NEW WORLD SECTION

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MIGRATION OF NEARCTIC SHOREBIRDS (CHARADRIIDAE AND SCOLOPACIDAE) IN BRASIL - FLYWAYS AND THEIR DIFFERENT SEASONAL USE

by Paulo de Tarso Zuquin Antas

Each year, twenty-five species of migratory shorebirds from the families Charadriidae and Scolopacidae reach Brasil. The southward migration has begun by mid August and lasts until mid November, while the return migration northwards lasts from early February until mid May. These long migration periods are related to the differences in timing of migration between species, as well as to the size and geographical shape of Brasil, which spans the latitude range 05° 15'N to 33° 45'S.

I should like to present here a proposal of the main flyways used by shorebirds during their migrations, and suggest a hypothesis to explain the seasonal difference in use of the Central Brasil and Central Amazonian/ Pantanal flyways (see below), based on seasonal differences in rainfall in each. The proposed flyways have been identified on the basis of field data, museum skins, distributional papers, habitat distribution and direct enquiries to other Brasilian ornithologists.

The Flyways

Shorebird migration in Brasil follows the major north-south river valleys and the sea shore. Figure 1 shows the proposed flyways. Starting in the east, the first is the Atlantic Ocean Flyway, where most of the maritime shorebirds occur. This flyway begins north of the mouth of the Amazon River, in the Amapa Federal Territory, where birds coming from the Guianas reach Brasil, and ends at the Rio Grande do Sul state, at the border with Uruguay.

Amapa has extensive mangrove stands along its shoreline, mainly Avicennia nitida and Rhyzophora mangle, with wet grasslands, and fresh and brackish water lagoons of different sizes behind the shore. The sea-water is, on average, less saline than to the south of the mouth of the Amazon River, because the river water is carried north/ northwest by the Guiana Current. Large tides of up to 9 metres range occur in this part of Brasil. This tidal difference has gradually destroyed parts of the old Amapa shoreline, mainly around the mouths of the rivers, and the phenomenon is locally called "pororoca". Sediments from shore destroyed by the pororoca are mixed with 'new' sediments from the Amazon, forming mudflats uncovered at low tide and used by shorebirds for feeding.

South-east of the mouth of the Amazon, the shoreline is very deeply indented, with narrow bays at each river mouth. Each bay has a mosaic of habitats, with an open sandy beach and sand flats on the outer shore, new mangrove growth and mud flats in the bay, and old mangrove stands towards the interior of the bay. This shoreline stretches from the mouth of the Amazon to Sao Marcos and Sao Jose bays, in which Sao Luis Island is situated.

The sea in this region has very good primary productivity, as reflected by the importance of shrimping and fishing in the local economy. The mosaic of habitats found in the area is important for migrating shorebirds for food and rest, as well as for some populations which winter near the mouth of the Amazon. Some Willets Catoptrophorus semipalmatus, all Short-billed Dowitchers Limnodromus griseus which reach Brasil, Wilson's Plovers Charadrius wilsonia and some Least Sandpipers Calidris minutilla remain in this area for the winter (November to February).

East of Sao Luis, the coast consists mostly of sand beaches with a few mangrove stands and mudflats in the mouths of the rivers. Here the most common mangrove is Rhyzophora mangle. This section ends at the north-eastern tip of Brasil; further south mangroves again become more common, and the coast has large sea bays and more rivers reaching the sea. Salvador Bay probably marks the division of this region, which contains the major wintering grounds of Semipalmated Sandpipers Calidris pusilla and Calidris minutilla, as well as part of the populations of Grey Plovers Pluvialis squatarola and Whimbrel Numenius phaeopus.

South of Baia de Todos os Santos, there are extensive mangrove stands, again mainly Rhyzophora mangle, as well as sandy beaches. The mangroves and mudflats here are found in channels and salt water lagoons behind the beaches, at the mouths of the rivers and in the interior of the bays. The sandy beaches are mainly ocean beaches. This pattern extends to 29°S, which marks the southern limit of the mangroves.

After the end of the mangroves, the last section of shoreline is a long and straight sandy beach, with lagoons of all sizes near the ocean. This part of the country is the major wintering ground for many of the shorebirds that reach Brasil. In fact, the habitats of the south-east of Brasil can be linked with those from Uruguay and Argentina near the estuary of the Rio de la Plata.

In north-eastern Brasil, some species fly over the mainland between Sao Luis Island and the mouth of the Parnaiba River, thus cutting the corner to Baia de Todos os Santos. It is known that Calidris pusilla, Solitary Sandpipers Tringa solitaria, Greater Yellowlegs Tringa melanoleuca and Lesser Yellowlegs Tringa flavipes use the dams made for human and agricultural use in the semi-arid north-eastern hinterland. Species using only this flyway are Pluvialis squatarola, Semipalmated Plover Charadrius semipalmatus, Ruddy Turnstone Arenaria interpres, most Catoptrophorus semipalmatus, Calidris pusilla, Sanderling Calidris alba and Numenius phaeopus.

The second flyway, the Central Brasil Flyway, begins at the mouth of the Amazon River, where birds coming from further north along the South American coast, and from the Amapa Territory, enter the Araguaia/Tocantins and Xingu river valleys. Shorebirds here use the mudflats of the lower valleys, as well as sandflats and long stretches of sandy/muddy beaches in the mid and upper parts of the rivers. Bananal Island in the Araguaia River and the

Figure 1. Brasil, showing the proposed shorebird flyways.

nearby river banks are of special importance. This region has a mosaic of lakes, small mudflats and large sandy beaches used by numbers of shorebirds during their southward migration. In the Bananal region, most shorebirds that have followed the Xingu River enter the Araguaia River valley. Just a few follow the Tocantins River after the junction with the Araguaia River, since the latter has more suitable habitat. The birds following the Tocantins River on their way south pass near Brasilia. This flyway joins the Parana River valley, where the birds use mudflats and the shores of large dams built in the last twenty years. Using perhaps mainly the Tiete and Paranapanema river valleys, some birds reach the shore of the Atlantic Ocean, joining those birds which came south along the coast. This is shown clearly by Golden Plovers Pluvialis dominica, which are found on Brasil's seashore only north of the Amazon River mouth and south of the state of Rio de Janeiro.

The birds which stay in the Parana River valley reach Paraguay, Argentina, the south of Brasil (Rio Grande do Sul state) and Uruguay by flying down the Parana River itself, the wetlands of the Entre Rios region in Argentina, or the mid Uruguay River valley. Pluvialis dominica, Tringa solitaria, T.melanoleuca, T.flavipes, White-rumped Sandpipers Calidris fuscicollis, Pectoral Sandpipers Calidris melanotos and Upland Sandpipers Bartramia longicauda are common species on the Central Brasil Flyway.

The third flyway is the Central Amazonia/Pantanal Flyway. Shorebirds using this flyway probably reach the Trombetas, Branco and Negro river valleys using the valleys of the rivers Maroni (French Guiana), Courantine (Suriname), Essequibo (Guyana) and Orinoco (Venezuela), or by a direct flight from the Caribbean coast. Owing to the general north/south direction of these rivers and of the Amazon tributaries, they are natural migratory corridors for shorebirds. Shorebirds reach the Amazon River itself in the Tupinanbarana Island region, where the biggest wetlands of the Amazon occur. These are formed between the mouths of the Negro and Madeira rivers and the Obidos Strait, where the Amazon River narrows from 30km to 2km in width. From this area, the birds use the Madeira and Tapajos river valleys on their way south to the Pantanal area.

The Pantanal is a very extensive (250,000 sq km) mosaic of mudflats, sandflats, small lagoons and wet grasslands mixed with belts of forest. The wetlands, the most important in size in all Brasil, are formed by the upper Paraguay River and its tributaries. The basin in this region consists of a broad semicircle of rivers entering a very flat region (with a gradient of only some 3cm per kilometre) with a small mouth (50km in width) between the Corumba/Ladario mountains and the Bodoquena Mountains.

After leaving the Pantanal, the birds follow the wetlands of the Paraguay River into Paraguay and Argentina. Birds using the eastern part of the Pantanal may merge with those using the Parana valley at the south-eastern tip of the Pantanal. Species found on this flyway include Pluvialis dominica, Tringa solitaria, T.melanoleuca, T.flavipes, Calidris fuscicollis, C.melanotos, Buff-breasted Sandpiper Tryngites subruficollis, and Bartramia longicauda. There is an old record of the Eskimo Curlew Numenius borealis from the Paraguay River and another one from the Amazonas River (between the mouths of the Negro and Madeira rivers, Pinto 1964), which suggest a probable use of this flyway in the past by this now almost extinct bird. Wilson's Phalaropes Phalaropus tricolor have used this flyway.

The fourth flyway, the Western Amazonia Flyway, is used by shorebirds which reach Brasil in western Amazonia and which have come via Central America and Colombia. Little is known of the species,and numbers, using this part of Brasil. It is known that most first-year Pluvialis dominica use this flyway in September/October. Some Stilt Sandpipers Micropalama himantopus and Calidris melanotos also use this route. Birds coming from western Amazonia use the Guapore River valley, which contains a small complex of wetlands and grassland. This is the region where Pelzen collected the only Hudsonian Godwit Limosa haemastica known from the interior of Brasil (Pinto 1964). From the Guapore River, the birds merge with those in the Pantanal Flyway, following this route further south.

Seasonal differences in the use of the Flyways

When shorebirds return northwards on migration, there are differences in their use of the flyways. For instance, Pluvialis dominica does not return via the Central Brasil Flyway and it is not common in the Pantanal area: there are many fewer birds using the Central Amazonia/Pantanal and central Brasil flyways in February/May than in August/November. Shorebirds may perhaps make greater use of the Atlantic Ocean and Western Amazonia flyways, entering the upper valleys of the Amazonian rivers in Bolivia, Peru and Colombia, as does Pluvialis dominica, or they may cross central Brasil to the mouth of the Amazon River in a non-stop flight. More data are needed to determine which strategy is used. This seasonal difference in use of the two central flyways appears to be related to the strong difference in rainfall between central Brasil and the Amazon Basin.

1. Rainfall in Central Brasil

As shown in Figure 2, there is a well-marked dry season in central Brasil, mainly in the region between 8°S and 21°S, and 46°W and the border with Bolivia and Paraguay. The Pantanal, Guapore River, headwaters of the Xingu River and most of the Araguaia and Tocantins river valley wetlands are in the same region. The dry season begins by the end of April, the rainfall dropping from an average of 200-300mm to almost zero in some places by June/July. The wet season lasts from the end of September through March. Almost 70% of the rainfall is concentrated between November and March (Nimmer 1977b). This very wet period results from the southern movement of the Intertropical Convergence Line, which stays over central Brasil at this time of the year because the Southern Hemisphere is closer to the sun than in the fall/winter.

Owing to this enormous rainfall (varying from 1500mm to 2500mm, Nimmer 1977b), the rivers receive a very concentrated input of water after November. By December, the sandy beaches and mudflats are covered by water, which also invades the small lagoons nearby. The river floods its flood plains between the end of December and mid-June, covering the feeding habitats of shorebirds (Figure 3).

The same is true for the Pantanal, only more so. The upper Paraguay River basin forms a broad semicircle with the only exit consisting of a small gap of about 50km between Bodoquena Mountain in the south-east and the Ladario/Corumba mountains in the north-west in the border region with Bolivia and Paraguay. Both factors act to maintain the water at high levels during the northward migration of shorebirds, covering most of the suitable habitats (Figure 4).

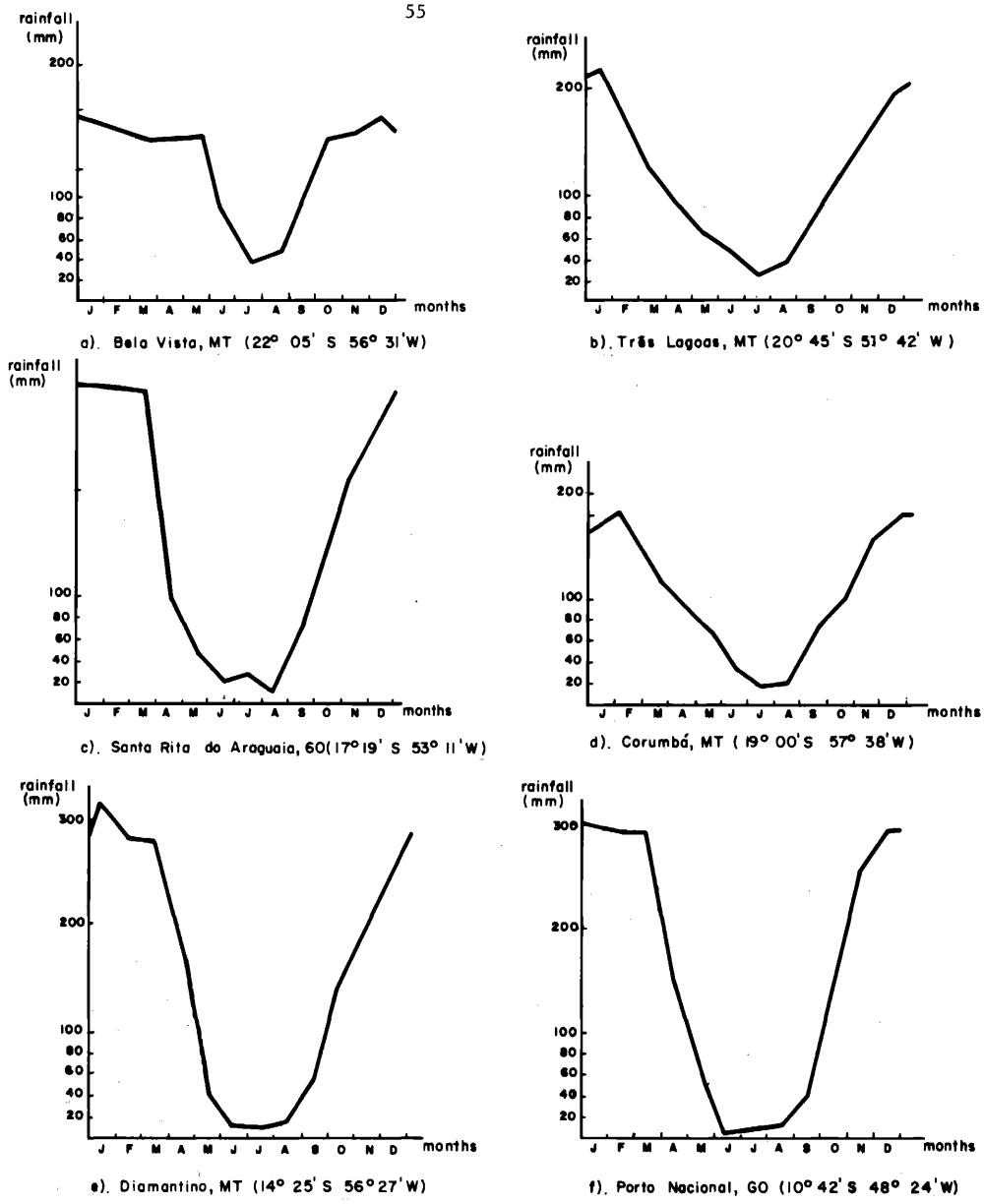

Figure 2. Seasonal variation in rainfall in Central Brasil (modified from Nimmer 1977a, 1977b)

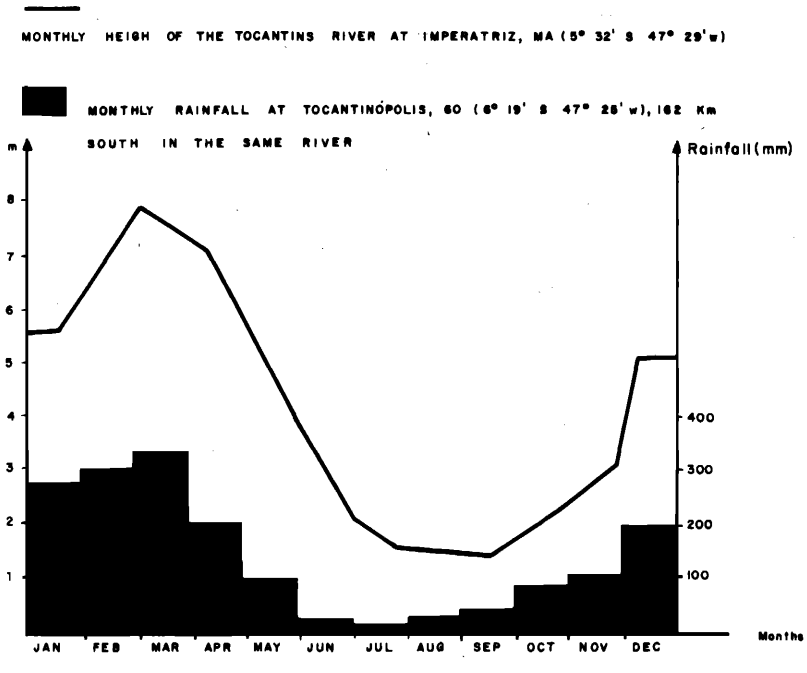

Figure 3. The water level in the Tocantins River is linked to the Seasonal Variation in rainfall (from Innocencio,1977)

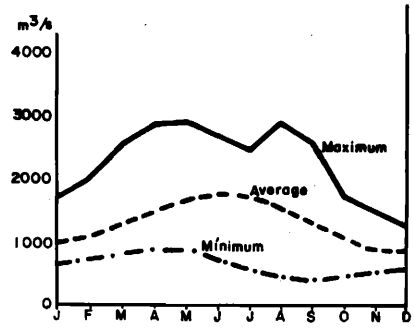

Figure 4. The waterflow of the Paraguay River at Ladario, MT (19°00'S 57°35'W), the gap at the southern end of the Pantanal, from 1900 to 1968. The waterflow is not linked directly to the local rainfall - see Figure 2d for rainfall (from Innocencio 1977).

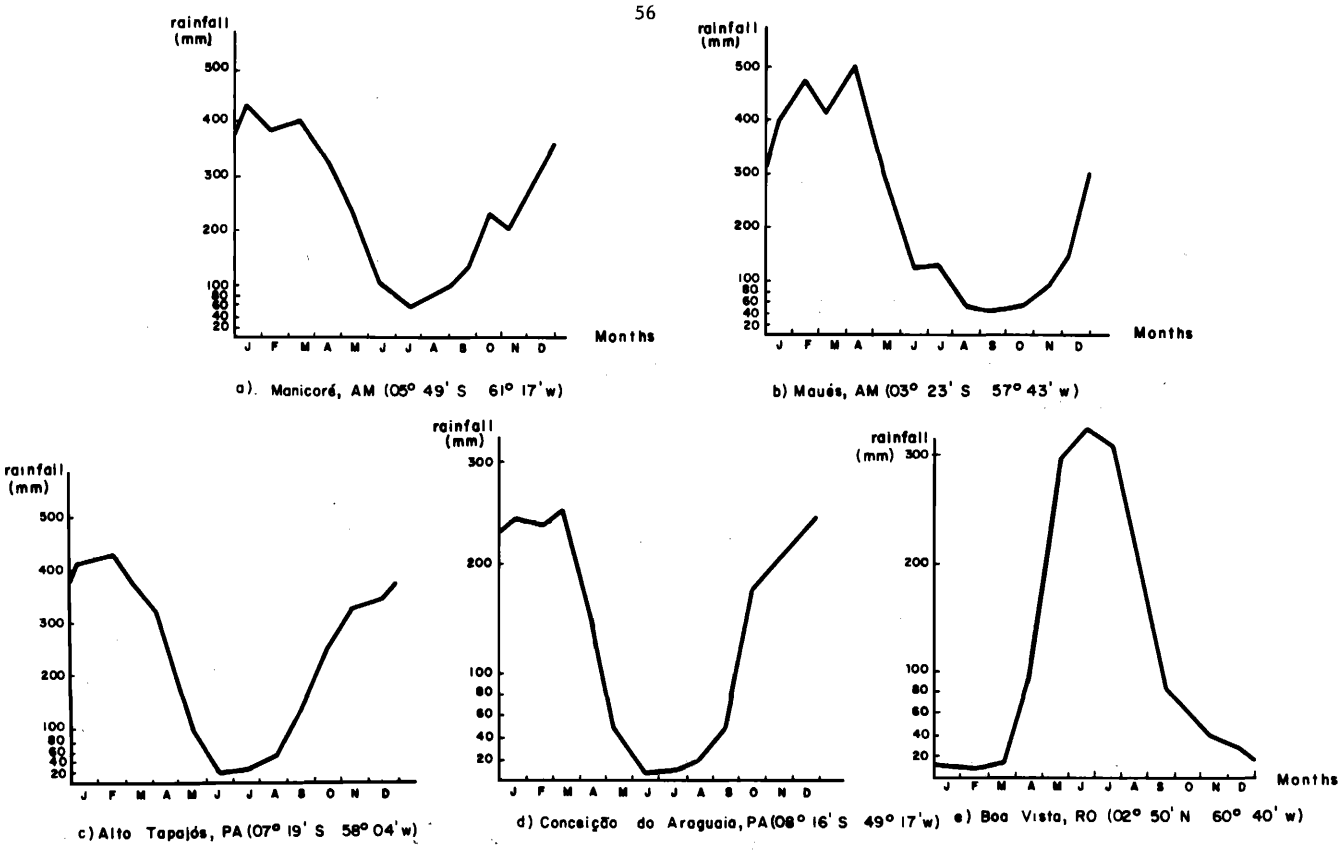

Figure 5. Season variation in rainfall in the Amazon Basin (from Nimmer 1977a)

2. Rainfall in the Amazon Basin

The Amazon Basin itself has a short dry season, not as strongly marked as that in central Brasil, but enough to modify the level of the rivers, resulting in the uncovering of sandy beaches and mudflats. However, the timing of the wet and dry seasons is different between the rivers on the south bank of the Amazon and those on the north bank, as the equator crosses the basin some 200-400km north of the Amazon River itself (Figure 5). As perhaps one-fifth of the Amazon Basin in Brasil is in the northern hemisphere, the river levels differ somewhat with their geographic position. For the south bank rivers, the flood peak is in February and for the north bank rivers it is in July. Nevertheless, it is important to point out that the low valleys of the northern rivers are affected by the Amazon flood owing to the geomorphology of the valleys, which are at almost the same level as the Amazon River itself. This results in high water levels being maintained between February and May, the end of the northern migration season, with less water in the river between July and December, when the Amazon is at a lower level and its water runs rapidly. This phenomenon is of importance in the life cycle of the Arraw Podocnemis expansa. This fresh water turtle needs sandy beaches for nesting and there are breeding populations on both banks of the Amazon Basin. Perfect synchronisation occurs in nesting between the northern and southern populations at the end of October/November, by which time there is suitable nesting habitat on both sides of the river at the same time. A similar availability of habitat can be assumed for shorebirds.

Conclusions

Shorebirds on southward migration in Brasil use four main flyways, with some movement between the main routes. This has important implications for long-range biological, ecological and conservation research on nearctic shorebirds in Brasil. Each flyway could be managed as a different unit, in which environmental concerns over particular major stopover areas could be related.

There is a seasonal difference in the availability of suitable feeding and resting habitat for shorebirds during spring (northwards) and autumn (southwards) migrations in central Brasil, and in most of the Brasilian Amazon Basin. Seasonal differences in rainfall result in habitats which are available when water levels are low during southward migration being covered with water during the birds' northward migration. During their northern journey, shorebirds may perhaps make greater use of the Atlantic Ocean Flyway, or of suitable habitats elsewhere in the upper Amazon valley, in Bolivia, Peru, Colombia or westernmost Brasil, or they could make a direct flight over central Brasil to the mouth of the Amazon River or to the northern sea coast of South America. More data are needed to determine which strategy is used by shorebirds during their northward migration.

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