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Priority Areas for Conservation of Migratory and Resident Waterbirds on the Coast of Brazilian Amazonia

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Resumo. **Áreas Prioritárias Para a Conservação de Aves Migratórias e Residentes na Costa Amazônica Brasileira.** O presente estudo propõe gerar um mapa de ocorrência para a avifauna migratória e residente na costa amazônica brasileira e ao mesmo tempo recomendar áreas prioritárias para a sua conservação. A base de dados se refere a censos populacionais realizados entre 1998 e 2005 em 44 localidades da costa amazônica brasileira incluindo os estados do Amapá, Pará e Maranhão, com uma área de aproximadamente 300.000ha. Todas as áreas foram percorridas no período de invernada, utilizando-se embarcações a motor e os censos feitos através de binóculos (9x35). Um total de 56.453 aves costeiras foi censado. Os municípios de Cururupu (MA), Viseu (PA) e Maracanã (PA) apresentaram as maiores concentrações, com respectivamente 19550, 12301 e 10142 indivíduos censados e foram considerados como áreas prioritárias para a conservação na costa amazônica brasileira. O maior número censado em Cururupu (35% do total) pode ter sido devido ao maior número de ilhas neste trecho da costa amostrada. No município de Viseu (PA), foi detectada uma alta abundância do maçarico *Calidris canutus* (2000 indivíduos) que apresenta um claro declínio populacional global. Na Vila do Penha, margem direita da baía do Maracanã (PA), foram observadas uma das maiores concentrações do maçariquinho *Calidris pusilla* (6000 indivíduos). Os dados indicam a excepcional importância da zona costeira amazônica como um sítio hemisférico e a necessidade urgente de sua conservação. Para uma visão mais acurada da abundância e distribuição de aves costeiras são sugeridos métodos de censos aéreos e terrestres a serem executados em sincronia.

Palavras chave: Áreas prioritárias, conservação, aves migratórias e residentes, costa amazônica brasileira.

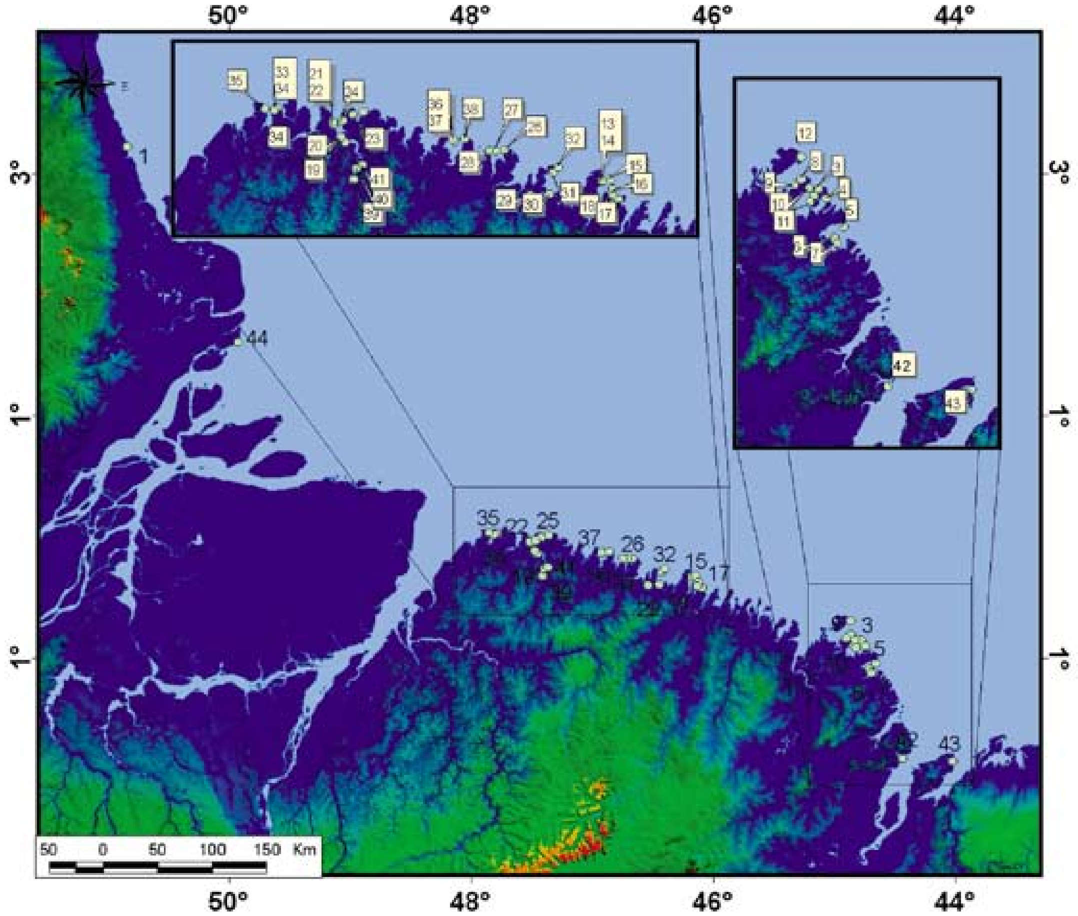
Abstract. The present study provides a georeferenced map of the occurrence of migratory and resident waterbirds on the coast of Brazilian Amazonia, and identifies priorities for the implementation of conservation strategies. The data base is derived from censuses of populations conducted at 44 localities in the Brazilian states of Amapá, Pará and Maranhão between 1998 and 2005, covering a total area of 300,000 ha. All sites were surveyed by motorboat during the wintering period, using 9 x 35 binoculars. A total of 56,453 birds were counted. The municipalities of Cururupu (Maranhão), Viseu (Pará) and Maracanã (Pará) presented the largest concentrations of birds, with 19,550, 12,301, and 10,142 individuals counted, respectively. These localities were identified as the main priorities for conservation within the region. The highest number of birds observed at Cururupu (35% of the total) may have been related to the large number of islands located around this site in comparison to others along the Amazonian coast. The Red Knot (*Calidris canutus*), a species in marked decline, was abundant at Viseu, with up to 2,000 individuals, and a major concentration (6,000 individuals) of Semipalmated Sandpipers, *Calidris pusilla*, was recorded at Vila do Penha, on Maracanã Bay. The data emphasize the importance of the coastal zone of Brazilian Amazonia as a strategic site, as well as the urgent need for its conservation. A combination of aerial and terrestrial survey techniques is also suggested as the most reliable strategy for estimating the distribution and abundance of waterbirds.

Key words: Priority areas, conservation, migratory and resident waterbirds, Brazilian Amazonian coast.

The loss and degradation of wetlands used by waterbirds during migration and wintering is a critical conservation issue for migratory species. In the 1980s, the U.S. Fish and Wildlife Service, and the Manomet Bird Observatory (as it was then known) recorded a steep decline, of up to 80% in the populations of some species. More recent data from aerial surveys at Delaware Bay, in the United States, have confirmed the ongoing decline of the populations of a number of migratory shorebird species (Clark *et al*. 1993). The International Conference of the Wader Study Group, which was held in Cadiz, Spain in 2003, reported a significant decline in the populations of migratory shorebirds throughout the world, and found that, at least for these species, reversing this process will be almost impossible without significant, conservation-oriented investments from governments on all five continents.

At this same meeting, the recent decline in the populations of the Red Knot, *Calidris canutus rufa*, on the Atlantic coast of the United States and Canada was attributed tentatively to the overexploitation of its main prey (Horseshoe Crabs *Limulus polyphemus*) by human populations in the Delaware Bay (Baker *et al*. 2004, Morrison *et al.* 2004). Rodrigues (2000, 2001) and Rodrigues and Lopes (2000) have recorded a local decline in the populations of both this species and *Calidris pusilla* on the northern coast of Brazil over more than ten years of monitoring.

In order to protect habitats critical to migratory shorebirds, the Western Hemispheric Shorebird Reserve Network (WHSRN) was created in 1985 by the then Manomet Bird Observatory, the Academy of Natural Sciences of Philadelphia, and the Canadian Wildlife Service. Given its importance as a refuge for thousands of migratory shorebirds coming from the northern hemisphere (Morrison and Ross, 1989), the western half of the coast of the Brazilian state of Maranhão, known as the "Reentrâncias Maranhenses", was included in this network in 1993. This area is also a RAMSAR site. Despite this initiative, the wintering habitats available to waterbirds on the coast of Brazil continue to suffer intense anthropogenic pressure.



ESTAÇÕES	ID
Praia do Goiabal	1
São Lucas	2
Ponta do Mutiritius	3
Caçacueira	4
Manguaça	5
Ponta da Croa	6
Croa Alta	7
Porto Alegre	8
Ponta Seca	9
Mangue Seco	10
São João Mirim	11
Ilha de Mainó	12
Ilha do Meio	13
Ponta do Bode	14
Lombo Grande	15
Croa Criminosa	16
Ponta do gato	17
Ilha Carauaçu	18
Rio Maracanã	19
Ponta do Aricuru	20
Praia Suar Suar	21
Praia do Maia	22
Vila do Mota	23
Vila do Penha	24
Praia do Maçarico	25
Praia do Pilão	26
Lombo grande	27
Praia do Maciel	28
Furo do Chinê	29
Ilha Felipa	30
Ponta do Camaraçu	31
Lombo do Murici	32
Praia Grande	33
Ilha Santa Rosa	34
Praia da Romana	35
Ilha Otelina	36
Baixio na Ilha Otelina	37
Ponta do rasgado	38
Porto de Maracanã	39
Igarapé Açu	40
Igarapé Pedrinhas	41
Ilha do Cajual	42
Praia de Panaquatira	43
Ilha do Parazinho	44

Figure 1. Map of the recorded localities of migratory and resident waterbirds on the coast of Brazilian Amazonia during the study period (1998-2005). Data from the Gulf of Maranhão, the area between Tubarão Bay to the Parnaíba estuary, Turiaçu Bay, and Cumã Bay (in Maranhão) and Marajó Island (in Pará) were from the literature (Morrison and Ross 1989, Rodrigues, 2000)

Aerial surveys over the coast of Brazilian Amazonia carried out by the Canadian Wildlife Service in 1981, 1982, and 1986 (Morrison and Ross 1989) provided an overview of the abundance and distribution of shorebirds, and valuable data on the populations of a number of species. However, those surveys were somewhat unreliable with regard to the identification of smaller species and the numbers of those resting in mangrove forest at high tide. However, those surveys are the only wide-scale aerial studies of the coast of Brazilian Amazonia available in the literature. The available terrestrial surveys for this coast (Wilson *et al* 1999; Rodrigues 2000, 2001; Rodrigues and Lopes 2000) cover only specific portions of the area traversed by Morrison and Ross (1989). More recent data from terrestrial surveys in the Gulf of Maranhão, have confirmed the importance of this sector to Ciconiiformes species (Marinez 2005).

The coast of Maranhão, and part of that of the state of Pará are officially protected by Areas of Environmental Protection (APAs), but this has not guaranteed the conservation of coastal habitats, and the fauna that inhabits them. A number of resource-management ("extractivist") reserves have also been implemented in the Amazonian coastal zone, and a number of others are planned. These reserves appear to be more restrictive, and aim to preserve the traditional artisan lifestyle of local fisherman. The coast of Amapá is far better protected, not only by reserves, but also through more effective monitoring and controls.

Given the dimensions of the northern coast of Brazil, and its known importance for migratory and resident waterbirds, the lack of recent aerial or terrestrial surveys precludes a more reliable assessment of the present-day status and trends of shorebird populations. In addition to the size of the region, and the relative remoteness of many sites, there is a worrying lack of trained personnel and shorebird specialists to conduct regular monitoring.

This paper provides a georeferenced map of the occurrence of the resident and migratory waterbirds on the coast of Brazilian Amazonia, in addition to recommending priority areas for conservation. Hopefully, this study will provide an important database for decision-makers in government agencies, especially with regard to the development of conservation strategies for the coastal zone, using waterbirds as bioindicators.

STUDY AREA AND METHODS

The study was conducted on the coast of Brazilian Amazonia. This coast is highly indented and dominated by mangrove forest. The area contains a wide variety of habitats with

extensive muddy intertidal areas and sandy beaches. The high productivity of this area is probably due the high discharge of water and sediments from the Amazon River.

Census Methods. The data base presented here is the result of censuses conducted between 1998 and 2005 at 44 localities along the coast of Brazilian Amazonia, including the states of Amapá, Pará, and Maranhão (Figure 1), covering a total area of approximately 300,000 hectares. Exact geographic coordinates of the localities surveyed are available upon request. All areas were surveyed by motorboat, and censuses were conducted by a single observer, equipped with 9 x 35 binoculars. Migratory shorebird species were prioritized, as was the southern hemisphere wintering period (December through February) when the autumn migration is over, and migratory movements are at a minimum level.

Because of logistic limitations, not all sites were surveyed in all years, and in fact, some sites were studied only once. Given this, it was decided to present the results in the form of the maximum number of individuals recorded for each species in a given year at each site during the study period. Counts were normally taken at high tide, or within two hours either side of this point. Three census procedures were adopted: 1) for small to medium concentrations of individuals (between one and 500), the observer conducted the census from the boat at a mean velocity of 5 km/h, and at a distance of approximately 50 m from the flock; 2) for flocks of more than 500 individuals, the observer conducted the census from the shore in order to guarantee the precision of the count; 3) birds perched in mangrove vegetation at high tide were counted from the boat. At the few sites accessible by road, counts were taken from the ground.

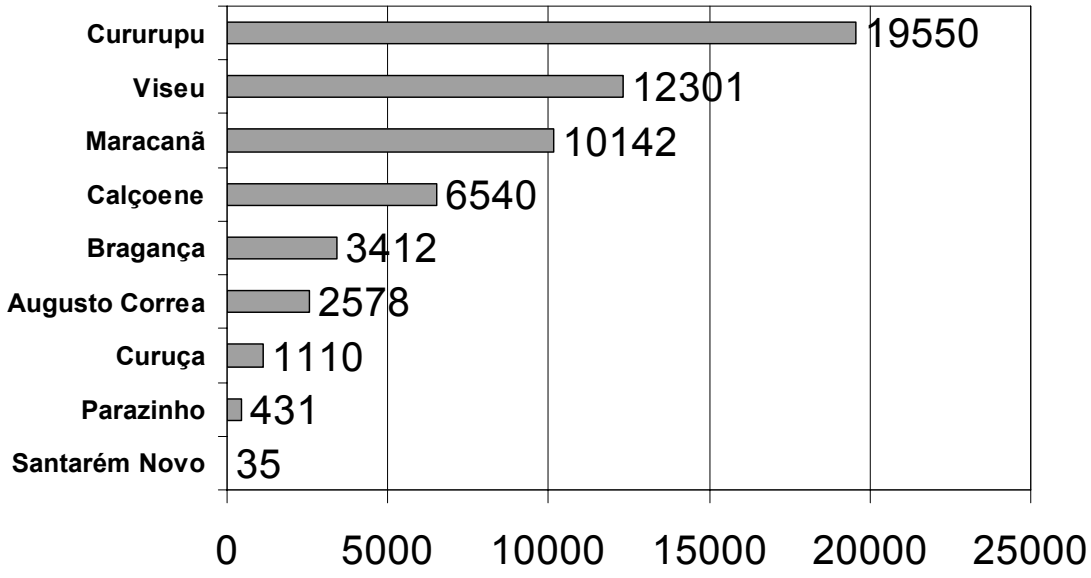
Logistic limitations prevented data collection at a number of sites in Maranhão and Pará. These included the eastern coast from Tubarão Bay to the Parnaíba estuary, Turiaçu Bay and Cumã Bay, in the municipality of Guimarães. In Pará, the Marajó Island was not visited. The results of Morrison and Ross (1989) were used for these sites. In the case of the Gulf of Maranhão, data from the present study were supplemented with those available in the literature (Morrison and Ross 1989, Rodrigues 2000).

RESULTS AND DISCUSSION

A total of 56.453 waterbirds were counted during the study (Figure 2). The largest concentrations of waterbirds were recorded in the municipalities of Cururupu (Maranhão), Viseu and Maracanã (both in Pará), which summed 75% of total number counted (Figure 2), and are thus considered the areas with the highest priority for conservation on the coast of Brazilian Amazonia.

Cururupu – Maranhão. The largest flocks of waterbirds were recorded at Cururupu (35% of total records), which may be due to the large number of islands in this stretch of coast. These islands provide many safe roosts, during high tide, and feeding areas, during low tide. Eleven major concentrations of waterbirds were detected (Table 1).

Most individuals gathered on sandy beaches, mainly on sandbars. Two sites – Croa Alta and Maiaú Island – were especially important for migratory shorebirds. The largest flocks of Semipalmated Sandpipers, *Calidris pusilla* (9,000 individuals) were recorded at these sites. Mudflats on Maiaú Island were important feeding sites for this species, corroborating Rodrigues (2001). Large (e.g. *Catopthrophorus semipalmatus* and *Numenius phaeopus*) and small-bodied species (e.g. *Pluvialis squatarola*) were well represented at Croa Alta, with a total of 1,600 individuals. Gatherings of up to 1,200 Short-billed Dowitchers (*Limnodromus griseus*), a medium-sized species, were recorded at Ponta Seca. By contrast, a number of sites (Ponta do Muricitiua, Porto Alegre, São João Mirim,



.Figure 2. Censuses of waterbirds on the coast of Brazilian Amazonia, between 1998 and 2005.

Mangue Seco, and Caçacueira) had less than one thousand individuals (Table 1).

An interesting behavior was recorded on São Lucas Island, where approximately one thousand Semipalmated Sandpipers perched on the roots of mangrove trees (*Rhizophora* sp.) during high tide. In general, these birds seek refuge on sandbanks and beaches during high tide, where they wait for low tide before moving to feeding sites.

Viseu – Pará. Viseu had the second largest concentrations of waterbirds recorded during the survey (Table 2), accounting for a quarter of the total recorded. Large flocks were observed at Croa Criminosa, including the largest ones of Gray Plovers (*Pluvialis squatarola*) recorded in the whole region (1,200 individuals). At the same locality there were many Red Knots *Calidris canutus* (2,000 individuals). The populations of this medium-sized species, which is characterized by large-

Table 1 – Species and number of individuals recorded during censuses carried out in the municipality of Cururupu – MA. Nomenclature and sequence follows CBRO (2006).

Species	São Lucas	Ponta do Muricitiua	Caçacueira	Mangunça	Ponta da Croa	Croa Alta	Porto Alegre	Ponta Seca	Mangue Seco	São João Mirim	Maiaú Island	Total
Ardeidae												
Nycticorax. nycticorax	0	1	0	0	0	0	0	0	0	0	0	1
Egretta thula	0	50	0	0	0	0	0	100	0	0	12	162
Threskiornithidae												
Eudocimus ruber	0	30	0	0	0	0	0	0	0	0	25	55
Haematopodidae												
Haematopus palliatus	0	5	0	0	0	0	0	0	0	0	4	9
Charadriidae												
Pluvialis squatarola	0	5	0	70	0	400	0	0	0	0	50	525
Tringa melanoleuca	0	0	0	0	0	20	0	0	0	0	5	25
Charadrius semipalmatus	0	0	0	50	0	0	10	0	0	0	120	180
Charadrius wilsonia	0	0	0	7	0	0	0	0	0	0	6	13
Scolopacidae												
Limnodromus griseus	500	250	0	15	0	0	50	1200	0	100	250	2365
Numenius phaeopus	20	50	0	80	400	700	0	40	0	100	80	1470
Catoptrophorus semipalmatus	100	150	0	60	200	800	0	0	0	50	50	1410
Arenaria interpres	0	30	0	50	0	0	50	150	0	0	30	310
Calidris canutus	0	0	0	0	0	0	0	0	0	0	80	80
Calidris pusilla	1000	250	0	800	500	4000	150	0	0	0	5000	11700
Laridae												
Larus atricilla	10	0	20	0	150	0	100	150	150	0	0	580
Sternidae												
Phaetusa simplex	0	0	5	0	0	0	0	0	0	0	15	20
Sternula antillarum	0	0	30	100	0	0	0	0	0	0	40	170
Gelochelidon nilotica	0	0	0	0	150	0	0	0	0	20	0	170
Thalasseus sandvicensis eurygnathus	20	0	0	0	0	0	0	0	0	0	5	25
Rynchopidae												
Rynchops niger	0	10	80	150	0	0	0	0	0	10	30	280
Total	1650	831	135	1382	1400	5920	360	1640	150	280	5802	19550

Table 2 – Species and number of individuals recorded during censuses carried out in the municipality of Viseu – PA. Nomenclature and sequence follows CBRO (2006).

Species	Meio Island	Ponta do Bode	Lombo Grande	Croa Criminosa	Ponta do Gato	Carauaçu Island	Total
Threskiornithidae							
Eudocimus ruber	0	0	0	0	200	0	200
Charadriidae							
Pluvialis squatarola	0	50	50	1200	0	0	1300
Scolopacidae							
Limnodromus griseus	0	300	0	300	0	0	600
Limosa fedoa	0	0	1	0	0	0	1
Numenius phaeopus	300	50	120	200	50	0	720
Catoptrophorus semipalmatus	1200	50	0	0	50	0	1300
Arenaria interpres	0	100	0	300	0	0	400
Calidris canutus	0	0	0	2000	0	0	2000
Calidris alba	0	200	0	400	0	0	600
Calidris pusilla	0	200	0	0	100	0	300
Laridae							
Larus atricilla	0	20	600	500	0	3000	4120
Sternidae							
Gelochelidon nilotica	0	0	30	0	0	0	30
Thalasseus maximus	0	10	0	20	0	100	130
Thalasseus sandvicensis eurygnathus	0	0	250	30	0	0	280
Rynchopidae							
Rynchops niger	0	0	120	0	200	0	320
Total	1500	980	1171	4950	600	3100	12301

scale migrations, are in marked decline (Clark *et al*., 2001). *Catopthrophorus semipalmatus* (1,200 individuals) and *N. phaeopus* (300 individuals) were seen perching on *Rhizophora* roots during high tide on do Meio Island, in a similar fashion to *C. pusilla* in Cururupu.

The Marbled Godwits *Limosa fedoa* was recorded at Lombo Grande. However, this species has been observed in several occasions on the coast of Brazilian Amazonia, which represents an expansion of the known winter range down the Atlantic Coast of South America to the northern coast of Brazil (Kober *et al.* 2006).

Gulls were recorded at various localities along the Amazon coast. The largest concentrations of Laughing Gulls (*Larus atricilla*), with up to 3,000 individuals, were recorded in this municipality, on Carauaçu Island and probably represents the most important wintering area for this species in Brazil.

Maracanã – Pará. The outermost areas of Maracanã Bay had medium-sized concentrations of waterbirds (Table 3), found mainly at three sites: Vila do Penha, and Maçarico and Maia beaches. The largest flocks of *C. pusilla* (6,000 individuals) were observed at Vila do Penha, on the eastern margin of the bay. Medium-sized flocks of this species (2,500 individuals) were also recorded 12km further north, at Maçarico beach. Similar concentrations of shorebirds were recorded at a nearby complex of sandy beaches, including Maia and Soar Soar (Table 3).

The latter site was responsible for the largest flock (500 individuals) of Neotropical Cormorants (*Phalacrocorax brasilianus*) recorded at any locality surveyed. This spotty distribution is unusual, but it may be related to specific characteristics of the site, such as a higher influx of freshwater from local rivers, and a relative high abundance of fish, a significant factor for these piscivorous birds.

While flocks at Maia beach had less than one thousand individuals, this site presented the greatest species richness, and substantial numbers of herons (*Butorides striata* and *Nycticorax nycticorax*). The remaining three sites (Ponta do Aricuru, Rio Maracanã, and Vila do Mota) were of minor importance, with total counts of less than 100 waterbirds (Table 3).

Bragança – Pará. In Bragança, the greatest abundance of waterbirds was recorded at Lombo Grande on Canela Island (Table 4), a prominent site known for its resident breeding population of Scarlet Ibis (*Eudocimus ruber*) – Roma (2001). The most abundant shorebird species on this island was *C. pusilla*.

Waterbirds were relatively rare in this municipality, however, because of reduced availability of resting areas at high tide, reduced feeding sites at low tide; and intense disturbance

Table 3 – Species and number of individuals recorded during censuses carried out in the municipality of Maracanã – PA. Nomenclature and sequence follows CBRO (2006).

Species	Maracanã River	Ponta do Aricuru	Suar Suar Beach	Maia Beach	Vila do Mota	Vila do Penha	Maçarico Beach	Total
Phalacrocoracidae								
Phalacrocorax brasilianus	0	10	500	0	0	0	0	510
Ardeidae								
Nycticorax nycticorax	0	0	0	50	0	0	0	50
Nyctanassa violacea	0	0	0	100	0	0	0	100
Threskiornithidae								
Eudocimus ruber	5	0	0	0	0	0	0	5
Haematopodidae								
Haematopus palliatus	0	0	0	4	0	0	0	4
Charadriidae								
Pluvialis squatarola	0	10	0	100	0	5	25	140
Charadrius semipalmatus	0	0	0	10	0	0	60	70
Scolopacidae								
Limnodromus griseus	0	0	0	200	15	0	20	235
Numenius phaeopus	0	1	0	100	0	0	0	101
Catoptrophorus semipalmatus	0	0	0	15	0	0	5	20
Actitis macularius	0	0	0	0	10	0	40	50
Arenaria interpres	0	1	0	0	0	0	10	11
Calidris pusilla	0	0	0	0	0	6000	2500	8500
Calidris fuscicollis	0	0	0	1	0	0	3	4
Laridae								
Larus atricilla	25	50	0	200	0	15	0	290
Sternidae								
Phaetusa simplex.	2	5	0	0	0	0	0	7
Rynchopidae								
Rynchops niger	0	0	0	30	0	0	15	45
Total	32	77	500	810	25	6020	2678	10142

by fishing, crabbing, and boat traffic from the local port (Bragança), which may have affected local ecosystems. In addition, much of the coastline is inhabited, which may reduce bird activity at many sites.

While the abundance of birds in Bragança was not high, species richness was fairly high, especially on Canela Island. Medium-sized flocks of *L. atricilla* were recorded on Maciel beach.

Augusto Corrêa – Pará. Lombo do Murici, close to Camaraçu Point, was the site with the main concentrations of waterbirds in this municipality (Table 4). Once again, *C. pusilla* was the most abundant species. This municipality is adjacent to Bragança, and is affected by similar (but slightly less intense) anthropogenic factors, which may account for the reduced abundance of waterbirds.

Curuçá, Tracuateua and Santarém Novo – Pará. These three municipalities were characterized by low numbers of waterbirds (Table 5), with the lowest values recorded in the study area. A key site in Curuçá is the Furo da Campina, where a colony of *Eudocimus ruber* can be found. In Tracuateua, species are distributed more homogeneously, but nevertheless in lower numbers (Table 5). One factor may be the relative lack of sandy resting areas during high tide, although the proximity of Curuçá to Marajó Bay may be crucial. This bay is part of the Amazon estuary, characterized by reduced salinity and low abundance of zoobenthos (especially polychaets), the basis of the diet of many shorebird species.

Santarém Novo presented the lowest values of any site for both abundance and species richness (Table 5). The almost complete absence of shorebirds from this locality may be accounted for by its inland location on the Maracanã river, which has no sandy beaches to provide resting areas, and probably reduced resources.

Calçoene and Parazinho Island – Amapá. Goiabal beach in Calçoene returned the largest concentration (3,000 individu-

als) of Sanderlings *Calidris alba* at any of the sites surveyed on the coast of Brazilian Amazonia (Table 6). The most important wintering areas for this species are located on the Pacific coast (Morrison and Ross 1989). On the Atlantic coast, from eastern Brazil to southern South America, *C. alba* tends to be present in medium-sized flocks, with 6,618 individuals recorded at Lagoa do Peixe in Rio Grande do Sul (Morrison and Ross 1989). While *Calidris* spp. are relatively abundant on the coastline of French Guyana and Surinam, these authors recorded only 72 *C. alba* in these countries, and only two during their aerial surveys of Amapá. The results of the present study thus indicate that the wintering populations of *C. alba* in northern South America are much larger than was previously thought.

Parazinho Island is characterized by a reduced abundance of migratory shorebirds (Table 6). Collared Plover *Charadrius collaris* is the most abundant species at this site.

Priority areas for the conservation of waterbirds and the importance of aerial and terrestrial censuses. This study highlights Cururupu, Viseu, and Maracanã as the areas with the highest priority for the conservation of migratory waterbirds on the coast of Brazilian Amazonia, based on overall numbers (above 10,000 individuals). The data also strengthens the global importance of these sites. The sites at Cururupu and Viseu are very important for a large number of species, and play an extremely important role in the migratory cycle, by providing both resting and feeding areas. There is little doubt, from our results, that all three areas should be prioritized as conservation targets.

Table 4 – Species and number of individuals recorded during censuses carried out in the municipalities of Bragança and Augusto Correa – PA. Nomenclature and sequence follows CBRO (2006).

	BRAGANÇA				AUGUSTO CORREA				
Species	Pilão Beach	Lombo grande	Maciel Beach	Total	Furo do Chibé	Felipa Island	Ponta do Camaraçu	Lombo do Murici	Total
Ardeidae									
Ardea cocoi	0	0	0	0	1	0	0	0	1
Threskiornithidae									
Eudocimus ruber	0	0	0	0	10	0	0	0	10
Charadriidae									
Pluvialis squatarola	0	100	0	100	0	0	70	19	89
Charadrius semipalmatus	0	400	0	400	0	0	0	0	0
Charadrius wilsonia	0	2	0	2	0	0	0	0	0
Charadrius collaris	0	25	0	25	0	0	0	0	0
Scolopacidae									
Limnodromus griseus	0	200	0	200	0	0	0	250	250
Numenius phaeopus	0	35	0	35	0	0	0	0	0
Catoptrophorus semipalmatus	0	20	0	20	0	1	0	0	1
Actitis macularius	0	50	0	50	3	0	0	0	3
Arenaria interpres	0	25	0	25	0	1	1	0	2
Calidris canutus	0	200	0	200	0	0	30	250	280
Calidris alba	0	305	0	305	0	0	80	30	110
Calidris pusilla	0	1500	0	1500	0	0	0	1502	1502
Laridae									
Larus atricilla	40	0	300	340	0	0	200	15	215
Sternidae									
Gelochelidon nilotica	80	0	0	80	0	0	0	0	0
Sterna hirundo	50	0	0	50	0	0	0	0	0
Thalasseus maximus	0	0	0	0	0	0	5	15	20
Thalasseus sandvicensis eurygnathus	50	0	0	50	0	0	15	80	95
Rynchopidae									
Rynchops niger	30	0	0	30	0	0	0	0	0
Total	250	2862	300	3412	14	2	401	2161	2578

Table 5 – Species and number of individuals recorded during censuses carried out in the municipalities of Curuçá, Tracuateua, and Santarém Novo – PA. Nomenclature and sequence follows CBRO (2006).

	CURUÇA				TRACUATAEUA				SANTAREM NOVO			
Species	Grande Beach	Santa Rosa Island	Romana Beach	Total	Otelina Island	Otelina Island	Ponta do Rasgado	Total	Porto de Maracanã	Igarapé Açu	Igarapé Pedrinha	Total
Ardeidae												
Nyctanassa violacea	0	0	0	0	0	0	30	30	0	0	0	0
Egretta thula	0	2	0	2	0	0	0	0	0	0	0	0
Egretta caerulea	0	0	0	0	0	0	0	0	0	4	0	4
Threskiornithidae												
Eudocimus ruber	2	500	0	502	0	0	20	20	0	0	0	0
Charadriidae												
Pluvialis squatarola	0	0	0	0	0	5	15	20	0	0	0	0
Charadrius semipalmatus	0	0	0	0	40	0	0	40	0	0	0	0
Charadrisu wilsonia	0	0	0	0	8	0	0	8	0	0	0	0
Charadrius collaris	0	0	0	0	4	0	0	4	0	0	0	0
Scolopacidae												
Limnodromus griseus	0	10	20	30	0	80	40	120	0	0	0	0
Numenius phaeopus	0	18	10	28	0	3	0	3	0	0	0	0
Tringa melanoleuca	0	0	0	0	2	0	0	2	0	0	0	0
Catoptrophorus semipalmatus	0	15	0	15	0	0	0	0	0	5	0	5
Actitis macularius	0	5	0	5	0	0	0	0	6	10	10	26
Arenaria interpres	0	13	0	13	5	0	0	5	0	0	0	0
Calidris canutus	0	0	0	0	5	30	0	35	0	0	0	0
Calidris alba	0	0	15	15	0	0	0	0	0	0	0	0
Calidris pusilla	300	0	200	500	50	0	0	50	0	0	0	0
Stercorariidae												
Stercorarius sp.	0	0	0	0	2	0	0	2	0	0	0	0
Laridae												
Larus atricilla	0	0	0	0	10	0	0	10	0	0	0	0
Sternidae												
Thalasseus maximus	0	0	0	0	5	0	0	5	0	0	0	0
Total	302	563	245	1110	131	118	105	354	6	19	10	35

Despite lower numbers of birds, Bragança, Augusto Corrêa, and Curuçá also require attention and specific conservation measures. All three areas have medium-sized populations of *C. pusilla*, and the small flocks of *C. canutus* observed at Lombo do Murici and Lombo Grande in Augusto Corrêa and Bragança, respectively, emphasize the importance of these sites from the conservation viewpoint. All three municipalities also have important populations of Scarlet Ibises. Local fishermen reported a large roost of *E. ruber* on Felipa Island in Augusto Corrêa, and a flock of 500 individuals was confirmed on Santa Rosa Island in Curuçá. The importance of specific sites, such as the mudflats on Otelina Island in Tracuateua, which are an important feeding site for waterbirds, must also be considered in the development of comprehensive conservation strategies.

Some of the sites not included in this study may also be important for the conservation of waterbirds. Morrison and Ross (1989) recorded 9,048, 49,999, and 74,443 individuals, respectively, on the east coast of Maranhão, Cumã Bay, and Turiaçu Bay, with a total count of 133,490 birds. In the Gulf of Maranhão, they censused 67,155 shorebirds, whereas Rodrigues (2000) recorded 31,131 shorebirds at Panaquatira beach and Cajual Island. By contrast, Marajó Island appears to be far less important, with a count of only 1,033 shorebirds (Morrison and Ross 1989).

Aerial surveys are an extremely important tool to assess the occurrence of wading birds in coastal areas. They can provide more reliable data on both abundance and distribution over a much wider area than terrestrial surveys, although they are less reliable regarding species identification. In their survey, for example, Morrison and Ross (1989) failed to identify the species of 270,000 individuals – of small, medium and large body size – counted during their survey of the coast of Amapá, Pará, and Maranhão. By contrast, terrestrial surveys are not only more efficient in terms of species identification, but also permit more detailed behavioral observations. The large flocks of birds seen perching in mangrove forest during the present study, for example, would not have been recorded during aerial surveys. Some species rest in inland areas during high tide, precluding reliable counts, as in the case of *C. alba* in Calçoene, where 3,000 individuals returned to the sandy beach at Goiabal two hours after high tide. Overall, the most reliable estimates of the distribution and abundance of waterbirds will be provided by a combination of aerial and terrestrial procedures, as demonstrated by Warnock *et al*. (1998).

The data collected in the present study nevertheless emphasize the exceptional strategic importance of the coastal zone of Brazilian Amazonia for the conservation of waterbirds. Results indicate considerable differences among sites, reflecting differing conservation priorities. Although the data presented here are not comparable with the aerial survey of Morrison and Ross (1989), the number of some species is in evident decline, confirming which was reported at The International Conference of the Wader Study Group, in Spain 2003. The loss and degradation of wintering areas used by shorebirds on the coast of Brazilian Amazonia is a critical conservation issue for migratory and resident species.

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Table 6 – Species and number of individuals recorded during censuses carried out in the municipalities of Calçoene and the Bailique Archipelago - AP. Nomenclature and sequence follows CBRO (2006).

	CALÇOENE	BAILIQUE ARCHIPELAGO
Species	Goiabal Beach	Parazinho Beach
Charadriidae		
Pluvialis squatarola	8	0
Charadrius semipalmatus	1000	6
Charadrius wilsonia	3	3
Charadrius collaris	4	340
Scolopacidae		
Tringa melanoleuca	3	0
Arenaria interpres	6	6
Calidris canutus	5	0
Calidris alba	3000	2
Calidris pusilla	2400	8
Calidris minutilla	84	6
Rynchopidae		
Rynchops niger	0	60
Total	6513	431

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