebirds indeed were seen west of Georgetown to the border with Venezuela, the coastline consisting principally of tropical ocean beach.

Suriname. Suriname can be identified clearly as the most important area for shorebirds on the north coast of South America. An estimated 1,500,900 shorebirds were counted in Suriname, comprising 70% of the total for the north coast of South America (2,136,200) or 78% of the total for the three Guianas (over 1,933,800).

Small sandpipers were predominant, comprising 89% of the shorebirds in Suriname. Their total (1,342,400) represented 77% of the peeps in the three Guianas and 71% of the peeps on the areas of the north coast that were surveyed (Figure 2).

Suriname also contained high percentages of other shorebirds on the north coast, including yellowlegs (65,600 or 81%), Willets (15,200 or 87%), Whimbrel *Numenius phaeopus* (3,165 or 71%), unidentified medium-sized shorebirds (55,800 or 59%), Black-bellied Plover *Pluvialis squatarola* (3,942 or 68%) and Ruddy Turnstone *Arenaria interpres* (621 or 32%).

The most important areas were the large mudflats of the Wia Wia Bank in eastern Suriname and those in the west of the country towards Nieuwe Nickerie. The mudbanks are formed from deposition of sediments derived from the Amazon River.

French Guiana. French Guiana is the second most important country for shorebirds on the north coast of South America. Estimated counts totalled over 413,000, representing 19% of the shorebirds recorded on the north coast and 21% of the shorebirds in the Guianas.

"Peeps" (395,000) comprised 96% of the total shorebirds for French Guiana and represented 21% of the peeps recorded on the north coast of South America (Figure 2). The second largest number of Ruddy Turnstones recorded on the surveys (601) was in French Guiana, representing 31% of the total for the north coast, and there were significant proportions of several other species, including yellowlegs (5,000 or 6%), Whimbrel (380 or 9%), dowitchers (1,200 or 5%) and unidentified medium-sized shorebirds (9,400 or 10%).

The most important habitats were mud and sand flats in the western section of the country between the border with Suriname and Cayenne.

Brasil - North. The northern section of the coast of Brasil which was surveyed contained an interesting variety of shorebird species, but numbers were lower than in the Guianas. An estimated total of over 58,400 shorebirds was counted, representing 3% of the total for the north coast, and of which 73% (42,400) were small sandpipers (see Figure 2).

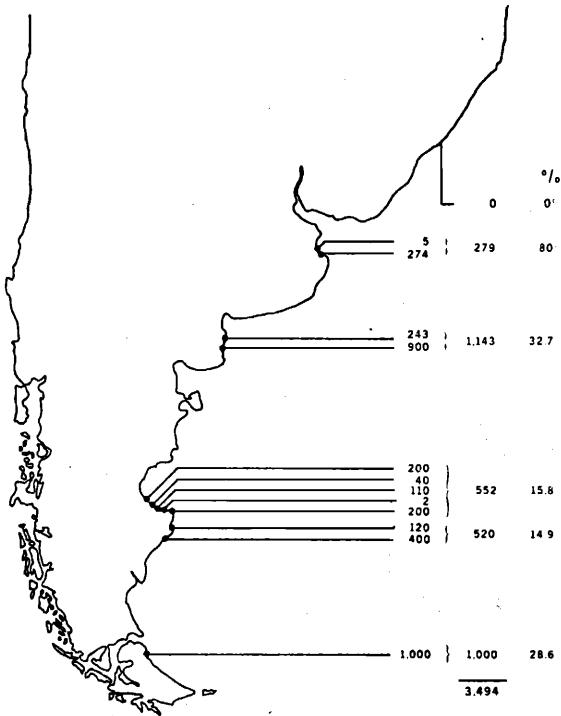


Figure 3. Distribution of Hudsonian Godwits (*Limosa haemastica*) during aerial surveys of Argentina and southern Brasil, January 1982.

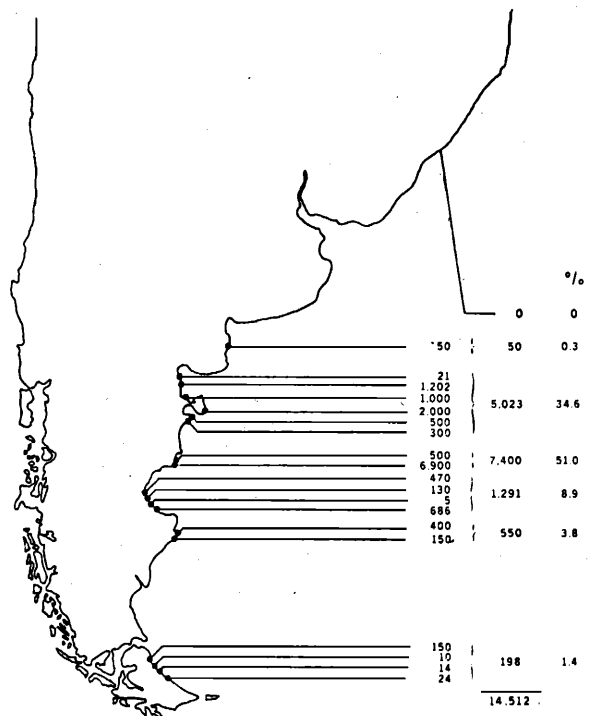


Figure 4. Distribution of Red Knot (*Calidris canutus rufa*) during aerial surveys of Argentina and southern Brasil, January 1982.

Three distinct zones were covered: the western section, running from the border with French Guiana to the north shore of the Amazon River, consisting principally of a muddy or sandy mangrove coast; the Amazon Delta itself, containing areas of sandflats backed by a mangrove and palm coastline; and an eastern section from the east shore of the Amazon River to the Para State border, consisting of a series of deeply indented shallow bays lined by mangroves and separated by sandy headlands. Many of the headlands and islands in the large bays contained lagoons.

The western section contained moderate numbers of shorebirds, especially in the Amapa area. Small and medium-sized species appeared relatively more common than large species compared to the eastern section.

The mouth of the Amazon River itself was notable for containing very few shorebirds, despite there being large areas of sandflats. It would appear likely that the fresh water input and strong, turbulent currents preclude development of suitable invertebrate food resources. The main area of note was an extensive marsh on the east side of Irla Caviana, where over 7,500 Scarlet Ibises *Eudocimus ruber* were found.

The section east of the mouth of the Amazon River contained good numbers and a moderate diversity of shorebirds, and a variety of habitats. Comparatively more large species were found than in the western section. Measurements of Semipalmated Sandpipers from this area in the Goeldi Museum in Belem indicated that birds of this species originated from breeding grounds in the eastern Canadian arctic (Morrison 1982).

Brasil - South. The Rio Grande do Sul coastline was surveyed from Porto Alegre to near the border with Uruguay. The outer coast consists entirely of ocean beaches backed by lagoons. The Lagoa do Peixe in the northern section is connected to the sea, whereas the lagoons in the southern section were not.

The most important area was the Lagoa do Peixe, which contained higher numbers of small sandpipers, probably mostly White-rumped Sandpipers *Calidris fuscicollis*, than any other individual area observed south as far as Tierra del Fuego.

Large numbers of Sanderlings were found on the outer beach (6,500), mostly in the northern section (6,000), the total representing some 83% of the Sanderlings observed south to Tierra del Fuego. Sanderlings, Golden Plovers *Pluvialis dominica*, and American Oystercatchers *Haematopus palliatus* were identified exclusively or principally on the outer beach, whereas Common Stilts and Southern Lapwings *Vanellus chilensis* occurred in the lagoons.

Argentina. An estimated total of nearly 52,000 shorebirds was counted in Argentina. Most numerous were small sandpipers (16,000 or 31%), mostly White-rumped Sandpipers, followed by Red Knot (14,600 or 28%), oystercatchers (11,400 or 22%) and Hudsonian Godwits (3,500 or 7%). Wintering areas identified for the Hudsonian Godwit and Red Knot are of outstanding international importance.

Aerial surveys indicated that important wintering concentrations of Hudsonian Godwits occurred in 1) Bahia Union/Bahia Anegada in the estuary of the Rio Colorado (1,140 or 33%), 2) on the restinga around Caleta Olivia south of Comodoro Rivadavia in Golfo San Jorge and areas south of there to past Puerto Deseado (1,070 or 31%), and 3) on the extensive mudflats of Bahia San Sebastian in Tierra del Fuego (1,000 or 29%) (Figure 3). Ground surveys indicated that Bahia San Sebastian is of outstanding international importance - an estimated 6-8,000 Hudsonian Godwits were observed in approximately 20% of the bay that could be reached on 18 January 1982, suggesting that a substantial proportion of the world population of this species may use the area during the northern winter (Morrison 1982).

The most important wintering areas for Red Knots identified on the aerial surveys occurred 1) around the Valdez Peninsula (5,020 or 35%) and 2) in the area of Bahia Bustamante and on the restinga from Caleta Olivia to around Cabo Blanco in Golfo San Jorge (8,690 or 60%) (Figure 4). On the Valdez Peninsula, Knots were found mostly on the outer coasts (Golfo San Jose was not surveyed) of, and to the north of, the Peninsula. The largest concentrations observed on the surveys occurred around Bahia Bustamante, where the coastline is rocky with sandy bays, but where there were also a series of low, scrubby swamplands near the shore. To these areas of importance must be added the Atlantic coastline of Tierra del Fuego: during ground surveys, flocks estimated to contain 1,000 and 1,200 birds were observed in Bahia San Sebastian and on the coast near Estancia Viamonte, respectively, and wintering flocks of 5,000 have previously been reported from the Rio Grande area (Devillers and Terschuren 1976, Harrington and Morrison 1980a,b).

Peeps, mostly White-rumped Sandpipers, were most numerous along the sandy bays and rocky headlands from Rawson to Bahia Bustamente and on the restinga of southern Golfo San Jorge from Caleta Olivia to Cabo Blanco (7,510 or 47%). The large estuaries at Bahia Blanca and of the Rio Colorado in Buenos Aires Province were also important (3,190 or 20%), and concentrations were seen in other areas of coast with sandy bays and rocky shores around the Valdez Peninsula, along the coast of Santa Cruz Province and in Tierra del Fuego.

Flocks of oystercatchers were most numerous between Rawson and Santa Cruz (10,600 or 93%); Black Oystercatchers Haematopus ater were recorded only on this section of coast. Sanderlings occurred principally on the ocean beaches of Buenos Aires Province and south to the San Antonio estuary and Valdez Peninsula (1,270 or 93%). Yellowlegs occurred mostly around the marshes of Bahia Samborombon and coastal lagoons in Buenos Aires Province (632 or 97%), as did Common Stilts (350 or 100%).

Discussion

The most important result of the surveys along the north coast of South America was the identification of Suriname as by far the most important area for shorebirds in the region. Of the estimated total of over 2,136,200 shorebirds counted on the north coast, 70% occurred in Suriname, with a further 19% in French Guiana, so that these two countries alone accounted for nearly 90% of the shorebirds observed on the surveys. These considerations applied to a wide variety of species. For small shorebirds, of the estimated 1.9 million 'peeps' (mostly Semipalmated Sandpipers) found on the surveys, over 90% of the birds occurred in Suriname and French Guiana, 70% of the total occurring in Suriname (Figure 2). Other species for which Suriname held major proportions included yellowlegs (81%), Willets (87%), Whimbrels (71%), Black-bellied Plovers (68%) and unidentified medium-sized shorebirds (59%). It is interesting to note that the estimate of two million Semipalmated Sandpipers along the coast of Suriname in September 1980 by Spaans and Swennen (1982) is of the same order of magnitude as totals observed on the present surveys, and that their observation of 400,000 birds near Krofajapasi during the same period is similar to aerial survey estimates for the Wia Wia Bank area in February 1982 and March 1981. The importance of the coast of Suriname for 'North American' shorebirds has been pointed out by Spaans (1978, 1979), Morrison and Spaans (1979) and Spaans and Swennen (1982), but this is the first time that large-scale survey results have provided the wide geographical perspective which clearly demonstrates this fact. The importance of Suriname is related to the occurrence of very extensive mudbanks on its coast, sediments of which are derived from the Amazon River and deposited after being transported westwards by the Guiana current.

Distribution of other shorebird species along the north coast of South America reflected habitat distribution and availability. For instance, Sanderlings were found principally along sandy coastlines, with 37% being found in such areas in the Orinoco River delta, 33% along ocean beaches east of the Amazon River, and a further 15% on the long, sandy coastlines of western Venezuela. Over 93% of the Common Stilts were recorded in coastal lagoons in central Venezuela and at Lake Maracaibo.

The other most important results of the surveys were the identification of major wintering areas for Hudsonian Godwits and Red Knot in Argentina (Figures 3 and 4). Large concentrations of Hudsonian Godwits had been found by Harrington and Morrison (1980b) in Tierra del Fuego at Bahia San Sebastian in December 1979. During ground surveys in January 1982, an estimated 6-8,000 Hudsonian Godwits were found on the 20% of Bahia San Sebastian that could be observed, indicating that a substantial proportion of the world population of this species may use the area during the northern winter (Morrison 1982). Concentrations of this magnitude have only elsewhere been observed in James Bay, Canada, though the birds are suspected to have a major stopover area at an intermediate area, probably somewhere in northern South America (Morrison and Harrington 1979, Morrison 1982). Other areas of importance for this species in Argentina included the restinga around Caleta Olivia in Golfo San Jorge and areas south of there to past Puerto Deseado, as well as the intertidal flats of Bahia Union/Bahia Anegada in the estuary of the Rio Colorado.

For Red Knots, the most important areas found on the aerial surveys were around Bahia Bustamente and on the restinga from Caleta Olivia to Cabo Blanco in Golfo San Jorge, as well as around the Valdez Peninsula. Ground surveys indicated that the Atlantic coast of Tierra del Fuego was also of major importance. In general, these results agree well with and extend the previous findings of Harrington and Morrison (1980a,b).

Acknowledgements

We acknowledge the magnificent cooperation and assistance that was received from counterpart agencies in all the countries visited during the surveys. Of particular assistance were the Argentinian National Parks Service (Dr. Arturo Tarak, Pablo Canevari), the Brazilian Banding Office (Paulo Antas), the Suriname Forestry Service (Ferdinand Baal, Ben de Jong, Henk Reichart), the Venezuelan Wildlife Service (Douglas Figueroa, Frank Espinosa) and the Wildlife Division of the Forestry Division in the Ministry of Agriculture, Lands and Fisheries in Trinidad (Bheesham Ramdial). We acknowledge the considerable contribution of the Argentinian Air Force in providing an aircraft for surveys in Argentina and of the Trinidad Ministry of National Security for making a coastguard helicopter available for flights in Trinidad.

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