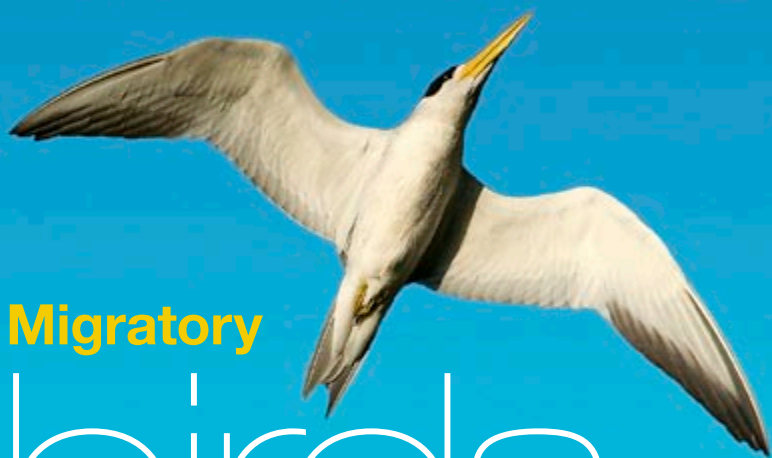




Brasil



Migratory

birds

in the *Pantanal*

Distribution of nearctic shorebirds and  
other water species in the *Pantanal*



## **MIGRATORY BIRDS IN THE PANTANAL**

DISTRIBUTION OF NEARCTIC SHOREBIRDS  
AND OTHER WATER SPECIES IN THE PANTANAL

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*Pantanal* of the Nhecolândia – Mato Grosso do Sul

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## PRESENTATION

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**T**hose who visit the *Pantanal*, in the Brazilian Mid-west region and also in Bolivia and Paraguay, are dazzled by the great quantity and variety of birds that inhabit the region.

Also known as the Kingdom of Waters – with large flooded areas throughout almost all of the rainy period – the *Pantanal* has rich animal and plant biodiversity, with 656 bird species.

Due to environmental characteristics and geographic location, the *Pantanal* is also on the route of migratory birds, which find ideal conditions to make a pit stop in their journey. Thus, it is one of the best places for bird watching in Brazil.

A study conducted in 1996 named Distribution of Nearctic Shorebirds and other Water Species in the *Pantanal* recorded the birds found in the region's salt water beds, flooded, planes and plateau areas. The study is a guide for those who want to know more about the wealth of birds in the *Pantanal*.

Among the surveyed species, there are some very well known as the Jabiru, symbol of the *Pantanal* and the Macaw which, thanks to conservation projects supported by WWF-Brazil, has experienced a considerable increase in its population. However, there are others which are not as well known such as the Yellow-billed Tern and the Coscoroba Swan.

Because of the importance of the researchers' work, WWF-Brazil – institution that has worked with conservation projects in the region since 1998, through the Pantanal Forever Programme decided to support this publication, making it accessible to the public.

WWF-Brazil believes that scientific knowledge is essential for conservation actions. Our objective, in supporting this publication, is to give due value to the *Pantanal's* wealth, as the birthplace of a great variety of birds and help to disseminate knowledge about them.

On top of the musical and scenic spectacle that birds provide us with when we watch them, they are very important environmental indicators and essential to the composition of the *Pantanal's* landscape. Our intention is to encourage, through information, the conservation of the *Pantanal* and of the species that chose it as their birthplace, where they reproduce and live.

**Denise Hamú**

CEO

WWF-Brasil

**Micheal Becker**

Coordinator

Pantanal Forever Programme



## EXECUTIVE SUMMARY

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**A**erial surveys were conducted in October 1996 in the Pantanal – the biggest and most important wetland in the planet – to:

- 1 determine the distribution and abundance of nearctic and neotropical shorebirds during the southward migration period of nearctic species;
- 2 determine the distribution and abundance of neotropical water birds;
- 3 investigate the use of habitat by nearctic and neotropical species.

It is expected that through this work, the bases to assess potential or effective impacts of business ventures, which may have an effect on the region's water regime, will be established. These were the first large scale surveys carried out in the Pantanal for these avifaunal groups.

The results point to a clear difference between the use of habitat and the regional distribution of nearctic and neotropical shorebirds, when compared to a great variety of other neotropical water species. The shorebirds concentrate around a number of lagoons – locally called bays or salt beds – in the Pantanal's central region.

Additionally, the habitats formed by small plants from the

Graminease family, mainly found in the Nhicolândia region, showed to be very important for two nearctic shorebird species. In contrast, the majority of the neotropical species groups were found in the most diverse habitats and regions of the Pantanal.

Generally speaking, the number of neotropical and nearctic shorebirds found in the salt water lagoons are of international relevance, exceeding the limit for inclusion in the Western Hemisphere Shorebird Reserve Network as an International Reserve or under the Ramsar Convention (relative to the preservation of water environments at a world level).

The distribution characteristic of the shorebird species in the Pantanal shows that special conservation measures need to be applied to this important bird group.

## INTRODUCTION

The *Pantanal* is one of the biggest and most important fresh water wetlands in the world (Bucher *et al.* 1993, By 1995, Swarts 2000), as well as being the biggest and probably the most important wet area for water birds in South America (Scott and Carbonell 1986). It is recognized world wide for its diversity and abundance of wild life (Alho *et al.* 1988, Por 1995).

The region shelters impressive numbers of plant species (over 1.700 species identified), fish (over 400 species), mammals (80 species), butterflies (over 1.100 species) and birds – 463 in the plane itself and over 650 species, when considering the immediate surroundings (Marins *et al.* 1981, Brown 1986, Francischini 1996, Pott and Pott 1997, Tubelis and Tomas 2003).

Its importance and the need for its protection and preservation has been recognized by several initiatives, including its designation as a preservation area under the Ramsar Convention and as Human Heritage, as well as the creation of several national and state, public and private protected areas, such as the establishment of the *Pantanal's* Biosphere Reserve (Swarts 2000, UNESCO 2001, WCMC 2001, RAMSAR 2002).

Although the biggest part of the *Pantanal* is in remote and not very altered areas, the increasing interest in the region's eco-

nomic development has resulted in various environmental threats (Dolabella 2000). Deforestation for cattle breeding, pasture land and the growth of agricultural activities – in particular in the higher upstream areas of the surrounding plateau, for example – led to the alteration of the water flow and an increase in silting, especially along the *Taquari* and *São Lourenço* Rivers.

The building of dams and dikes altered the normal water flow, resulting in flooding and drought in some areas, with the loss of the soil fertility in others. Pollution problems have resulted from the use of agrochemicals, emission of non-treated sewage and industrial activities, such as ethanol production and prospection for gold and diamonds. Overfishing and, at a smaller scale, hunting, have affected wild life populations.

Large scale development projects, the expansion of the Brazil-Bolivia pipeline and a Waterway (Hidrovia) on the Paraguay River may bring irreversible changes to the water standards that control the region's ecological cycles, as well as showing potential to drastically alter the habitats and cause lasting effects on the local biota<sup>1</sup> (Bucher *et al.* 1993, Dolabella 2000).

At a global scale, in the different migrational routes known to water and shorebirds in general, between 33% and 68% of the populations, of the 511 populations of 214 species, are declining, when compared with only 0%-20% of increase. The reasons for this decline are many, but the majority is related to the loss and degradation of habitat (Stroud *et al.* 2006).

In this biome there are innumerable species of water birds, including anatidae, ciconiiformes (i.e; herons, maguari stork,

1. Group of living things, flora and fauna that inhabit or used to inhabit a certain geological environment, such as sea biota, land biota.

wood stork, etc), larids<sup>2</sup> and shorebirds<sup>3</sup> as well as neotropical – which are distributed from the Caribbean to the south of the South American continent – such as the nearctic, species which have its reproductive areas in North America, from the Arctic to Mexico. The *Pantanal* is a renowned reproductive area, an important reproductive site of many bird species. However, little is known in relation to the migrational movement of nearctic species, which use the region for a certain period of the year or pass through it.

In South America, banding studies<sup>4</sup> revealed movement from a series of water birds between the *Pantanal* and the wetlands of the lower part of the *Parana* River, in the south of Brazil and Argentina (Antas 1994). However, the *Pantanal* can also provide essential habitats to migrant species that are in transit between the northern and southern hemisphere, such as the nearctic shorebirds, some of which have their reproductive site in the northern North America, but spend the boreal winter in the Southern *Pantanal* (Morrison and Ross 1989).

Although the potential importance to these groups has been recognized (Antas 1983, Scott and Carbonnel 1986, Bucher *et al.* 1993), there is need for documentation in relation to the distribution standards, be it at a temporal or seasonal scale, as well as the use of habitats, among other relevant aspects from the perspective of its preservation.

Knowing these parameters is a key element for preservation and necessary to several ends, such as planning conservation units, designing management plans for various species, ecological

2. Gulls, terns.

3. Species that live in muddy soil, on the coast, be it with fresh or salt water.

4. Technique that uses metal rings to tag birds.

tourism, management of fishing resources and hunting activity, improvement of industrial activities, etc. In this sense, this work has as its objectives:

- ❶ determine the number and distribution of nearctic and neotropical shorebirds during the southward migration period;
- ❷ determine the number and distribution of neotropical water birds;
- ❸ identify key-regions used by water birds, with emphasis on shorebirds; and
- ❹ investigate the use of the habitat by both groups.

## METHODS

### Routes flown over

**a** For the biggest part of the *Pantanal*, a stratified approach for the effective coverage of the main water *habitats* was employed, involving flight routes that covered the wetlands associated to the main rivers, lagoons and lakes, as well as other types of open wet areas or floodable grasslands dominated by graminoid, which are used by water birds.

A systematic survey approach by quadrants was not used, as extensive areas in the *Pantanal* do not have water habitats. The month of October was selected, so as to coincide with the lowest level of water in the best part of the planes, mirroring the smallest seasonal availability of water environments, except for the region from *Nabileque* until *Murtinho* Port.

**b** In the bay and salt bed regions, in the center of the *Pantanal*, linear transects were flown over to estimate the number of birds using the lagoons, as well as the land habitat between them.

The survey was conducted using a Cessna 206 aircraft, which flew between 40 and 120m of altitude at an approximate speed of 220 km/h. The positions and flight routes were determined with the assistance of a GPS (Global Positioning System). Two



observers recorded the birds seen on each side of the aircraft with the assistance of a tape recorder.

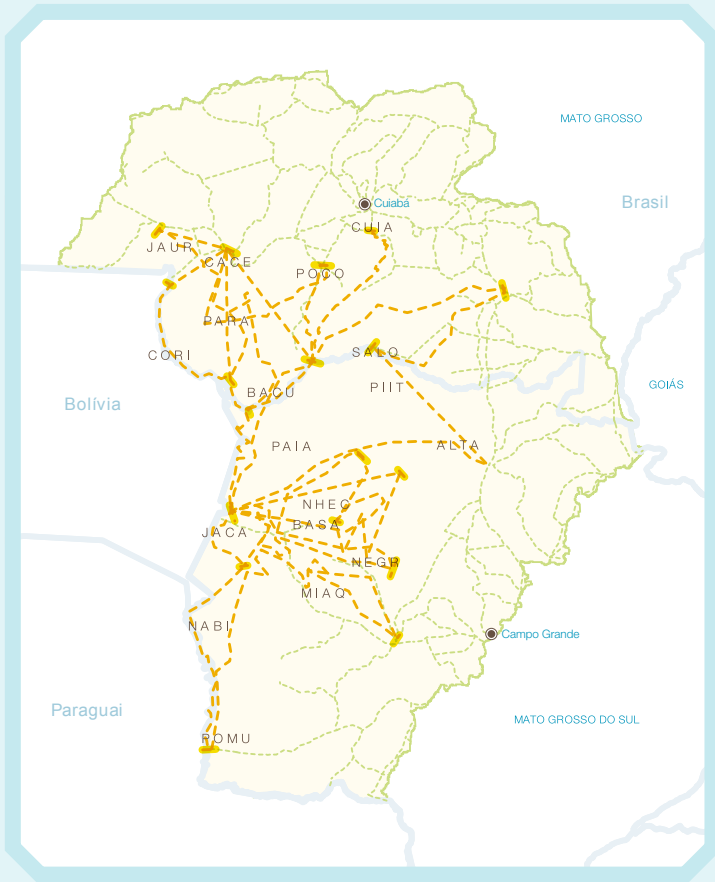
The observations were made within a strip with 150m of width each side of the aircraft; observation of rare species or notable concentration of birds outside of the transect belt were recorded separately.

The sample totaled 38.4 hours of flight, distributed throughout seven days, covering an estimate of 4.944 km, and flight lines divided in 75 sectors and 18 analysis regions (see figure 1). In the region of the lagoons, the width of the transect (150m each side) was kept, but the flight routes were adjusted to include all the salt water bays that occurred in an estimated area of 3-5km of width; for each lagoon, a point number and coordinates were recorded with the assistance of the GPS and all birds were counted.

The fly overs were carried out from the 8<sup>th</sup> to the 14<sup>th</sup> of October 1996, leaving from *Cuiabá*; the northern region was surveyed between the 8<sup>th</sup> and 10<sup>th</sup> of October, based in *Cáceres* and the central and southern regions, from the 11<sup>th</sup> to the 14<sup>th</sup> of October, based in *Corumbá*. In general, the atmospheric conditions showed to be good for the surveys, with sunny or cloudy days and moderate wind. Only one afternoon was lost due to rain and thunder.

The temperatures reached an average of 30°C at the beginning of the period, dropping to 18°C due to a cold front during the surveying of the *Pantanal*'s southern region.

The species' common names were used, based on their name in Portuguese and followed the Brazilian Ornithological Records Committee's list (CBRO 2008), regional names are also used, when known. In English, they follow the American Ornithologist Union List (AOU 1998).



**FIGURE 1** • Regions and routes sampled in the *Pantanal*. The routes flown are illustrated by a dotted line, with the sector's limits shown by a bar. The acronyms for the regions are: **CUIA** (Cuiabá), **POÇO** (Poconé), **CACE** (Cáceres), **JAUR** (Jaurú), **PARA** (Paraguai), **COGR** (Corixo Grande), **BACU** (Low Cuiabá river), **SALO** (São Lourenço river), **PIIT** (Piquiri/Itiquira rivers), **ALTA** (High Taquari river), **NHEC** (Nhecolândia), **PAIA** (Paiaguás), **BASA** (Bays and Salt beds), **JACA** (Jacadigo), **NABI** (Nabileque), **POMU** (Murtinho Port), **MIAQ** (Miranda/Aquidauana), **NEGR** (Negro river).

### Data analysis

The *Pantanal* was divided into 18 regions (see Figure 1) for the purpose of comparing bird distribution and identifying key areas. The delimitation of such was based on geographic and/or ecological criteria, considering the flow of the main Rivers (i.e; *Jaurú* and Lower *Cuiabá* River) or regions with unique ecological characteristics (i.e; Bays and Salt Beds, areas of the fresh and salt water lagoons in the *Pantanal's* central region). The names and relation with subregions previously described are presented below (see Description of Habitat).

The number of birds was determined through direct counting, when the flocks were small, or through visual estimate, when there were larger concentrations. The identifications were made at the species level whenever possible; when it was not possible, identification was based on similarities among species. (i.e; small sandpipers, herons, ducks, etc.).

Soil checks to determine the precision of the count, were not done as it was impossible reach many of the areas where a large number of birds were found. However, the number obtained with the aerial survey may be considered subestimates of the real number of birds that may be found in the area under study.

Total bird counts were generated for each sector in the following way: the counts carried out by the two observers on each side of the aircraft were compared and the highest values were selected for each species or group. The differences in the counts may be the result of one of the observers being temporarily involved in navigation and photography activities or equipment checks. Therefore, the totals of both sides of the aircraft were then added. The numbers on the tables (Appendix 1) represent

the data obtained in the field, which may have been rounded up in the text whenever appropriate.

The length of the transects for each sector were measured with an aeronautical chart in the scale of 1:1.000.000 and the linear density of the birds was calculated by dividing the number of individuals by the sector's length. The statistic comparisons of the distribution and the use of the habitat followed Morrison *et al.* (1997). The mapping was done using the MapInfo software using a scale of 1:1.000.000 for MapInfo's digital charts (ADC 1993).

The statistical analyses were done using the *Statística* software. The densities per sector were used to illustrate the distribution of birds in the maps. The regional distribution and habitat graphs together with the shorebird species texts, use acronyms described in the Description of habitats session (for the habitats) and in Figure 1 (for the regions).

### Area of study

The *Pantanal*, considered one of the biggest swamp complexes in the world (Alho *et al.* 1988, Por 1995, Swarts 2000), is located in South America and is formed by the flooded area of the high Paraguay river and its tributaries. Estimates of its size vary between 140.000 and 200.000 km<sup>2</sup> (OEA 1971, Tricart and Frecaut 1983), of which, approximately 138.200 km<sup>2</sup> are in Brazilian territory (Francischini 1996), while, 12.350 km<sup>2</sup> are in Bolivia and 4.000 km<sup>2</sup> in Paraguay (Scott and Carbonell 1986). It is considerably bigger than many small European countries, being similar to the area of Suriname or Guyana in the north of South America or the Maritime Provinces (New Brunswick, Nova Scotia and Prince Edward Island) in the east of Canada.

Geologically, the *Pantanal* is an immense alluvial plane, with approximately 65 million years of existence (UNDP 1973, Tricart 1982). The area is extremely flat, with altitudes between 80 and 150m and gradients varying from 0,7-5 cm/km in the north-south direction; and 5-50cm in the east-west direction (UNDP 1973, Francischini 1996). It is surrounded by a crystalline plateau with 600-700 m of altitude (Filho 1986) and the drainage canal is restricted to a narrow strip of approximately 50km of width between *Corumbá/Ladario* and *Bodoquena* mountain (Antas 1983).

The average annual precipitation varies between 1.100 and 1.200mm, with approximately 45% of the total concentrated between December and February – the rainy season, which takes place from November to March. This concentration results in extensive flooding, as the quantity of water this area receives during this period, exceeds the volume able to leave through the draining canals (and evaporation). Many areas close to the large rivers are completely flooded, before the water levels drop in the second half of the year.

Considerable variation may occur from year to year, depending on precipitation, in such a way that the extension of flooded areas may vary up to five times (Bucher *et al.* 1993). It is this unique combination of geology, morphology and hydrology that contribute to the wealth and variety of the ecosystems in the *Pantanal*, which include various types of permanent and temporary flooded areas, as well as localized forests and *cerrados* on higher ground.

As expected, in such an extensive area, there is considerable variation of the types of wetlands and landscape that can be found in the regions of the *Pantanal*. The main flooded areas or

wetlands are found in the central part along the main rivers, with forest areas occupying higher parts of the ground (PCBAP 1997).

Approximately 10 to 11 regions have already been described for the *Pantanal* (Por 1995, Francischini 1996, PCBAP 1997). In general, the main factors that determine vegetational variation are the soil's moisture and its topography, in such a way that in very flat regions, small variations in the ground's elevation result in abrupt alterations to the habitat (Eiten 1975).

On the whole, trees are capable of tolerating areas that are permanently flooded and areas that are constantly moist or dry, but not alternations between extremely saturated and dessicated conditions (Cole 1960). Therefore, dense forest areas are generally found alongside rivers, the so called gallery forests, or in higher lands, where a type of semideciduous forest can be found.

In the intermediate parts, subject to periodical flooding, a more open type of vegetation develops. In these, a succession of vegetation (of *cerrado*) may be seen, going from an open and dry grassland (clean field), to grasslands with scattered trees and shrubs (dirty field), areas with growing coverage of trees and a decreasing proportion of grasses – closed field (campo/*cerrado*), *cerrado*, *cerradão* (augmentative of *cerrado*), up to a dense forest that represents the climax of the savannah and takes place at the top of the mountain ranges (Goodland 1971, Eiten 1983, Coutinho 1990).

Sandy soil is predominant in the *Pantanal's* central region, surrounding the alluvial plane of the *Taquari* River, in the Paraguay/*Coricha Grande / Nabileque* area (Amaral Filho 1986); these areas tend to be relatively dry, hosting extensive areas of *cer-rados* and fields. Soils with average granulometry characterize the area of *Cuiabá-São Lourenço*, in the north, where extensive

flooded areas and *cerrados* can be found. Fine and clay soils are found around the Paraguay River and in the systems further south (*Miranda, Aquidauana, Apa* and *Nabileque*), hosting a semi-arid herbaceous vegetation (see Amaral Filho 1986, Ponce 1995, Por 1995).

Of particular interest, as shown by the present study, is the area with fresh and salt water bays found in the central-south of the *Pantanal*, in the *Nhecolândia* region. This unique region is a little more elevated than its surroundings, being characterized by localized moderate floods of short duration, as well as the predominance of savannah vegetation (Adamoli, in Por 1995).

Fresh and salt water bays are close to one another: the first generally flow and/or connect to the water courses, while the salt bays do not flow and are often semi-surrounded by a forest located on higher sandy ground, known as mountain range.

The salt water bays fill up during the rainy season and dry up in the dry season, leaving the river banks muddy, which are used by shorebirds and others. The fresh water bays present a variety of vegetational species and are sometimes completely overrun by them, while the salt bays generally do not have vegetation.

Although the great variability in water levels, climate and landscape conditions results in low levels of endemic species (Brown 1986), the vast wetland habitats provide resources for very large numbers of waterbirds, and the area supports the main breeding colonies of many fish-eating birds in South America (Antas 1994). Several authors recognize its important potential as a stopover point for North American migrants and from other parts of South America (Antas 1983, 1994, Brown 1986, Cintra and Yamashita 1990). The description of avifauna include regional summaries (Scott and Carbonell 1986), regional



biogeographic analyses (Brown 1986, Dubs 1983, 1992, Cintra and Antas 1996, Tubelis and Tomas 2003), local lists (Mauro and Tomas 1994), some studies about the diversity of reproductive strategies, reproductive colonies and contamination by mercury (Yamashita and Valle 1990, Vieira *et al.* 1992, Tubelis and Tomas 1996, Marques *et al.* 1996), as well as biology and conservation of the Jabiru (Antas e Nascimento 1996). Summaries related to various studies conducted in the *Pantanal* were published by EMBRAPA (EMBRAPA 1996, EMBRAPA-CPAP 1997) and a general overview of the biome was published by Swarts (2000).

### Descriptions of habitat

Simple qualitative descriptions of habitat were made for each surveyed sector based on the characteristics of the relevant landscape for water birds, such as the presence of marshes with graminoid, height of the graminoid stratum (long, short), presence of water bodies with muddy banks, vegetation with shrubs or trees, type of forest, characteristics of lagoons (fresh, salt water, the presence of muddy river banks) etc. The predominant habitat for each sector was used as the determinant habitat for that sector.

The habitat categories were selected to reflect the general structure of the landscape/vegetation, to which it is assumed the birds respond to (Knopf *et al.* 1990). The 10 habitat categories adopted in the present study are intimately related to the habitats and relations/successions of habitats described by Coutinho (1990) and others (see Por 1995, and Area of study above), and these relations are indicated below.

## 1 BASA (BAYS AND SALT BEDS – FRESH AND SALT WATER LAGOONS)

The fresh and salt water lagoons (regionally called the bays) which occur in the central-south part of the *Pantanal* (BASA region in *Nhecolândia*) make up a characteristic type of landscape found only in this region. The fresh water bays are small depressions that vary in round and oval shapes and occur isolated or in groups, having water vegetation. They are almost totally delimited by forests, known as mountain ranges.

The salt water bays differ from these because they are surrounded by mountain ranges and water surfaces, without water vegetation and drainage canals. The color of the water may vary from light brown to green or black, according to the concentration of predominant salts. After the rainy season, the beds are usually full, but in October the majority of the rivers water levels decreases, revealing muddy banks around a pool of water or mud. These habitats are broadly used by nearctic and neotropical shorebirds.

In contrast, the fresh water bays have abundant water vegetation: some are covered by water hyacinth or soft rush, others have dense growing of graminoid, some are almost totally covered by plants, while others show no presence of vegetation in the central part. Contrary to the salt water bays, the fresh water bays are connected to drainage canals or water courses. Among the lagoons, there is mainly herbaceous vegetation, with some patches of shrubs and trees, many fresh water depressions occur, some resembling miniature bays.

## 2 FGSW (FOREST-GRASSLAND-SCRUB-WET)

Parts of the land covered mainly by forests, with small areas of graminoid and shrubs, generally wet.

## 3 GLOM (GRASSLAND-LONG-OPEN-SOME MUD)

Open areas with long graminoid and water bodies with muddy banks. Equivalent to fields, mainly open, where shrubs and trees are usually not found. The presence of water bodies with muddy banks makes up an adequate habitat for nearctic shorebirds.

## 4 GLOW (GRASSLAND-LONG-OPEN-BY WATER)

Areas covered by long graminoid and some shrubs near the water (i.e; grasslands around the *Uberaba* Bay) bodies with vegetation up to the bank; these are not muddy.

## 5 GLSF (GRASSLAND-LONG-SCRUB-FOREST)

Open floodable areas, interspersed with shrubs and forests, with wet and dry areas.

## 6 GLSFD (GRASSLAND-SHORT-SCRUB-FOREST-DRY)

Open terrain mainly covered by short graminoid, interspersed with isolated shrubs and forests, basically not floodable.

## 7 GLSFW (GRASSLAND-LONG-SCRUB-FOREST-WET)

Marshy areas covered with long graminoid, between which, isolated shrubs and forests can be found with water bodies, with vegetation up to the banks.

## 8 GSSF (GRASSLAND-SHORT-SCRUB-FOREST)

A very distinctive type of habitat consisting of extensive areas covered by short graminoid used for cattle grazing. Isolated shrubs and forests occur in these areas' surroundings, giving them the appearance of a golf course. This type of habitat is mainly found in *Nhecolândia*.

## 9 RIWE (RIVER-WETLANDS)

Complex wet, marshy habitats directly associated with the main rivers; generally composed of open areas, although with the presence of isolated shrubs and forests. The majority of the marshy areas are occupied by long graminoid. Small lagoons or water bodies usually have vegetation up to their banks, without muddy substratum. This habitat is equivalent to the *cerrado*, with areas of gallery forests alongside the rivers.

## 10 RIWF (RIVER WETLANDS-WET-FOREST)

Wet areas directly associated to the course of the main rivers, consisting of densely forested patches, although some open areas may also occur. Equivalent to the *cerradão* or to the gallery forests alongside the course of the rivers.



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# Shorebirds

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## *Vanellus chilensis*

### Southern Lapwing

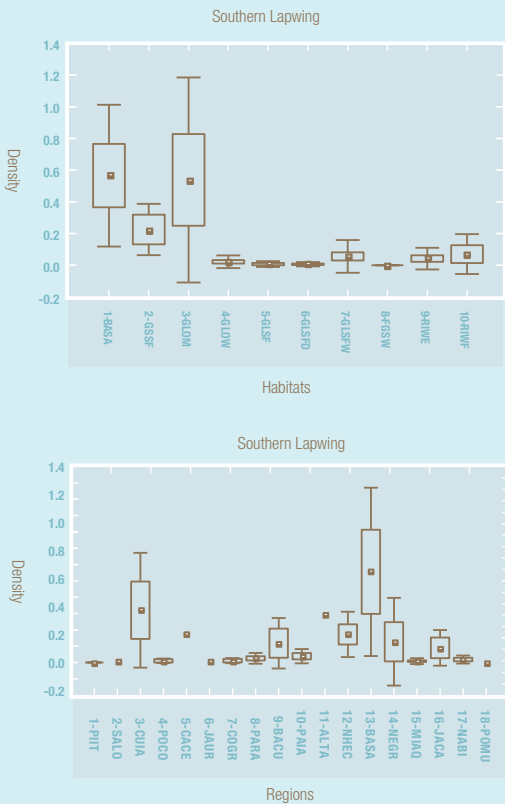
Mark Peck



**T**he Southern Lapwing is a neotropical species resident of the *Pantanal* (Brown 1986). It is widely spread in South America and one of the most popular birds. It is considered to be sedentary, with limited post-breeding dispersal, though some southern populations may move to less cold areas during the austral winter. Outside of the reproductive period, it occurs in small groups. Four subspecies are recognized, with the *Pantanal*'s population probably belonging to the *V. c. lampronotus* (Piersma and Wiersma 1996).

This species was observed in relative small numbers (total of 550 or 3.5% of the total of the neotropical shorebird species). They were widely distributed throughout 16 of the 18 surveyed areas, although more common in the *Pantanal*'s central region (BASA,

NHEC, JACA, NEGR), along the lower *Cuiaba* River (BACU), and in the north (CACE, CUIA). The species was observed in 9 of the 10 surveyed habitats, though more common in open grassy areas in the region of the lagoons (BASA), in marshy areas with muddy water bodies (GLOM) and in areas with short graminoid and in the surroundings of the *Nhecolândia* region (GSSF). Smaller densities were observed in wet areas next to the rivers (RIWE, RIWF) and in marshy areas with shrubs and forests (GLSFW).





*Pluvialis dominica*

American Golden Plover

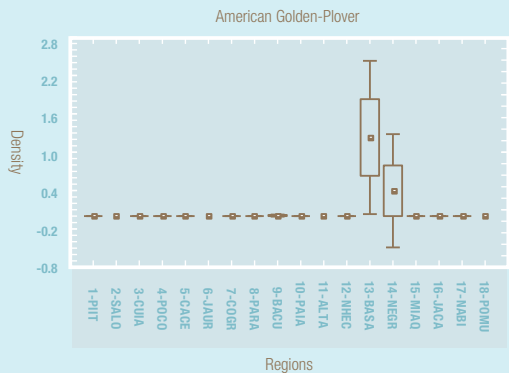
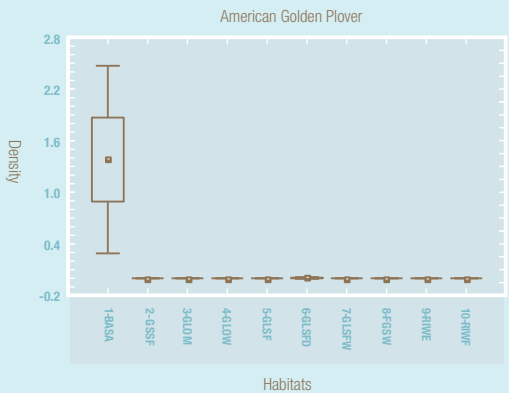
Mark Peck



As it reproduces in most parts of the Arctic, it is believed that it migrates to its wintering grounds, in central South America, following an elliptical pattern, it goes south, crossing the Atlantic Ocean from East Coast of North America and returning through the inland of the United States and Canada (Piersma e Wiersma 1996). Many of them occupy inland rural areas, extending from the north to the south of the *Pantanal*, and we can expect them to occur there as a migrant as well as a potential resident during the austral winter.

It was the third among the nearctic shorebird species in number of recorded individuals (total: 583 or 10.3% of the total). It represents a significant number of the non-identified medium sized shorebirds (which totaled 2.167 or 38.4% of the total of the

nearctic shorebirds). It was observed almost exclusively (580 of the 583) in salt water bays (BASA) and in the *Negro* River region (BASA, NEGR), with only three individuals being recorded in other places in the region of the Lower *Cuiabá* River (BACU), in dry shrubby savannah with long graminoid (GLSFD).



## *Himantopus mexicanus*

### Black-necked Stilt

Mark Peck

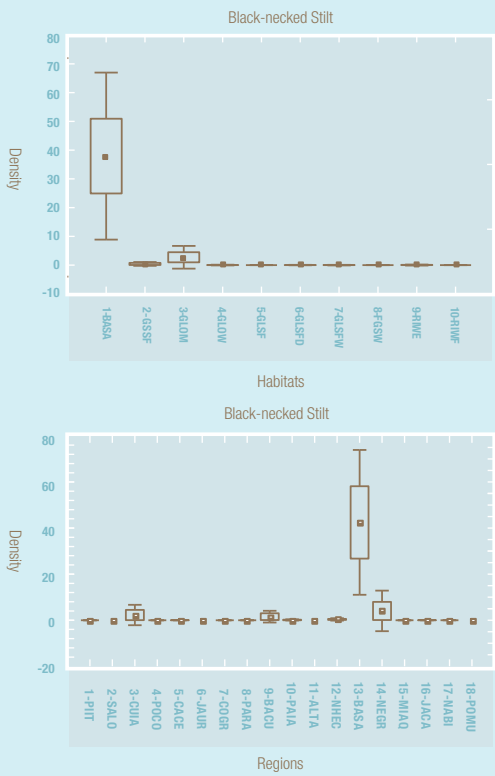


This is a neotropical species and considered to be sedentary, although with local or long distance movements, the patterns of which are still little known. They migrate between July and November, returning in March-May (Piersma *et al.* 1996).

It was the most numerous shorebird species in the survey, representing 70,7% (15.579) of the total observed (22.046) and 95,0% of the total of neotropical shorebirds (16.402). Widely spread (8/10 habitat categories and 10/18 regions) in the habitat of the salt water bays (BASA, 94.9% of the total) in the *Pantanal's* central region (BASA, 83.0% of the total) and in the *Negro River* region (NEGR, 12.2% of the total). Other important habitats include muddy areas often associated with marshes (GLOM, 3.4% of the total), such as those that occur in *Sinhá Mariana* near *Barão*

de Melgaço, in the regions of *Cuiabá* (CUIA, 2.0% of the total) and Lower *Cuiabá* River (BACU, 1.6% of the total). Water bodies located between marshy areas covered with short graminoid (GSSF, 0.8% of the total) and in the *Nhecolândia* region (NHEC, 1.0% of the total) also sheltered smaller numbers.

Possibly over 100.000 stilts inhabit the *Pantanal*, as just the extrapolation of the numbers obtained for the region's salt water bays suggest that between 90.000 and 100.000 stilts may use these environments.



## *Jacana jacana*

### Wattled Jacana

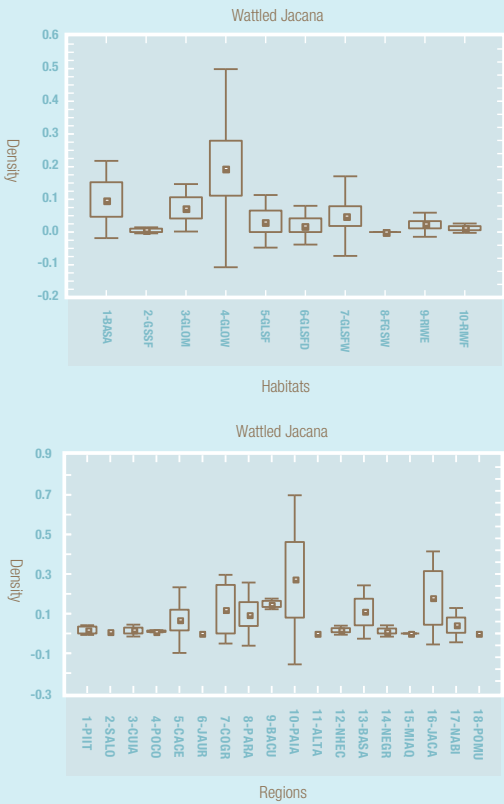
Cassiano Zaparoli



It is a species resident in the *Pantanal* and the only of its type found in South America. Piersma *et al.* (1996) suggests it is very sedentary.

It was observed in relative low numbers (173 or 1.8% of the 15.579 neotropical shorebirds), but in practically every survey, being found in 14 of the 18 surveyed regions. It showed to be more common in the central areas (PAIA, BASA, JACA, NABI), in the Lower *Cuiabá* River (BACU) and Paraguay River (PARA), in the *Corixo Grande* (COGR), near the Border with Bolivia and in the wetlands of the *Cáceres* region (CACE). It also occurs in a great variety of habitats, occupying nine of the ten considered classes. It was only not found in the densely forested wet areas

alongside the rivers. It showed to be uncommon in areas covered by short graminoid in the *Nhecolândia* region. The highest densities were observed in the marshy areas with long graminoid in the fresh water bays and in the the region of the bays and salt beds (BASA).



## *Tringa melanoleuca* and *T. flavipes*

### Greater Yellowlegs and Lesser Yellowlegs

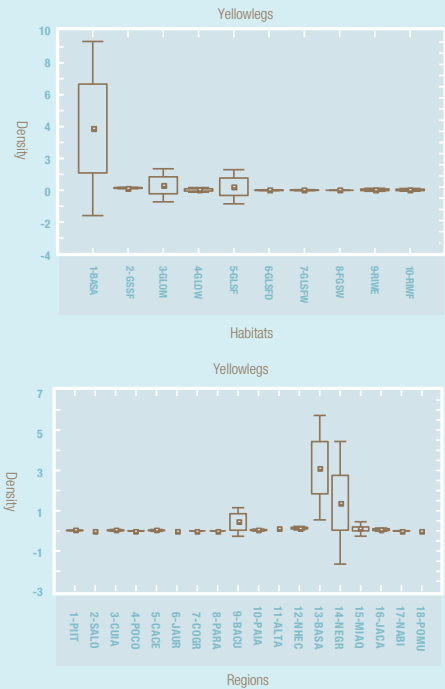
Cassiano Zaparoli



**T***ringa melanoleuca* and *T. flavipes* reproduce in the Arctic, in Alaska, east of Canada, migrating through James Bay, British Columbia, Mexico, Central and South America until the *Tierra del Fogo* (Piersma *et al.* 1996). They occur in the *Pantanal* during southward migration, however, northward migration has been little documented and the used strategies are not yet known. During the census, it was not always possible to distinguish between them and thus the numbers presented are the combined total of both species, the aerial and land observation indicate that the lesser yellowlegs represent the majority of birds spotted.



Together they represent the most common nearctic taxon<sup>5</sup> during the surveys (N=1784), as well as wide spread, being found in all habitat categories and in 14 of the 18 regions. The biggest concentrations were found in the Bays and Salt Beds regions (BASA) and *Nhecolândia* (NHEC), which shelter 88% of the total. Other key-habitats included marshy areas with long graminoid and muddy water bodies (GLOM, 4.0%) and water bodies that occur in habitats with short graminoid (GSSF, 2.9%), mainly in the regions of the Lower *Cuiabá* River (3.8%) and *Nhecolândia* (3.6%), respectively.



5 Taxon unit associated to a classification system.

## *Bartramia longicauda*

### Upland Sandpiper

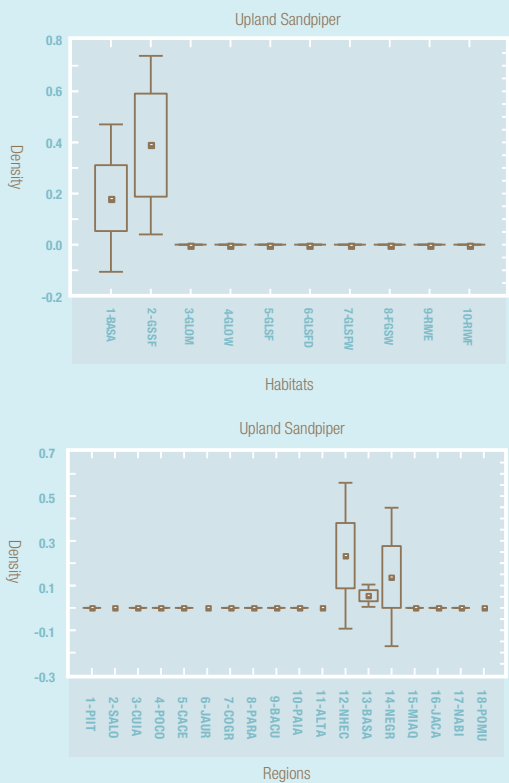
Mark Peck



It builds its nests and reproduces in North America, in the south-east of Alaska, in the central prairies of the United States and Canada, where it is more numerous, until the east of the continent. After breeding, it migrates through the central areas of North America in the direction of the rural ecosystems on central and eastern South America.

During the boreal winter it is seen in Suriname, Paraguay, south-east of Brazil, Uruguay and Argentina (Piersma *et al.* 1996). It prefers habitats with graminoids, such as prairies, pasture land, cultivated and natural fields, pampas and even golf courses and aircraft runways. It occurs in the *Pantanal* as a migrant and, possibly, also as a winter resident.

During the surveys, 202 were counted (3.6% of the nearctic shorebirds, which totaled 5.644). The species showed to be associated to open habitats with short graminoid (GSSF), with 123 of the 202 birds found in the habitats in the *Nhecolândia* region (NHEC). The rest were observed in similar habitats close to the Bays and Salt Beds (BASA) and the fresh water *Negro* (NEGR).



## *Calidris melanotos*

### Pectoral Sandpiper

Mark Peck

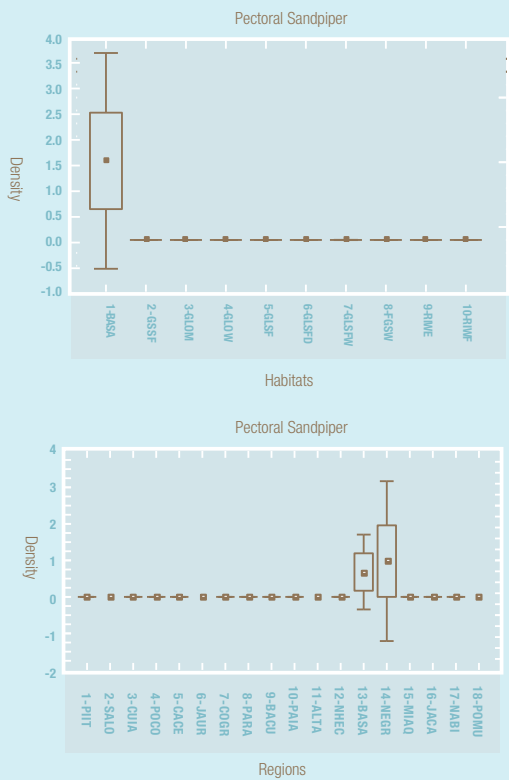


It is distributed from the Taymyr Peninsula, in Siberia, Alaska and all the Canadian Arctic regions to the West of Hudson Bay. After reproduction, it migrates via the Atlantic and Pacific Coast to wintering grounds in South America, from the south of Bolivia, Paraguay until Argentina (Piersma *et al.* 1996).

Migration appears to be elliptical, in a southward direction over the west of the Atlantic Ocean and returning through the central parts of North America. As the wintering grounds extend themselves throughout the whole of the *Pantanal* and south of this region, it can also be occasionally present in the austral winter.

It was the second most numerous nearctic shorebird species (720, or 12.8% of the total of the nearctic shorebirds) and it seems to have represented an important part of the non-identified

medium sized nearctic shorebirds (which added up to 2.167 or 38.4% of the total of the nearctic shorebirds). It was only spotted in the Bays and Salt Beds region (BASA) and in the adjacent region of the *Negro* River (NEGR), where it was confined to the bays and salt water habitat (BASA) (719 of the 720), with only one bird being recorded in the wet savannah/*cerrado* with long graminoid (GLSFW).



## *Tryngites subruficollis*

### Buff-breasted Sandpiper

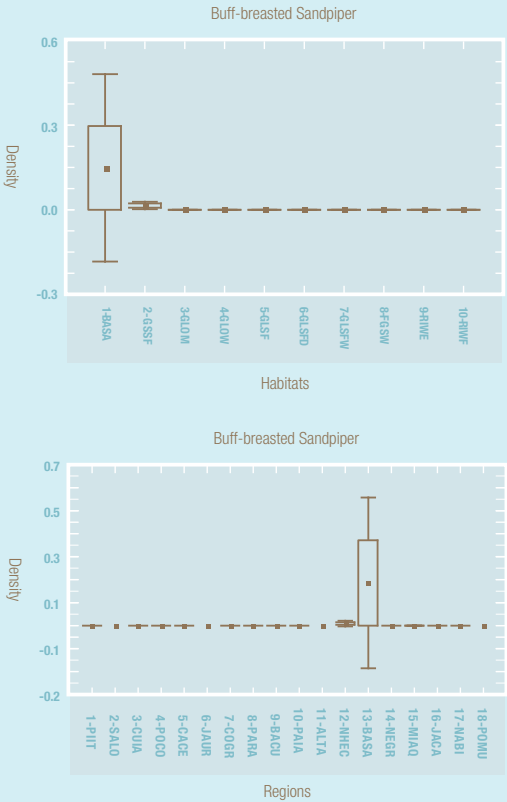
Mark Peck



**A**fter reproduction in the center and north-west of the North American Arctic, it migrates from the end of July to mid September to its wintering grounds in the Southern Hemisphere, mainly situated in the Uruguayan and Argentinian pampas. In general, it follows a route with no stopovers through the inland of North America, Canadian coastal provinces, crossing the Gulf of Mexico, until it reaches the north of South America. It flies through the continent's inland, with wintering grounds in the south-east of Bolivia, Paraguay, south of Brazil and north of Argentina. It prefers open habitats with short graminoid (Piersma *et al.* 1996).

They were seen in modest numbers (80 in total, or 1.4% of the 5.644 nearctic shorebirds) in the aerial surveys and

had a very restrictive distribution. They were only found in the Bays and Salt Beds region (BASA) and *Nhecolândia* (NHEC), and in only 2 of the 10 habitat categories, salt water lagoons (BASA) and fields with low graminoid (field) in *Nhecolândia* (GSSF). Rural áreas which surround many fresh water bays make these regions particularly adequate to this species.





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## Other species of nearctic shorebirds

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Five other species of nearctic shorebirds were seen in small number during the flights. The results are presented below



## *Actitis macularius*

### Spotted Sandpiper



Mark Peck

The spotted-sandpiper (total of 15) was widely distributed in small numbers through all of the *Pantanal* (nine of the eighteen surveyed regions and six of the ten habitats). Where it was found, it was mainly associated to large rivers and central and northern parts.

## *Tringa solitaria*

### Solitary Sandpiper

Mark Peck



Only four solitary sandpipers were spotted from the aircraft: two in the *Piquiri* River, one in the *Jauru* River and one in the Bays and Salt Beds area.

## *Limosa haemastica*

Hudsonian Godwit



Mark Peck

Nine *Limosa haemastica* were recorded in the central-south of the *Pantanal*: two in the *Nhecolândia* region and seven in the Bays and Salt Beds.

## *Arenaria interpres*

Ruddy Turnstone

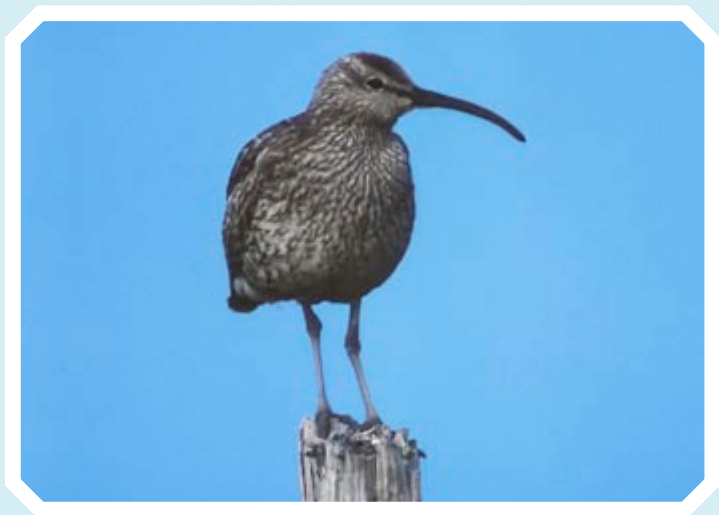
Mark Peck



Two were spotted in the Bays and Salt Beds region (BASA).

## *Numenius phaeopus*

Whimbrel



Mark Peck

A group of 29 were recorded in the Bays and Salt Beds area.



## Neotropical species

For neotropical species, maps and short notes are presented to illustrate their distribution in the Pantanal

PHALOCROCORACIDAE AND ANHINGIDAE

*Phalacrocorax brasilianus*

Neotropical Cormorant



Cassiano Zaperoli

Distributed along the courses of the great rivers, with the highest numbers and densities recorded in the Lower *Cuiabá* River (BACU). (**N=7.665**) = number observed.

ANHINGA ANHINGA

## Anhinga

Anhinga



Mark Peck

Widely distributed in the *Pantanal*. Mainly found in marshy environments with long graminoid and wetlands along the river. (N=141).



ARDEIDAE

*Ardea coccoi*

White-necked Heron



Cassiano Zapparoli

Widely distributed in the *Pantanal*, in particular alongside the main rivers; less common in the fresh and salt water bays in the central region. Found in marshy lands with long graminoid. (N=2.196).

## ARDEIDAE

*Ardea alba*

## Great Egret

Mark Peck



Numerous and widely distributed in the *Pantanal* in marshy habitats; less common in forest habitats or fresh and salt water bays. (N=12.715).

ARDEIDAE

*Egretta thula*

Snowy Egret



Mark Peck

Widely distributed, with highest numbers/densities in the *Cui-abá* and *Negro* River regions. Found mainly in marshy habitats with long graminoid. (N=3.254).

## ARDEIDAE

*Bubulcus ibis*

## Cattle Egret



Mark Peck

Moderate widespread distribution, with elevated densities in the *Cuiabá* region and in the central part of the *Pantanal*. The highest densities were recorded in the bays and salt bed habitats; other favored habitats included marshy lands with long graminoid and water bodies with muddy banks, as well as marshy lands with shrubs and forests. (N=3.597).

## *Tigrisoma lineatum*

Rufescent Tiger-Heron



Cassiano Zapperli

Relatively well distributed, but not abundant. The densities tended to be higher between *Cáceres* and *Paiaguás*. Less frequent in the *Pantanal*'s central region (BASA region and habitat). (N=62).

## CICONIIDAE

*Mycteria americana*

## Wood Stork

Cassiano Zapparoli



Numerous, with higher concentrations in the central region (NHEC, BASA, NEGR e MIAQ) and between Poconé/Cáceres (POCO and CACE regions). Most used habitats were those with long graminoid, shrubs and forests. (N=10.728).

CICONIIDAE

## *Euxenura maguari*

Maguari Stork



Cassiano Zaperoli

Mainly concentrated along the wetlands of the Paraguay River and the Negro River regions, where there were marshy lands with long graminoid. (N=1.291).

## CICONIIDAE

*Jabiru mycteria*

## Jabiru Stork

Cassiano Zapparoli



It is the biggest of the ciconiids to inhabit the *Pantanal*, nests in all its area and was adopted as a symbol of the region. It is seasonally present in the *Pantanal*, from April to December. Tracking studies carried out with satellites showed wide movement in the plane's inland, without there being a seasonal pattern (Antas and Nascimento, 1996).

A total of 6.790 jabirus were counted during the flights. The species showed wide distribution, occurring in 17 of the 18 surveyed regions; the only region where it was not found was in the High Taquari River (ALTA). It was most numerous in Miranda-Aquidauana (1.619, MIAQ) and Cuiabá (1.604, CUIA). Higher densities suggest two main concentration areas: one in the



*(Continuation of Jabiru Mycteria)*

northern regions of Cuiabá-Poconé-Cáceres (CUIA, POCO, CACE) and the second, in the central-south regions, involving the regions of Nhecolândia, the Bays and Salt Beds, and the Negro and Miranda/Aquidauna (NHEC, BASA, NEGR, MIAQ). The densities were lower along the main canal of the Paraguay River and in the higher stretches of its tributaries. The species was observed in all habitat categories, with higher densities in the closed field type vegetation, which consists of long graminoid, with shrubs and forests.

## THRESKIORNITHIDAE

*Theristicus caudatus*

## Buff-necked Ibis

Cassiano Zapparoli



Small numbers observed, especially in the *Pantanal*'s central region (NHEC, NEGR, MIAQ regions). (N=61).

THRESKIORNITHIDAE

## *Phimosus infuscatus*

Bare-faced Ibis



Cassiano Zaperoli

Observed regularly, especially in the *Pantanal*'s central region and in the Lower *Cuiabá* River (N=982).

## THRESKIORNITHIDAE

*Platalea ajaja*

## Roseate Spoonbill

Mark Peck



Seen in the whole of the *Pantanal*, with higher concentrations in the central regions. Found in the majority of habitats, except forests. (N=2.163).

## *Chauna torquata*

Southern Screamer



Cassiano Zaperoli

Moderately common, found in higher numbers in open areas next to the *Cuiabá* River and *Nhecolândia*. (N=458).

## ANATIDAE

*Dendrocygna viduata*

## White-faced Whistling Duck

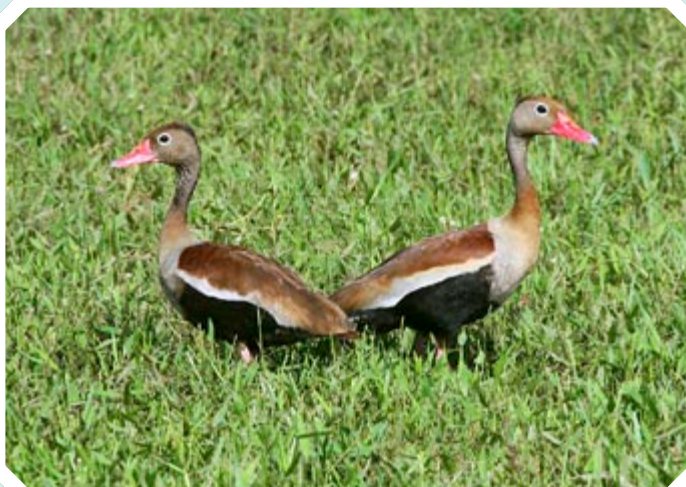
Cassiano Zapparoli



More common in the *Pantanal*'s central region, with elevated densities in the region of *Nhecolândia*, in the bays and salt beds and in the Lower *Cuiabá* River (BACU). The highest densities were observed in the Bays and Salt Bed habitats. (N=3.079).

*Dendrocygna autumnalis*

Black-bellied Whistling Duck



Cassiano Zapparoli

More common in the south and center of the *Pantanal*, with significant numbers in the bays and salt beds (BASA), as well as in the wetlands by the riverside. (RIWE). (N=3.485).

## ANATIDAE

*Amazonetta brasiliensis*

## Brazilian Duck



Cassiano Zapparoli

Small numbers were observed in the *Pantanal's* central region (BASA and NHEC regions) and in the region of the Lower *Cuiabá* River. (N=38).



*Cairina moschata*

## Muskovy Duck



Cassiano Zaperoli

Occurs alongside the Rivers and wetlands of the Lower *Cuiabá* River and in the *Pantanal*'s central region, in a great variety of habitats. (N=240).

## ANATIDAE

*Coscoroba coscoroba*

## Coscoroba Swan

Cassiano Zapparoli



Coscoroba Swans were found in some bays that occur in the *Pantanal*'s central region, west of *Fazenda Firme/Nhecolândia*, with the biggest group consisting of 14 birds. This species had not been recorded in the region previously. (N=49).

ACCIPITRIDAE

*Rothramus sociabilis*

Snail Kite



Cassiano Zapparoli

Observed alongside the courses of the main Rivers, usually close to marshes with long graminoid and some forest. (N=103).

## ACCIPITRIDAE

*Pandion haliaetus*

## Osprey

Mark Peck



Small numbers were recorded in all of the *Pantanal*, always close to the courses of the main rivers. (N=13).

## ARAMIDAE

*Aramus guarauna*

## Limpkin



Mark Peck

Observed in small numbers in many parts of the *Pantanal*, mainly in areas with long graminoid with some shrubs and forests (GLSFW). The highest quantities were recorded in the regions of *Cuiabá* and *Jacadigo*.

## STERNIDAE E RYNCHOPIDAE

*Sterna superciliaris*

## Yellow-billed Tern

Cassiano Zapparoli



Observed in small numbers alongside the rivers, more common in the *Pantanal*'s central region. The only sectors in which they were not found were those dominated by bays and salt beds. (N=211).

STERNIDAE E RYNCHOPIDAE

*Phaetusa simplex*

Large-billed Tern



Cassiano Zaperoli

Regularly observed, mainly on the sand dunes of the river-side systems, more common in the *Pantanal*'s central region (N=1.461).

STERNIDAE E RYNCHOPIDAE

## *Rhynchops nigra*

Black Skimmer

Mark Peck



More common in the center and south of the *Pantanal*, along Rivers and lagoons. (N=1.249).



## FINAL REMARKS



**T**he aerial surveys revealed clearly that the nearctic and neo-tropical species of shorebirds concentrate at a high degree in the fresh and salt water bays that occur in the *Pantanal*'s central region.

A small number used the fresh water habitats and concentrations of shorebirds occurred in few other locations. Moderate numbers were found in *Sinhá Mariana*, near *Barão de Melgaço*, where there are several lagoons very similar to the fresh water ones found in the central region. Small concentrations were also found at a limited number of locations, where water bodies with muddy banks occur in extensive marshy areas (i.e; the south-east of *Jofre* Port). Such places are relatively uncommon – the majority of small bays and water bodies found in the *Pantanal* have densely vegetated banks with little or no clay substratum.

Another particular habitat used by a more restrictive group of shorebirds, which favored higher rural habitats, were pasture lands with short graminoid, characteristic of the *Nhecolândia* region. These types of habitats do not seem to be widely distributed and were mainly used by *Bartramia longicauda*, as well as *Tringites subruficollis*.

Several statistical analyses (Morrison *et al.* 1997) support the conclusion that shorebirds had a different distribution from the other water bird groups in the habitats found in the *Pantanal*. Non-parametric analyses showed that densities were significantly higher in the regions of the salt water bays than in any other part of the *Pantanal*.

Cluster and principal component analyses revealed that nearctic shorebirds make up a distinct group from other species, compatible in the use of muddy and salt water habitats found in the central region. On the other hand, the cluster analysis, based on the composition of birds from the different surveyed sectors, revealed that groups from sectors composed of bays and salt beds make up an isolated group from the other wet environments in the *Pantanal*.

Regional analyses showed that shorebirds occur in densities significantly superior in specific regions of the *Pantanal*, where they can find their favorite habitats. Although these regions are represented by geographic areas related to drainage canals, they have a distinct geomorphological composition (Silva 1986).

The results of the flights suggest that conservation measures for nearctic shorebirds as a whole, should be different from the one being applied to other bird groups with wider distribution in the *Pantanal*. The salt water bays that occur in the central region do not seem to be regularly flooded during the seasonal floods, which affect many other regions of the *Pantanal*, because they are surrounded by higher ground areas than the ones found alongside the courses of the main rivers, such as the Paraguay.

The lagoons, in their turn, fill up with rain water and thus, are much more isolated than the habitats that are flooded during the inundation period. If these lagoons are connected through the flow

of underground water is still a matter for debate (Leão 1996).

However, the relative proximity between them suggests that the conditions of a determined lagoon depend on the local soil's chemical conditions and the river bed's characteristics. The coloring of the water in different lagoons varied considerably during the fly overs conducted in May 1997 and October 1998 (data not published), going from coffee-brown to black, going through green.

While the majority of the lagoons was totally full in May 1997, the water levels in October 1996 varied considerably, with an estimated water coverage in the different basins, varying between almost empty to 80% full. No drainage canal or stream was apparent in the lagoons and the loss of water seems to be the result of mainly evaporation or maybe movement through the soil. These observations suggest that very distinctive conditions develop in different lagoons, depending on the salinity, temperature and local nutrients.

The differences resulting in productivity, would also lead to a variety of food resources of potential use by shorebirds and other animals. Salt water bays, for example, are important breeding grounds for caymans (Emiko Kawakami de Resende, com. Pess).<sup>6</sup>

Estimates of the number of lagoons in the regions of the Bays and Salt beds, calculated from the transects (densities), vary between approximately 280 and 480, depending on the effective transect width applied. (Morrison *et al.* 1997).

Although the water regime of the salt and fresh water bays in the central region may not be directly related to seasonal

6. Personal communication of the researcher.

flooding patterns, as in the fresh water habitats located next to the drainage canals of the main rivers, this does not necessarily mean that the lagoons are not affected by the changes in water regimes that result from the large scale alterations in the *Pantanal's* water dynamics – such as those that may result from the implementation of the proposed Waterway.

Hypothetically speaking, changes to the main rivers' hydrology may affect the conditions in the areas of the fresh and salt water bays through the alterations of the water table levels and/or climate patterns. Therefore, it is evident that more studies about the ecology of these bays, in the central region of the *Pantanal*, are needed to understand how these important ecosystems work (Ferreira *et al.* 1996). Such knowledge is essential to design more appropriate approaches to preserve the resources provided by these unique and notable ecosystems.

The results presented here suggest that the number of nearctic shorebirds using the *Pantanal* is of great importance when compared to other inland locations of South America.

Although the numbers presented are not as large as the ones found in the coastline, which support a great number of migratory shorebirds in South America (Spaans 1978, Harrington *et al.* 1986, Morrison and Ross 1989, Vooren and Chiaradia 1990), the numbers as well as the diversity of the species, are considerably higher than the majority of other inland locations, where studies were conducted during the migration and winter periods.

Even if the species that occur in Asuncion Bay and other areas of Paraguay are very similar to those found in the *Pantanal*, for example, the quantities there are much smaller (Hayes *et al.* 1990, Hayes and Fox 1991). Similar considerations may be applied to inland sites studied in Venezuela and the Peruvian

Amazon (Thomas 1987, Bolster and Robinson 1990), as well as in Argentina (Myers and Myers 1979).

Surveys exclusively conducted in the region of salt water bays indicated that over 100.000 shorebirds were present in the region in October 1996. They reveal, from the shorebird's perspective, that many areas in the *Pantanal* meet the criteria used by Conservation Initiatives at a global scale, such as the KBAs (Key Biodiversity Areas) in Europe and Africa, for the identification and recognition of key conservation areas (Eken *et al.* 2004), in particular, gregarious species, or IBAS (Important Bird Areas), in the United States and Canada (Bennun *et al.* 2005). They also meet criteria established by the Ramsar Convention, for the designation of water environments of international importance, of which the country has been a signatory since 1993.

The salt water bays in the central region of *Nhecolândia* could be recognized as an International Reserve under the Western Hemisphere Shorebird Reserve Network (WHSRN) system (see Morrison *et al.* 1995).

The region still needs to be designated as protected areas under the National Conservation Unit System, although its wealth and potentialities have been recognized nationally and internationally. To ensure that its sustainable development and ecological integrity walk hand in hand are challenges for the future and should be part of any management proposal or strategy for this very important Human Heritage site.

Without the adoption of measures that protect the biome's biodiversity, its continuity will remain uncertain.

# ACKNOWLEDGEMENTS

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# APPENDIX

## Total of birds counted during the aerial surveys of the Pantanal in October 1996

See Figure 1 for regions' acronyms

### Acronyms for the name of species found on Table 1

- SOLA** Southern Lapwing
- AGPL** American Golden-Plover
- BNST** Black-necked Stilt
- WAJA** Wattled Jacana
- YELL** Yellowlegs species (Greater e Lesser yellowlegs)
- SOSA** Solitary Sandpiper
- SPSA** Spotted Sandpiper
- UPSA** Upland Sandpiper
- WHIM** Whimbrel
- HUGO** Hudsonian Godwit
- RUTU** Ruddy Turnstone
- PESA** Pectoral Sandpiper
- BBSA** Buff-breasted Sandpiper
- MESB** Medium-sized shorebirds (aves limícolas de médio porte)
- SMSB** Small shorebirds (aves limícolas de pequeno porte)

Table 2:

<b>OLCO</b>	Neotropical Cormorant
<b>ANHI</b>	Anhinga
<b>WNHE</b>	White-necked Heron
<b>GREG</b>	Great Egret
<b>SNEG</b>	Snowy Egret
<b>CAEG</b>	Cattle Egret
<b>RTHE</b>	Rufescent Tiger Heron
<b>WOST</b>	Wood Stork
<b>MAST</b>	Maguari Stork
<b>JAST</b>	Jabiru Stork
<b>BNIB</b>	Buff-necked Ibis
<b>BFIB</b>	Bare-faced Ibis
<b>SPOO</b>	Spoonbill
<b>SOSC</b>	Southern Screamer
<b>WFWD</b>	White-faced Whistling Duck
<b>BBWD</b>	Black-bellied Whistling Duck
<b>BRDU</b>	Brasilian Duck
<b>MUDU</b>	Muskovy Duck
<b>COSW</b>	Coscoroba Swan, SNKI Snail Kite
<b>OSPR</b>	Osprey
<b>LIMP</b>	Limpkin
<b>YBTE</b>	Yellow-billed Tern
<b>LBTE</b>	Large-billed Tern
<b>BLSK</b>	Black Skimmer

TABLE 1. Total of nearctic and neotropical shorebirds counted during the surveys in the *Pantanal* in October 1996.

REGIONS	SOLA	AGPL	BNST	WAJA	YELL	SOSA	SPSA	UPSA	WHIM	HUGO	RUTU	PESA	BBSA	MESB	SMSB
1-PIIT	0	0	0	2	3	2	0	0	0	0	0	0	0	0	0
2-SALO	2	0	0	3	0	0	1	0	0	0	0	0	0	0	0
3-CUIA	80	0	314	2	6	0	0	0	0	0	0	0	0	24	0
4-POCO	4	0	0	4	1	0	0	0	0	0	0	0	0	0	0
5-CACE	43	0	6	29	7	0	0	0	0	0	0	0	0	41	1
6-JAUR	1	0	1	0	1	1	1	0	0	0	0	0	0	0	0
7-COGR	1	0	0	11	0	0	0	0	0	0	0	0	0	0	0
8-PARA	6	0	0	18	0	0	0	0	0	0	0	0	0	2	1
9-BACU	20	3	243	32	67	0	0	0	0	0	0	0	0	55	1
10-PAIA	16	0	33	64	9	0	4	0	0	0	0	0	0	0	0
11-ALTA	34	0	0	0	12	0	1	0	0	0	0	0	0	11	0
12-NHEC	89	0	153	7	65	0	2	123	0	2	0	0	6	107	0
13-BASA	165	394	12925	24	921	1	1	14	29	7	2	259	74	1299	40
14-NEGR	60	186	1899	6	648	0	3	65	0	0	0	461	0	626	0
15-MIAQ	5	0	0	0	36	0	0	0	0	0	0	0	0	0	6
16-JACA	13	0	2	35	6	0	1	0	0	0	0	0	0	2	0
17-NABI	11	0	3	36	2	0	1	0	0	0	0	0	0	0	0
18-POMU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals	550	583	15579	273	1784	4	15	202	29	9	2	720	80	2167	49



TABLE 2. Total of neotropical shorebirds counted during the surveys in the *Pantanal* in October 1996.

REGIONS	OLCO	ANHI	WNHE	GREG	SNEG	CAEG	RTHE	WOST	MAST	JAST	BNIB	BFIB
1-PIIT	0	3	6	8	5	0	1	0	0	2	0	0
2-SALO	2	3	13	42	21	67	1	45	5	89	2	0
3-CUIA	129	8	73	1261	761	892	3	268	45	1604	0	0
4-POCO	8	7	35	1282	544	747	0	1533	94	476	0	0
5-CACE	4544	13	160	653	103	14	9	420	163	371	0	0
6-JAUR	3	6	15	115	10	6	3	0	4	6	0	0
7-COGR	0	1	13	18	18	0	7	0	4	15	0	0
8-PARA	65	15	172	610	119	30	7	48	47	70	0	0
9-BACU	780	2	126	371	72	366	5	76	123	150	10	444
10-PAIA	734	16	577	1619	308	44	5	70	204	122	2	15
11-ALTA	4	0	16	10	0	0	0	0	0	0	8	0
12-NHEC	23	14	70	1421	169	330	1	1119	39	714	26	34
13-BASA	26	2	28	419	113	662	0	612	35	430	0	190
14-NEGR	80	3	87	771	346	106	1	1409	91	429	4	17
15-MIAQ	322	6	140	2041	427	175	8	3990	79	1619	9	88
16-JACA	189	15	161	686	131	108	4	85	166	196	0	72
17-NABI	680	21	456	1264	83	6	7	1011	177	483	0	122
18-POMU	76	6	48	124	24	44	0	42	15	14	0	0
Totals	7665	141	2196	12715	3254	3597	62	10728	1291	6790	61	982

Continues

TABLE 2 (continuation). Total of neotropical shorebirds counted during the surveys in the *Pantanal* in October 1996.

REGIONS	SPOO	SOSC	W/FWD	BBWD	BRDU	MUDU	COSW	SNKI	OSPR	LIMP	YBTE	LBTE	BLSK	OTHERS
1-PIIT	1	7	0	0	0	0	0	0	0	0	0	21	8	19
2-SALO	45	9	0	0	0	2	0	0	1	2	1	8	24	34
3-CUIA	10	108	30	0	0	2	0	0	0	50	4	26	54	140
4-POCO	101	13	0	0	0	5	0	1	1	2	0	0	0	3115
5-CACE	22	17	0	0	0	6	0	5	1	3	0	43	7	861
6-JAUR	6	10	0	0	0	4	0	0	0	0	1	1	160	85
7-COGR	0	2	0	0	0	0	0	0	0	1	0	1	0	1
8-PARA	3	10	0	80	0	12	0	8	1	3	8	7	7	274
9-BACU	90	71	343	469	13	70	0	1	1	1	3	21	132	1784
10-PAIA	42	35	0	141	0	15	0	14	1	11	55	751	257	1398
11-ALTA	3	11	0	0	0	0	0	0	1	0	3	18	15	94
12-NHEC	313	48	825	449	7	22	0	0	0	0	57	70	31	1020
13-BASA	215	26	1042	577	18	24	34	0	0	3	0	204	5	27
14-NEGR	162	53	187	478	0	17	15	0	0	11	4	4	85	584
15-MIAQ	786	22	50	10	0	25	0	56	2	12	0	2	5	634
16-JACA	27	5	10	0	0	1	0	11	1	122	34	209	256	447
17-NABI	324	9	582	843	0	20	0	3	0	7	33	52	148	369
18-POMU	13	2	10	438	0	15	0	4	3	1	8	23	55	107
Totals	2163	458	3079	3485	38	240	49	103	13	229	211	1461	1249	10993

TABLE 3. Total of birds/categories counted during the aerial surveys in the Pantanal in October 1996

REGIONS	SHOREBIRDS	ANATIDAE	CICONIIDAE	ARDEIDAE	PHALACROCORA-CIDAE	STERNIDAE AND RYNCHOPIDAE	THRESKIORNITHI-DAE	ACCIPITRIDAE	ANHIMIAE	OTHERS	NEARCTIC SHOREBIRDS	NEOTROPICAL SHOREBIRDS	TOTAL
1-PIIT	7	0	2	38	3	29	0	1	7	1	5	2	88
2-SALO	6	6	147	203	5	33	2	10	12	1	1	5	425
3-CUIA	426	32	1935	3111	137	84	55	6	108	0	30	396	5894
4-POCO	9	65	2112	5733	15	0	19	6	13	1	1	8	7973
5-CACE	127	6	963	1803	4557	50	0	16	18	3	49	78	7543
6-JAUR	5	4	10	235	9	162	1	4	10	0	3	2	440
7-COGR	12	0	19	57	1	1	0	1	2	0	0	12	93
8-PARA	27	92	166	1214	80	22	0	11	10	1	3	24	1623
9-BACU	421	2600	358	1070	782	156	456	29	71	2	126	295	5945
10-PAIA	126	358	398	3781	750	1063	17	32	35	2	13	113	6562
11-ALTA	58	0	0	76	4	36	8	47	11	1	24	34	241
12-NHEC	554	1626	1931	2894	37	159	72	24	62	11	305	249	7370
13-BASA	16155	1705	1077	1440	28	209	198	0	26	4	3041	13114	20847

Continues

TABLE 3 (continuation). Total of birds/categories counted during the aerial surveys in the *Pantanal* in October 1996

REGIÕES	AVES LIMÍCOLAS	ANATIDAE	CICONIIDAE	ARDEIDAE	PHALACROCORA-CIDAE	STERNIDAE E RYNCHOPIIDAE	THRESKIORNITHI-IDAE	ACCIPITRIDAE	ANHIMIIDAE	OUTRAS	AVES LIMÍCOLAS NEÁRTICAS	AVES LIMÍCOLAS NEOTROPICAIS	TOTAL
14-NEGR	3954	755	1929	1968	83	99	26	27	55	4	1989	1965	8900
15-MIAQ	47	85	5849	4034	328	7	113	70	22	0	42	5	10555
16-JACA	59	11	447	1506	204	635	112	16	5	0	9	50	2995
17-NABI	53	1593	1673	2323	701	238	154	9	9	0	3	50	6753
18-POMU	0	566	71	254	82	86	0	11	2	0	0	0	1072
Totais	22046	9504	19087	31740	7806	3069	1233	320	478	31	5644	16402	95319





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