

## EARTHWATCH INSTITUTE FIELD REPORT 2004

**Project Title:** Birds and Dynamic Habitat Mosaics in the Pantanal, Southwestern Brazil

**Principal Investigator:** Reginaldo José Donatelli

**Position/Affiliations:** Ph.D. assistant/Biology Department, Universidade Estadual Paulista, Bauru, São Paulo (UNESP-Bauru)

**Research Site:** Fazenda Rio Negro, Pantanal, Aquidauana, Mato Grosso do Sul, Brazil

**Key Research Objectives:** species richness, species abundance, habitat diversity, seasonality, dynamics of birds' community, migratory species, conservation

**Date Report was Completed:** December 2004

### RESEARCH

#### **Data Collection and Results:**

In 2004 I made four expeditions to the Fazenda Rio Negro in the "município" (county) of Aquidauana, Mato Grosso do Sul, and one to Fazenda Santa Emília, in the "município" of Rio Negro. The expeditions were designed to gather additional data on avian species in the first place as part of a broader project to conserve wildlife in the southern portion of the Pantanal. I spent a week in the second area as an experimental visit in order to know the place and to check out whether it could work for future EWI expeditions. The following tasks were performed at Fazenda Rio Negro: 1) surveys of birds in a range of habitats; 2) estimation of indices (Diversity, Evenness, and Similarity, among others) describing bird community dynamics, particularly seasonal variation, given that the area has two well-defined seasons (wet and dry); 3) reporting on the status of bird species in different areas and habitats, with special emphasis on migratory species and those endangered in anyway (e.g. by direct or indirect anthropomorphic actions, e.g. habitat destruction, cattle impacts, etc.). At Santa Emília's I visited distinct habitats and counted birds all over the ranch. Data from this site are not included in this report because the expedition lasted only one week and also because it was an experimental expedition in a new place.

We counted the following number of species (and individuals) during quantitative survey, respectively, in April, August, September and October expeditions': 136 (1390), 134 (1645), 168 (3061) and 147 (2755). Eight new species were added to the cumulative species list for the region, *Hirundo rustica*, *Riparia riparia*, *Hirundo pyrronota*, *Piaya minuta*, *Myiozetetes cayanensis*, *Podilymbus podiceps*, *Calidris melanotos* and *Tachyphonus rufus*, taking the total number of species listed to 411. In April's expedition we counted 205 species of birds, the maximum registered in one expedition. Fifty four birds (from 23 species) were captured in mist nets and 44 were banded.

## Significance/Benefits of Research:

### Summary Table

Relevant Data and Research Results	Threats and Conservation Issues addressed	Significance / application to Conservation
<b>Pantanal:</b> <ul style="list-style-type: none"><li>reference (pristine) vs. disturbed site comparisons of bird communities associated with specific habitat types</li><li>identification of habitats with high diversity and/or that are important to migratory birds</li></ul>	Hydrological Cattle impacts Pollution Tourism	<ul style="list-style-type: none"><li>identification of environmentally impacted sites</li><li>present evidence of impacts to landowners, policy makers, and regional conservation organizations</li><li>identify and prioritize management actions to reduce impacts and restore degraded sites</li><li>prioritize actions to preserve biodiverse habitats and those used extensively by migratory birds</li><li>use data to plan and implement biodiversity corridors</li><li>provide data for biodiversity monitoring programs, e.g. TEAM<sup>a</sup></li></ul>
<b>Partner fazendas and private reserves:</b> <ul style="list-style-type: none"><li>species lists and community-level surveys of birds by habitat and season</li><li>seasonal habitat &amp; vegetation use by migrating (or wide-ranging) birds</li><li>bird nesting sites, rookery locations, &amp; breeding seasons</li></ul>		<ul style="list-style-type: none"><li>reference database from pristine and disturbed regions of the Pantanal</li><li>useful for spatial and temporal monitoring and mapping of biodiversity on private lands</li><li>identification of habitats, particular sites, &amp; plant species in need of special protection, because of their importance to migrations &amp; bird movements in general</li><li>prevention of tourist-related disturbance during breeding seasons</li><li>identification of sites that require special protection (e.g. limited visitation, not used by cattle, etc.)</li></ul>

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<sup>a</sup>, TEAM = CI's Tropical Ecology Assessment and Monitoring program.

## **Dissemination of Results:**

### ***Publications and Media Presentations:***

- A field guide to birds of the Pantanal and a web-based species list are being developed.
- CRI-Pantanal Annual Reports: 2001 to 2003.
- Talk at the Centro de Estudos Ornitológicos (CEO) at Universidade de São Paulo in 2003 (audience: Ornitologists from the Estate of São Paulo; 34 people)
- Talk in the Departamento de Ciências Biológicas at Universidade Estadual paulista in 2004 (audience: Lectures and Professores from the Faculty of Sciences; 16 people).
- Two scientific papers will be submitted for publication in 2005 (English language) – copies of all publications will be sent to EWI as soon as they are published.

## **SECTION II: RESEARCH GOALS, VOLUNTEERS AND COMMUNITIES**

### **1. Introduction and Objectives:**

The Pantanal is perhaps one of the least known regions of the globe. Scientific information is surprisingly scarce, according to Por (1995), who highlights vertebrates in a review of the literature on the Pantanal's wildlife. Probably nowhere in the world can such diverse bird life be so easily observed in such impressive populations as in the Pantanal (Por 1995). Naumburg (1930) was one of the pioneers in describing birds of the Pantanal, followed by Mitchell (1957), and Silva & Oniky (1988). Cintra & Yamashita (1990) went a step further and described the habitats, distribution, and abundance of bird species in the northern Pantanal. Brown (1986) analyzed the distribution and biogeographical affinities of over 650 bird species in the Pantanal. More recently, Dubs (1992) presented a catalogue of birds from southwestern Brazil and bordering regions. However, an analysis of the diversity and dynamics of bird species in the Pantanal region is still lacking.

The overall objective of this study is to provide information related to the community structure of birds and to identify environmental threats that directly or indirectly affect these communities. In addition, we hope to share results from this study with landowners and other community members to illustrate the importance of the Pantanal in terms of its unique pattern of wildlife diversity.

Some specific questions we are investigating include:

1. to what degree are bird assemblages distinct in specific habitats?,
2. are differences between wet and dry season assemblages greater in extreme environments like grasslands?,
3. are frugivorous species more diverse in the wet season when fruit availability is greater?, and
4. are migratory peaks species-specific, or are there general patterns related to seasonal fluctuations and habitat characteristics?

### Objectives:

- document the abundance and distribution of bird species among habitats in the Rio Negro region of the southern Pantanal,
- determine diversity, degree of endemism, timing of bird migrations, and importance and fragility of habitat types,
- investigate the effects of habitat change on bird communities at Fazenda Rio Negro and on neighboring *fazendas*,
- identify threats to particular species (with special emphasis on migratory and endangered species) and habitats and propose effective conservation actions.

## 2. Methods:

Bird species movements and dispersal depend on the structure and size of landscape components. In order to identify and census the species of birds that occur in particular habitats, we used two current ornithological methods:

1) The linear transect method (LTM). Described by Bibby *et al.* (1993), this method was applied in open habitats, including those that are and are not subjected to flooding. These habitats are easier to reach by boat, car, or by foot and do not present significant obstacles to field work. These open habitats allow us to keep moving, so it is possible to cover larger areas per time than with other methods. Using this procedure, we were able to: a) calculate relative densities of bird species in the habitats censused, and make comparisons among habitats; b) provide wide-scale monitoring of birds in different habitats; c) make status assessments of birds in the different habitats; and d) describe the influence of habitat change on bird communities.

The importance of using a particular methodology is the capacity to compare this methodology [in all areas or habitats of study] after the study has been made. For results to be comparable, a well-defined protocol must be used. The following protocol was used for the LTM: 1) routes were selected according to accessibility and were of a fixed length so that transects could be completed during a single session of fieldwork; 2) a minimum of about 40 registrations [observed birds and/or their vocalizations] were needed for reasonably accurate and precise density estimates; 3) in order to avoid double counting of birds, right and left sides were censused separately; and 4) surveys were done from dawn to approximately mid-morning and late afternoon to sunset. This standardized way of applying the linear transect method allowed us to compare results among open habitats. Line transects were used in *cerrado*, gallery forest, swamp, lake margins (*baías* and *salinas*), and grassland habitats.

2) Point counts. Blondel *et al.* (1970) were pioneers of using a quantitative method that involves an observer recording birds from a single point for a standardized time period. Point counts (PC) became very popular among ornithologists and are currently the most widely used quantitative method. Point counts are used for dense habitats where it is often difficult for an observer to detect the bird while moving. By standing in one place, it is possible to count all birds that are seen or heard near the observation point. This method is very useful in tropical areas where access is difficult and where birds are hard to see but easy to hear (Bibby *et al.* 1993). However, there are some distinctions between point counts in temperate and tropical environments, because the latter involves a greater diversity of bird species and calls. In temperate areas, the amount of time spent counting birds varies from 5 to 10 minutes depending on the distance

between counting stations (Ralph *et al.* 1995). I used the recommendations from Viellard and Silva's (1990) proposals for tropical environments. Thus, points to be counted were selected randomly within each study habitat, points were 200 m apart with an unlimited observation radius, and counts were made over 10 minute periods. The number of point counts was established according to the size (area) of the habitats sampled. Point counts were used for *cerradão*, *capões*, and *cerrado* habitats. For these forested habitats, 10 points were visited each morning during the ten day field periods. Each habitat was visited twice in this period. Over the year, visits to a single habitat type totaled eight (maximum ten). The total number of point counts conducted during a single year was approximately 400. Using Point Counts, we can: a) calculate an index for the most abundant and rarest species in determined habitats; calculate relative densities of bird species in the habitats censused, and make comparisons among habitats; b) provide wide-scale monitoring of birds in different habitats; c) make status assessments of birds in the different habitats; and d) describe the influence of habitat change on bird communities.

### 3. Results:

#### Research Highlights:

- from 2000 to 2004, the project registered 45,979 bird contacts (sightings and songs),
- a total of 411 species were recorded (388 from Fazenda Rio Negro and 23 from neighboring ranches),
- in 2004, eight new species were added to the existing list of 403, *Hirundo rustica*, *Riparia riparia*, *Hirundo pyrronota*, *Piaya minuta*, *Myiozetetes cayanensis*, *Podilymbus podiceps*, *Calidris melanotos* and *Tachyphonus rufus*, the total number now reaches 411 species registered,
- four northern migrants (all swallows) were registered in 2004,
- 301 species were registered during quantitative censuses, and 111 of these were recorded  $\geq 50$  times,
- from 2000 to 2004, marked seasonal and annual fluctuations in diversity and abundance were observed for the bird communities of all habitats,
- from 2000 to 2004 the greatest variability between seasons and years was observed in the *salinas* (soda lake) and in the grassland habitats,
- overall, diversity was highest in *cerrado* (open, medium-canopy, savanna forest) and river habitats, and lowest in *cerradão* (closed, high-canopy, savanna forest) and grassland habitats,
- from 2000 to 2004, a total of 168 birds (from 63 species) were captured in mist nets and banded,
- in 2003, 3 new species were added to the existing list of 403, the chestnut-bellied heron (*Agamia agami*), the great-billed seed-finch (*Pheucticus aureoventris*), and the black-backed grosbeak (*Oryzoborus maximiliani*),
- in 2003, a flavescent warbler (*Basileuterus flaveolus*) that had been banded in 2000 was recaptured,
- in 2003, several distinct call types of a rarely seen or heard species, the speckled crane (*Coturnicops notata*), were recorded from a *baia* habitat,
- in 2003, the Aquatic and Bird projects initiated joint surveys on neighboring *fazendas* where cattle densities were high. Core samples of aquatic invertebrates and counts of aquatic birds at *salina* (soda lake) habitats showed

extremely low species diversity, but incredibly high numbers. In other words, the 1 or 2 species of aquatic invertebrates that inhabited cattle-impacted *salinas* were extremely productive, and the 1 or 2 species of aquatic birds that preferred to feed on the invertebrates became concentrated in huge flocks. We suspect that the impacted lakes are in the early stages of nutrient enrichment (eutrophication) caused by the input of cattle feces.

#### Qualitative (or exhaustive) data

We counted 301 bird species in the qualitative surveys performed during the four expeditions in 2004. Eight new species were added to cumulative species list, *Hirundo rustica*, *Riparia riparia*, *Hirundo pyrronota*, *Piaya minuta*, *Myiozetetes cayanensis*, *Podilymbus podiceps*, *Calidris melanotos* and *Tachyphonus rufus*, taking the total number of species listed to 411. Three hundred and eighty eight bird species have been recorded at Fazenda Rio Negro and 23 species in neighboring regions.

#### Quantitative data

Quantitative surveys for 2003 identified 231 species, while in 2004 the number reached 301. One hundred and fourteen birds (from 57 species) were captured in mist nets and banded in 2003 and fifty four birds in 23 species in 2004. The total number of contacts (records of sightings and songs/calls) from 2000 to 2004 is 45,979 in 2260 samples. More than one hundred and eleven species have been sighted or heard more than 50 times since 2000.

Results from 2001 to 2004 are presented in **Table 1** and show the total number of species and individuals recorded for each habitat during each field expedition, as well as the total number of species and individuals, and diversity and evenness indices for all habitats combined. **Figure 1** depicts the variation of diversity between 2001 to 2004 for distinct habitats. **Figure 2** depicts the variation of evenness between 2001 to 2004 for distinct habitats. **Table 2** shows the number of species in all bird families recorded from the quantitative censuses between 2001 and 2004, in descending order. The number of species recorded at Fazenda Rio Negro as a percentage of the total number of described species for each family in Brazil is also presented. **Table 3** shows the number of contacts recorded for the most abundant species (over 100 individuals) during quantitative censuses from 2001 to 2004, in descending order. **Table 4** presents the principal migratory species registered at Fazenda Rio Negro.

### **FIGURES 1 AND 2**

Frequency of occurrence (FO), expressed as a percentage, corresponds to the number of field expeditions during which a species was observed (Vielliard & Silva, 1990) during qualitative and quantitative surveys. FO indicates whether a species is occasional, resident, or migrant in accordance with the value obtained. **Table 5** shows the distribution (percents) of Frequency of Occurrence (FO) values for the bird community at Fazenda Rio Negro from 2001 to 2004. The Frequency of Occurrence (FO) for the most common bird species ( $\geq 25\%$ ) at Fazenda Rio Negro from 2001 through 2004 are shown in the Appendix 1. About 56% of all species registered were considered resident species ( $n=227$ ), and 44% were considered visitors or migrants, i.e. their frequency of occurrence was considered occasional ( $n=184$ ). Appendix II shows the total number of individuals (TI) observed, and the Index of Point Abundance (IPA) for species with  $\geq 50$  contacts.

## TABLES 1-5

In this analysis the aim is to understand bird community dynamics in the context of the Pantanal's distinct seasonality (wet and dry seasons), associated with the diversity of that community and with a given habitat. This gives rise to two questions: (1) Are the habitats for which diversity indices vary most widely those that do not have a resident bird community and are directly subject to stark shifts either in seasons or due to weather conditions? (2) Are they those in which a larger number of migratory birds are observed and thus play a key role for the bird community in general?

August 2001 was the richest month and also the one that showed the highest diversity index among all samples in the fazenda Rio Negro (195 species and 4250 individuals) probably due to the highest period of drought ever registered during a dry season (Table 3) when the birds are easily detectable. 109 bird species were registered in the Negro river and not any longer (the closest number was 107 registered in September 2002, after a long period of drought). Cerrado was the second richest habitat and showed a higher number of individuals ( $n=1154$ ), mainly due to the high concentrations of the Great Egret (*Ardea alba*) with 522 individuals all over ponds and lakes within the Cerrado.

The wet season, on the other hand, showed an unexpressive number of species and individuals (January and April) whatever decreased the diversity index during this season. June is normally dry in the Pantanal but it rained considerably in 2001 (Table 1). The result was a decrease in the number of species observed and a high number of individuals, mainly found in the salinas, which also resulted in the decrease of the diversity index. The evenness index varied from 0,84 (June) to 0,89 (January), with an average of  $E=0,87$  (Table 2). This pattern found in the Pantanal in 2001 makes this result plenty justifiable since some populations were composed of hundreds of individuals in all habitats in both seasons.

The observed monthly diversity indices clearly evidence the dynamics and seasonality of the bird community during 2002. Although the number of species and individuals in September was higher than in other months when sampling took place, these values did not reflect higher diversity or evenness mainly because of the very large number of individuals observed for three migratory species, e.g., *Tringa melanoleuca* (Greater Yellowlegs), *Tachybaptus dominicus* (Least Grebe), and *Dendrocygna viduata* (White-Faced Whistling Duck). All three species were observed in the salinas, where the diversity index was the lowest of all habitats for the months sampled and also for the year (Table 1).

The number of species was fairly similar for January, February and April but the number of individuals was higher in February and April, when the diversity index was also similar; in January, on the other hand, the number of individuals was smaller but the diversity index higher than in February and April.

The slightly larger number of species and individuals in June than in previous months did not reflect higher diversity: similar indices were observed in February and April. Given that evenness values were practically the same in February, April and June it can be inferred that in those months there was not a significant number of species with a large number of individuals and that in contrast with the same period of 2001 migratory birds were not yet present in large enough numbers to affect the indices.

In January the lowest diversity index was found for grassland and the highest for *cerrado* (Table 1). Values for *salinas*, gallery forest and river (Rio Negro) were similar, while values for *cerradão* was lower than the rest. It is possible that few birds remain in the grassland habitat during the rainy season (November-April); moreover, grasslands are preferred by migratory birds, especially finches, which reappear there in the dry season (May-October). Diversity indices for aquatic habitats were high for the time of year given the tendency for species and individuals to concentrate there in the dry season (see below). The *cerrado* was frequented by large numbers of species and individuals both because of the diversity of its vegetation and physiognomy and because it is a stopping-place for many large birds, such as waterfowl. Additionally, it is a habitat for a vast range of Psittacidae. The *cerradão* showed a poor diversity, and the only plausible explanation for this outcome is related to the low level of detection of bird species during the raining seasons in this habitat.

Evenness measures for January showed a balanced distribution of individuals across species in all habitats: in other words, no species was higher dominant (with a larger number of individuals than any other) in any habitat.

In February, when the amount of rainfall increases, all diversity indices fell. The highest diversity index was found for the *salinas*, an open environment where it is easy to observe and record birds. Evenness measures for the month clearly evidence the fact that certain species are easier to record and display a larger numbers of individuals in this rainy month. Dominant species are found above all in aquatic habitats such as the river and *salinas*, for example. The same was observed during the dry season but for different reasons, mainly associated with the arrival of many migratory species.

Diversity indices were highest for the *cerrado* and river habitats in April, normally the end of the rainy season. The *cerrado* has countless resident species all year round, in contrast with all other habitats, especially aquatic, where the size of the bird community varies with the presence or absence of migratory species, food and flooding. The same could be said for gallery forest except that because it contains denser vegetation than the *cerrado* where birds are less detectable and were registered mainly by vocalization.

The lowest diversity indices found in April were for *salinas* and *cerradão*, both relatively interlinked. The latter displayed low diversity indices throughout the year (see Table 2). Distribution of individuals was low in *salinas*, in line with diversity: this means there were few species in *salinas* but each was represented by a large number of individuals, thus probably leading to low diversity as well as low evenness.

The same can be said of the diversity indices recorded for June, a dry month in the Pantanal. The *cerrado*, river and gallery forest, which displayed higher diversity indices ( $H' > 3$ ), probably because birds are more easily detected during dry periods and also probably forage in water bodies found in these habitats which mainly contain fresh water in contrast with *salinas*, where the water is brackish and diversity indices were relatively low (see Table 2). The diversity index for grassland remained low, indicating that migratory birds, especially finches and some blackbirds, had not yet arrived there by June 2002. Evenness was again very low in *salinas*, evidencing the presence of a few species with many individuals: in other words, the distribution of individuals across species was highly irregular and distinct whatever decreased the diversity index for the *salinas*.

In 2002 the dry season peaked in September. High temperatures and low humidity associated with falling water levels throughout the Rio Negro's area left diversity high only in the river habitat, which is popular with birds during the dry season. In addition, many birds nest in the river habitat at this time of year: for example, the Black Skimmer nests only in the dry months, when sandy beaches are formed along the River Negro.

The diversity index for the *cerrado* was lower than in previous months, probably for reasons associated with the dry weather. On the other hand, the diversity index for grassland was higher, probably owing to the arrival of many migratory species that use this habitat in the dry season. The diversity index for the *salinas* was irregularly low in September owing to lack of water: many of these ponds shrank to half their normal size in the period. At the same time the evenness measure reached a critical level, slightly above  $n=0.5$ , meaning low diversity and few individuals per species. Even so evenness was higher than  $n=0.8$  for all habitats except *salinas*, showing that individuals were relatively well distributed across species represented and that no species dominated in terms of numbers of individuals.

It can be seen that the vast majority of migratory species were recorded in June and September 2002. The exceptions were *Crotophaga major* (Greater Ani), a summer migratory species recorded only in the high water (wet) season; *Anhinga anhinga* (Anhinga), normally recorded in large numbers during summer; *Phalacrocorax brasilianus* (Brazilian Cormorant), present in summer and the early dry season (winter in the Pantanal), disappearing in August; and *Phaetusa simplex* (Large-Billed Tern), another species that migrates in summer. There is also *Hirundo rustica* (Barn Swallow), not recorded in 2002 but seen in large flocks during summer 2001 (wet season).

The migratory species that begin arriving in the region at the end of high water and early dry season is *Tachybaptus dominicus* (Least Grebe).

The following migratory species are typical of winter (dry season): *Egretta thula* (Snowy Egret), *Tringa melanoleuca* (Greater Yellowlegs), *Tringa flavipes* (Lesser Yellowlegs) (not seen in 2002), *Dendrocygna viduata* and *D. autumnalis* (recorded in small numbers in 2002 and 2003), *Hoploxypterus cayanus* (Pied Plover), *Rhynchops nigra* (Black Skimmer), *Mycteria americana* (Wood Stork) (at least in Rio Negro), *Tachycineta albiventer* (White-Winged Swallow) and *Stelgidopteryx ruficollis* (Rough-Winged Swallow) among others.

Most of these migratory species are recorded as occurring in the river habitat (Rio Negro); however, the most abundant are frequently found in the *salinas*.

In 2003, species richness was greater than 150 only in January (Table 1). This is unexpected since January is a wet month and richness is usually greater in the dry season (May-October). In this case it was presumably due mainly to the fact that there was less rainfall than usual in the month in question; moreover, rainfall was more abundant than usual in November and especially December. The same can be said of the diversity indices for each expedition insofar as there was equilibrium in November-December and an increase in January. Relative abundance for January was due mainly to the large number of *Himantopus himantopus* (Common Stilts,  $n=297$ ) and *Phaetusa simplex* (Great Yellow-Billed Terns,  $n=174$ ) observed in the Brunet *salina* (causing low diversity for *salinas* in January – see Table 2).

January was an atypical month in 2003. High grassland diversity is concrete evidence of unexpectedly low rainfall. The number of species observed in this habitat was surprisingly large. Diversity in the *cerradão* (Table 2) also evidenced the disparity of movements by bird species in the month. Diversity for November and December showed a pattern for the rainy season and in line with levels seen in previous years.

The numbers of the four main migratory birds registered in 2003 (*T. melanoleuca*, *Hoploxypterus cayanus*, ducks in general, except *D. viduata*, and grebes), were much lower this year. *Himantopus himantopus* could not be considered a migratory species since it is found all year round in the fazenda Rio Negro. In all cases, however, the number were considered below the expected. It is hard to explain whatever happened in 2003 relative to migratory birds whether one compares with the results from 2002.

The results displayed significant differences due possibly to temperature, humidity and the long drought in 2002 up to January 2003.

According to figure one, we observe that the river and both forested habitats, as the gallery forest and the cerrado, showed a constant diversity in the last four years, being the river, the most constant among all. Cerrado showed some variation in 2001, which is the lowest diversity for this habitat in the last four years, and in 2002, the highest one. Both 2002 and 2003, diversity index was stable in the cerrado. The reason for this variation might be the long period of rain in 2001 (up to mid-July), an unusual fact for the Pantanal in the middle of the dry period. Salinas showed a couple-matched result: in 2001 and 2002 the diversity index was the highest one and 2003 and 2004, the lowest one. This could be associated to the extent migratory birds visit the salinas and probably in the last two years the number of individuals in the salinas was much higher than in the previous years, besides the decrease in the number of species visiting this habitat. Grasslands showed the biggest variation, mainly because it is a habitat subject to huge fluctuation of birds during the dry season, when many migratory birds come, and rainy season, period when the migratory birds leave this habitat. 2001 and 2002 the index of diversity was higher than 2003 and 2004. In August 2003 farm owners and fireman set fire to the grasslands as a training course effort to fight fire but the results were catastrophic. It took sometime until the next rainy season arrives to recuperate the natural grass again. This could be the reason of the results found for the grasslands in the last two years.

According to figure two, we distinguish the forested habitats from all others in terms of evenness. In these habitats there was a less variation in the number of species and individuals, that is, they showed more stability. The river (Rio Negro) showed an unexpected variation in 2002 when many individuals from few species were present against few individuals from the great part of the species registered in this habitat, though the diversity index has not showed this variation (figure 1). The same could be said about the gallery forest, and the reason could be linked to the proximity of these two habitats and the invasion of the river to the interior of the gallery forest mainly during the rainy season. This calls for more fishes in the *corixos* and more birds to feed on these fishes. The grasslands showed a pattern for the first three years but in 2004 evenness was the lowest one. Few species and an increase on the numbers of individuals per species might be the reason of these results. Salinas depend straight in the volume of water from the rains and the results showed no pattern at all. 2002 and 2004 evenness indexes were contradictory with the diversity indexes in the salinas (compare figure 2 with figure 1).

The data obtained in the last four years were of fundamental significance for discerning long-term trends and establishing new hypotheses and goals. Results verified (a) previously observed variability in diversity measures for the bird community, especially for aquatic environments between seasons and during periods of irregular weather such as those seen this year; (b) between-habitat variability of bird community dynamics as related to weather and food supply (the latter will be investigated in partnership with Don Eaton, who is studying aquatic environments; apparently the dynamics of the bird community is closely linked to the micro and mesofauna in these environments as well as weather conditions); (c) whether the presence of cattle on nearby properties interferes with bird community dynamics, especially in the case of migratory birds. It will also be important to try to understand bird community dynamics in inhospitable environments such as the grasslands.

The next steps are (1) to conduct similar on ranches where cattle raising is more extensive; (2) to make more intensive use of banding, and (3) to observe daily variations in the presence of migratory waterfowl and cross-reference this with data on food supply recorded by Don Eaton for *salinas*, *baías*, and the river in regions with and without cattle. The key to understanding bird community dynamics in the region is profiling or establishing a reference framework for the environments in which these dynamics take place. The habitats of Fazenda Rio Negro are clearly pristine, but those located on neighboring ranches and in other parts of the Pantanal are subject to human pressures of various kinds. The extent to which human pressures affect wildlife as a whole depends on how we understand the dynamics of wildlife in pristine environments. By understanding these dynamics and specifically the interaction of bird communities (and wildlife in general) with various habitats, it will be possible to infer how human pressure in related environments affects those habitats. In addition, it will be possible to suggest ways of conserving the habitats and resident species through environmental management.

#### **4. Discussion**

##### **(a) Engagement:**

From 2000 to 2004 the volunteers performed the following assignments:

- cutting, alignment, and transportation of bamboo and PVC poles for erection of mist nets;
- clearing of sites previously selected for mist nets;
- biometric measurement of birds, note-taking, and banding (bands were placed on legs; birds were removed from nets by my assistants and myself);
- recording of bird songs and calls;
- observation of the behavior of the most common and conspicuous species;
- clearing of paths;
- marking of Point Counts in all habitats surveyed;
- recording of bird observations on field spreadsheets;
- transfer of field data to computer spreadsheets;
- general observations of birds using qualitative methodology;
- locating new sites for bird observation and banding;
- observing and recording nocturnal birds;
- it is also worth noting many items of baggage and field material were carried by volunteers during all expeditions. Some volunteers with above-average computing skills helped to refine spreadsheets and solve day-to-day practical computing problems;
- the volunteers assisted with censuses at 2800 points between 2000 to 2004 (140 per expedition) and added new bird recordings to those already recorded in the previously years. They banded from 2000 to 2004, a total of 168 birds from 63 species. They also replaced markers at more than 100 stations where tapes decayed or disappeared.

**(b) Science:**

**Table 6** summarizes the significance and application of research results to conservation in the Pantanal and to management of partner fazendas and private reserves (RPPNs).

**TABLE 6**

**(c) Dissemination:**

***Publications and Media Presentations:***

- A field guide to birds of the Pantanal and a web-based species list are being developed.
- CRI-Pantanal Annual Reports: 2001 to 2003.
- Talk at the Centro de Estudos Ornitológicos (CEO) at Universidade de São Paulo in 2003 (audience: Ornitologists from the Estate of São Paulo; 34 people)
- Talk in the Departamento de Ciências Biológicas at Universidade Estadual paulista in 2004 (audience: Lectures and Professores from the Faculty of Sciences; 16 people).
- Two scientific papers will be submitted for publication in 2005 (English language) – copies of all publications will be sent to EWI as soon as they are published.

***5. Presentations, Meetings, Conferences/Workshops and Seminars:***

- Dec. 2003: participation by CRI-Pantanal researchers at the Landscape Species Workshop sponsored by WCS and Embrapa-Pantanal in Corumbá. Researchers contributing data or participating were: Erich Fisher, Don Eaton, Alexine Keuroghlian, Leandro Silveira, Helen Waldemarin, and Reginaldo Donatelli.
- June 2003: First Workshop of Pantanal Researchers, sponsored by EW and CI-Brazil.
- Jan. 2003: participation of CRI-Pantanal researchers at the “Mapping the Corridor” workshop, sponsored by CI-Brazil – participants: Leandro Silveira, Mauro Galetti, Andréa Araújo, Reginaldo Donatelli, Alexine Keuroghlian, and Don Eaton.

**6. Partnerships:**

*Instituto de Biologia da Conservação* (IBC) – logistics and future publications. **Website:**

- [www.ibcbrasil.org.br](http://www.ibcbrasil.org.br)
- 2003: Start-up grant for cattle impact studies from the *Instituto de Biologia da Conservação* (IBC) and CI-Brazil – Peccary, Frugivore, Bird, and Aquatic projects.

**Staff:**

- Gustavo Rosa, field assistant, PhD’s candidate at UNESP-Botucatu.
- Thiago Vernaschi Vieira da Costa: field assistant, Master in Zoology from UNESP-Botucatu.
- Carolina Demétrio Ferreira: field assistant, PhD’s candidate at UNESP-Botucatu.

**7. Acknowledgements:**

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TABLE 1

	2001					2002					2003			2004			
SPECIES/INDIVIDUALS	JAN	APR	JUN	AUG	OCT	JAN	FEB	APR	JUN	SEP	JAN	NOV	DEC	ABR	AGO	SET	OUT
<b>SALINAS</b>	44/459	28/585	41/159	49/611	45/15			71/109	48/108	62/321				35/370	16/261	55/879	47/124
			3		5	73/524	69/323	7	6	8	49/792	39/549	30/481				6
<b>GALERY FOREST</b>	52/330	38/177	31/151	52/257	28/10									66/242	26/88	65/145	47/202
				2		57/313	51/58	56/279	47/270	29/129	35/83	55/443	x				
<b>GRASSLANDS</b>	20/53	14/38	24/115	25/485	23/80	17/58	17/230	25/96	29/169	64/335	34/112	x	x	x	x	42/172	20/172
<b>RIVER</b>	86/720	104/11	96/617	109/10	50/31		92/164		83/106	107/13	93/114			67/526	72/388	99/100	65/550
	7		25	7		61/494	4	66/729	0	34	1	74/701	71/708			4	
<b>CERRADO</b>	88/512	18/114	38/144	78/115	51/12									49/167	65/231	113/64	77/282
				4	0	48/464	52/149	35/253	66/279	37/184	27/67	62/116	x			3	
<b>CERRADAO</b>	33/357	70/296	x	x	x	/98146	47/204	61/122	33/121	59/119	52/170	44/235	63/218	33/85	38/123	25/61	70/273
	155/26	156/34	131/32	195/42	136/8	156/18	150/26	146/24	155/31	164/54	158/24	139/21	137/16	136/13	134/11	168/30	147/27
<b>TOTALS</b>	40	4	29	50	79	00	90	09	96	05	00	29	87	90	85	61	55
<b>H'</b>	2.78	3.05	2.82	3.98	3.21	3.46	2.46	3.17	3.17	3.30	3.22	3.15	2.70	2.74	2.79	3.93	2.88

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0.89 0.88 0.84 0.86 0.88 0.88 0.63 0.83 0.81 0.83 0.85 0.82 0.78 0.77 0.86 0.87 0.82

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**TABLE 2**

	2001					2002					2003			2004			
	JA												APR	AGO	SEPT	OUT	
<b>DIVERSITY</b>	N	APR	JUN	AUG	OCT	JAN	FEB	APR	JUN	SEPT	JAN	NOV	DEC				
	3.1												2.26	1.16	2.60	2.10	
<b>SALINAS</b>	6	2.58	2.54	2.61	3.40	3.74	2.73	2.76	2.65	2.23	2.58	1.98	1.48				
	1.8													x	2.70	3.42	1.92
<b>GRASSLANDS</b>	0	2.00	2.63	1.71**	2.61	2.67	2.32	2.80	2.74	3.02	3.04	2.49	x				
	2.6													3.35	3.48	3.30	3.14
<b>GALLERY FOREST</b>	8	2.85	2.70	3.01	3.00	3.68	2.51	3.40	3.16	3.06	3.35	3.54	x				
	3.3													3.52	3.58	3.64	3.44
<b>RIVER</b>	3	3.94	3.40	3.52	3.37	3.61	2.43	3.58	3.30	4.05	3.37	3.71	3.44				
	3.2													2.30	3.10	3.50	3.45
<b>CERRADO</b>	0	3.04	2.83	2.51	3.67	4.06	2.49	3.72	3.78	3.78	2.93	3.46	x				
	2.5													2.30	2.70	3.00	3.27
<b>CERRADAO</b>	6	3.91	x	x	x	3.31	2.32	3.20	3.00	3.36	3.26	3.55	2.90				
<b>EVENESS</b>																	
	0.8													0.51	0.80	0.70	0.64
<b>SALINAS</b>	7	0.84	0.70	0.75	0.89	0.89	0.64	0.66	0.68	0.54	0.67	0.67	0.48				
<b>GRASSLANDS</b>	0.9	0.96	0.83	0.60**	0.83	0.94	0.73	0.87	0.81	0.82	0.86	0.87	x	x	0.85	0.92	0.66

	1																	
	0.9													0.86	0.86	0.87	0.95	
<b>GALLERY FOREST</b>	2	0.86	0.89	0.92	0.90	0.91	0.63	0.85	0.82	0.91	0.94	0.86	x					
	0.8													0.89	0.92	0.93	0.86	
<b>RIVER</b>	8	0.81	0.90	0.88	0.86	0.87	0.53	0.85	0.75	0.87	0.87	0.86	0.90					
	0.9													0.71	0.89	0.87	0.88	
<b>CERRADO</b>	0	0.94	0.90	0.65	0.93	0.88	0.63	0.90	0.90	0.93	0.89	0.86	x					
	0.8													0.87	0.83	0.93	0.94	
<b>CERRADAO</b>	9	0.90	x	x	x	0.85	0.60	0.90	0.85	0.93	0.93	0.86	0.89					

**Table 3**

<b>Species</b>	<b>English common names</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>Total numbers</b>
<i>Himantopus himantopus</i>	Black-necked Stilt	1098	1490	1077	673	4338
<i>Ardea alba</i>	Great Egret	1319	591	119	581	2610
<i>Dendrocygna viduata</i>	White-faced Whistling Duck	369	644	198	496	1707
<i>Ortalis canicollis</i>	Chaco Chacalaca	546	479	338	297	1660
<i>Aratinga acuticaudata</i>	Blue-crowned Parakeet	157	874	132	211	1374
<i>Egretta thula</i>	Snowy Egret	334	440	62	253	1089
<i>Brotogeris chiriri</i>	Canary-winged Parakeet	347	400	155	150	1052
<i>Amazona aestiva</i>	Blue-fronted Parrot	322	434	152	110	1018
<i>Phaetusa simplex</i>	Large-billed Tern	285	154	237	252	928
<i>Phalacrocorax brasilianus</i>	Brasilian Cormorant	175	640	29	2	846
<i>Dendrocygna autumnalis</i>	Black-bellied Whistling Duck	309	240	56	127	732
<i>Aburria pipile</i>	Blue-throated Piping Guan	202	218	131	149	700
<i>Leptotila verreauxi</i>	White-tipped Dove	195	197	207	97	696
<i>Guira guira</i>	Guira Cuckoo	254	208	122	106	690
<i>Ramphocelus carbo</i>	Silver-beaked Tanager	168	223	106	189	686
<i>Jacana jacana</i>	Jacana	130	143	105	286	664
<i>Ceryle torquata</i>	Ringed Kingfisher	183	296	157	26	662
<i>Columba picazuro</i>	Picazuro Pigeon	281	195	57	122	655
<i>Tachybaptus dominicus</i>	Least Grebe	3	554	39	1	597
<i>Crax fasciolata</i>	Bare-faced Currawong	164	171	153	86	574
<i>Phimosus infuscatus</i>	Bare-faced Ibis	248	169	36	114	567
<i>Crotophaga major</i>	Greater Ani	170	147	233	16	566
<i>Thryothorus leucotis</i>	Buff-necked Wren	198	164	109	95	566
<i>Cyanocorax cyanomelas</i>	Purplish Jay	162	213	91	98	564
<i>Pitangus sulphuratus</i>	Great Kiskadee	176	201	68	117	562
<i>Vanellus chilensis</i>	Southern Lapwing	261	133	71	85	550
<i>Rynchops nigra</i>	Black Skimmer	164	99	53	196	512
<i>Crypturellus undulatus</i>	Undulated Tinamous	205	93	116	95	509
<i>Anhinga anhinga</i>	Anhinga	97	252	85	69	503
<i>Tringa melanoleuca</i>	Greater Yellowlegs	89	376	35	1	501
<i>Chloroceryle amazona</i>	Amazon Kingfisher	124	220	134	23	501
<i>Paroaria capitata</i>	Yellow-billed Cardinal	140	204	71	81	496
<i>Hoploxypterus cayanus</i>	Pied Plover	144	85	118	78	425
<i>Ardea cocoi</i>	White-faced Heron	47	209	111	50	417
<i>Butorides striatus</i>	Striated Heron	98	163	79	41	381
<i>Crotophaga ani</i>	Smooth-billed Ani	87	135	50	95	367
<i>Stelgidopteryx ruficollis</i>	Southern Rough-winged Swallow	118	94	144	1	357
<i>Platalea ajaja</i>	Roseate Spoonbill	269	51	8	2	330
<i>Furnarius leucopus</i>	Pale-legged Hornero	66	57	89	101	313
<i>Amazonetta brasiliensis</i>	Brasilian Teal	104	57	44	78	283
<i>Tringa flavipes</i>	Lesser Yellowlegs	135	3	123	1	262
<i>Ara auricollis</i>	Yellow-collared Macaw	23	150	25	60	258

<i>Aratinga leucophthalmus</i>	White-eyed Parakeet	148	30	17	51	246
<i>Gnorimopsar chopi</i>	Chopi Blackbird	99	74	59	5	237
<i>Coragyps atratus</i>	Black Vulture	59	111	45	18	233
<i>Psarocolius decumanus</i>	Crested Oropendula	93	103	26	2	224
<i>Cacicus solitarius</i>	Solitary cacique	71	75	31	41	218
<i>Paroaria coronata</i>	Red-crested Cardinal	84	11	41	74	210
<i>Aratinga aurea</i>	Peach-fronted Parakeet	18	130	7	53	208
<i>Cercomacra melanaria</i>	Mato Grosso Antbird	49	65	64	27	205
<i>Furnarius rufus</i>	Rufous Hornero	101	56	34	6	197
<i>Chloroceryle americana</i>	Green Kingfisher	65	45	60	23	193
<i>Pitangus lictor</i>	Lesser Kiskadee	118	33	39	2	192
<i>Ara chloroptera</i>	Red-and-green-Macaw	47	40	46	57	190
<i>Ramphastos toco</i>	Toco Toucan	71	75	40	1	187
<i>Columba cayennensis</i>	Pale-vented Pigeon	74	29	57	19	179
<i>Eucometis penicilata</i>	Grey-headed Tanager	138	2	30	7	177
<i>Taraba major</i>	Great Antshrike	41	86	44	1	172
<i>Aramides cajanea</i>	Grey-necked Wood-Rail	39	57	12	55	163
<i>Thamnophilus doliatus</i>	Barred Antshrike	83	49	27	1	160
<i>Cyanocorax chrysops</i>	Plush-crested Jay	37	88	15	16	156
<i>Cairina moschata</i>	Moscovy Duck	26	70	18	39	153
<i>Mesembrinibis cayennensis</i>	Green Ibis	13	78	55	3	149
<i>Campylorhynchus turdinus</i>	Thrus-like Wren	74	8	24	37	143
<i>Syrigma sibilatrix</i>	Whistling Heron	61	45	29	1	136
<i>Tigrisoma lineatum</i>	Rufescent Tiger Heron	30	51	53	1	135
<i>Saltator coerulescens</i>	Greyish Saltator	35	51	43	1	130
<i>Galbula ruficauda</i>	Rufous-tailed Jacamar	33	51	33	5	122
<i>Cyclarhis gujanensis</i>	Rufous-browed Peppershrike	1	62	44	14	121
<i>Myiarchus tyrannulus</i>	Brown-crested Flycatcher	28	56	32	2	118
<i>Ara nobilis</i>	Red-shouldered Macaw	58	54	5	0	117
<i>Theristicus caudatus</i>	Buff-necked Ibis	62	35	18	1	116
<i>Synallaxis albilora</i>	White-lored Spinetail	6	66	41	1	114
<i>Nandayus nenday</i>	Nanday Parakeet	23	52	37	2	114
<i>Trogon curucui</i>	Blue-crowned Trogon	23	44	45	1	113

**Table 4**

<b>Species</b>	<b>English common names</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>Total Numbers</b>
<i>Dendrocygna viduata</i>	White-faced whistling Duck	369	644	198	496	1707
<i>Phalacrocorax brasilianus</i>	Brasilian Cormorant	175	640	29	2	846
<i>Egreta thula</i>	Snowy Egret	334	440	62	253	1089
<i>Phaetusa simplex</i>	Large-billed Tern	285	154	237	252	928

<i>Dendrocygna autumnalis</i>	Black-bellied whistling Duck	309		56	127	732
			240			
<i>Thachybaptus dominicus</i>	Least Grebe	003	554	39	1	597
<i>Crotophaga major</i>	Greater Ani	170	147	233	16	566
<i>Tringa melanoleuca</i>	Greater Yellowlegs	89	376	35	1	501
<i>Phimosus infuscatus</i>	Whispering Ibis	248	169	36	114	567
<i>Anhinga anhinga</i>	Anhinga	97	252	85	69	503
<i>Hoploxipterus cayanus</i>	Pied Plover	144	85	118	78	425
<i>Rhyncops nigra</i>	Black Skimmer	164	99	53	196	512
<i>Mesembrinibis</i>	Green Ibis	13		55	3	149
<i>cayanensis</i>			78			

**Table 5**

	Frequency of Occurrence Percentage Classes (%)					Totals
	Up to 24	25-50	51-75	76-99	100	
<b>Relative percentages</b>	46	16	12	14	12	100
<b>Number of species</b>	183	59	44	55	46	388

**Table 6**

Relevant Data & Research Results	Threats & Conservation Issues addressed	Significance / application to Conservation
<p><b>Pantanal:</b></p> <ul style="list-style-type: none"> <li>- reference (pristine) vs. disturbed site comparisons of bird communities associated with specific habitat types</li> <li>- identification of habitats with high diversity and/or that are important to migratory birds</li> </ul>	<p>Hydrological Cattle impacts Pollution Tourism</p>	<ul style="list-style-type: none"> <li>- identification of environmentally impacted sites</li> <li>- present evidence of impacts to landowners, policy makers, and regional conservation organizations</li> <li>- identify &amp; prioritize management actions to reduce impacts and restore degraded sites</li> <li>- prioritize actions to preserve biodiverse habitats and those used extensively by migratory birds</li> <li>- use data to plan and implement biodiversity corridors</li> <li>- provide data for biodiversity monitoring programs, e.g. TEAM<sup>a</sup></li> </ul>
<p><b>Partner fazendas &amp; private reserves:</b></p> <ul style="list-style-type: none"> <li>- species lists &amp; community-level surveys of birds by habitat and season</li> <li>- seasonal habitat &amp; vegetation use by migrating (or wide-ranging) birds</li> <li>- bird nesting sites, rookery locations, &amp; breeding seasons</li> </ul>		<ul style="list-style-type: none"> <li>- reference database from pristine and disturbed regions of the Pantanal</li> <li>- useful for spatial and temporal monitoring and mapping of biodiversity on private lands</li> <li>- identification of habitats, particular sites, &amp; plant species in need of special protection, because of their importance to migrations &amp; bird movements in general</li> <li>- prevention of tourist-related disturbance during breeding seasons</li> <li>- identification of sites that require special protection (e.g. limited visitation, not used by cattle, etc.)</li> </ul>

<sup>a</sup>, TEAM = CI's Tropical Ecology Assessment and Monitoring program.

## Appendix I

<b>Species:</b>	<b>English common name</b>	<b>Frequency of Occurrence (FO)</b>					<b>Total (17)</b>
		<b>2004 (4)</b>	<b>2003 (3)</b>	<b>2002 (5)</b>	<b>2001 (5)</b>		
<i>Crypturellus undulatus</i>	Undulated Tinamu	100%	100%	100%	100%	<b>100%</b>	
<i>Phalacrocorax brasilianus</i>	Brasilian Cormorant	100%	100%	100%	100%	<b>100%</b>	
<i>Anhinga anhinga</i>	Anhinga	100%	100%	100%	100%	<b>100%</b>	
<i>Syrigma sibilatrix</i>	Whispering Heron	100%	100%	100%	100%	<b>100%</b>	
<i>Ardea cocoi</i>	White-necked Heron	100%	100%	100%	100%	<b>100%</b>	
<i>Ardea alba</i>	Great Heron	100%	100%	100%	100%	<b>100%</b>	
<i>Butorides striatus</i>	Striated Heron	100%	100%	100%	100%	<b>100%</b>	
<i>Tigrisoma lineatum</i>	Rufescent Tiger-Heron	100%	100%	100%	100%	<b>100%</b>	
<i>Jabiru mycteria</i>	Jabiru	100%	100%	100%	100%	<b>100%</b>	
<i>Mesembrinibis cayennensis</i>	Green Ibis	100%	100%	100%	100%	<b>100%</b>	
<i>Platalea ajaja</i>	Roseate Spoonbill	100%	100%	100%	100%	<b>100%</b>	
	White-faced Whistering	100%		100%	100%	<b>100%</b>	
<i>Dendrocygna viduata</i>	Duck		100%				
<i>Coragyps atratus</i>	Black Vulture	100%	100%	100%	100%	<b>100%</b>	
<i>Cathartes aura</i>	Turkey Vulture	100%	100%	100%	100%	<b>100%</b>	
<i>Buteo magnirostris</i>	Roadside Hawk	100%	100%	100%	100%	<b>100%</b>	
<i>Polyborus plancus</i>	Crested Caracara	100%	100%	100%	100%	<b>100%</b>	
<i>Milvago chimachima</i>	Yello-headed Caracara	100%	100%	100%	100%	<b>100%</b>	
<i>Crax fasciolata</i>	Bare-Faced Currasow	100%	100%	100%	100%	<b>100%</b>	
<i>Ortalis canicollis</i>	Chaco Chacalaca	100%	100%	100%	100%	<b>100%</b>	
	Blue-Throated Piping-	100%		100%	100%	<b>100%</b>	
<i>Aburria pipile</i>	Guan		100%				
<i>Jacana jacana</i>	Jacana	100%	100%	100%	100%	<b>100%</b>	
<i>Vanellus chilensis</i>	Southern Lapwing	100%	100%	100%	100%	<b>100%</b>	
<i>Hoploxypterus cayanus</i>	Pied Plover	100%	100%	100%	100%	<b>100%</b>	
<i>Himantopus himantopus</i>	Black-necked Stilt	100%	100%	100%	100%	<b>100%</b>	
<i>Columba picazuro</i>	Picazuro Pigeon	100%	100%	100%	100%	<b>100%</b>	
<i>Leptotila verreauxi</i>	White-tipped Dove	100%	100%	100%	100%	<b>100%</b>	
<i>Anodorhynchus hyacinthinus</i>	Hyacinth Macaw	100%	100%	100%	100%	<b>100%</b>	
<i>Aratinga acuticaudata</i>	Blue-crowned Parakeet	100%	100%	100%	100%	<b>100%</b>	
<i>Brotogeris chiriri</i>	Canary-winged Parakeet	100%	100%	100%	100%	<b>100%</b>	
<i>Amazona aestiva</i>	Blue-fronted Parrot	100%	100%	100%	100%	<b>100%</b>	

<i>Piaya cayana</i>	Squirrel Cuckoo	100%	100%	100%	100%	<b>100%</b>
<i>Crotophaga ani</i>	Smooth-billed Ani	100%	100%	100%	100%	<b>100%</b>
<i>Guira guira</i>	Guira Cuckoo	100%	100%	100%	100%	<b>100%</b>
<i>Ceryle torquata</i>	Ringed Kingfisher	100%	100%	100%	100%	<b>100%</b>
<i>Chloroceryle amazona</i>	Amazon Kingfisher	100%	100%	100%	100%	<b>100%</b>
<i>Ramphastos toco</i>	Toco Toucan	100%	100%	100%	100%	<b>100%</b>
<i>Furnarius rufus</i>	Rufous Hornero	100%	100%	100%	100%	<b>100%</b>
<i>Thamnophilus doliatus</i>	Barred Antshrike	100%	100%	100%	100%	<b>100%</b>
<i>Machetornis rixosus</i>	Cattle Tyrant	100%	100%	100%	100%	<b>100%</b>
<i>Myiarchus tyrannulus</i>	Brown-crested Flycatcher	100%	100%	100%	100%	<b>100%</b>
<i>Megarynchus pitangua</i>	Boat-billed Flycatcher	100%	100%	100%	100%	<b>100%</b>
<i>Pitangus sulphuratus</i>	Great Kiskadee	100%	100%	100%	100%	<b>100%</b>
<i>Pitangus lektor</i>	Lesser Kiskadee	100%	100%	100%	100%	<b>100%</b>
<i>Thryothorus leucotis</i>	Buff-breasted Wren	100%	100%	100%	100%	<b>100%</b>
<i>Icterus icterus</i>	Troupial	100%	100%	100%	100%	<b>100%</b>
<i>Cacicus solitarius</i>	Solitary Cacique	100%	100%	100%	100%	<b>100%</b>
<i>Phaetusa simplex</i>	Large-billed Term	100%	100%	80%	100%	<b>94%</b>
<i>Trogon curucui</i>	Blue-crowned Trogon	100%	100%	100%	80%	<b>94%</b>
<i>Dryocopus lineatus</i>	Lineated Woodpecker	100%	100%	100%	80%	<b>94%</b>
<i>Furnarius leucopus</i>	Pale-legged Hornero	100%	100%	100%	80%	<b>94%</b>
<i>Taraba major</i>	Great Antshrike	100%	100%	100%	80%	<b>94%</b>
<i>Cercomacra melanaria</i>	Mato Grosso Antbird	100%	100%	100%	80%	<b>94%</b>
<i>Phimosus infuscatus</i>	Bare-faced Ibis	100%	75%	100%	100%	<b>94%</b>
<i>Amazonetta brasiliensis</i>	Brazilian Duck	100%	75%	100%	100%	<b>94%</b>
<i>Aramides cajanea</i>	Grey-necked Wood-Rail	100%	75%	100%	100%	<b>94%</b>
<i>Columba cayennensis</i>	Pale-vented Pigeon	100%	75%	100%	100%	<b>94%</b>
<i>Chloroceryle americana</i>	Green Kingfisher	100%	75%	100%	100%	<b>94%</b>
	Southern Rough-winged	100%		100%	100%	<b>94%</b>
<i>Stelgidopteryx ruficollis</i>	Swallow		75%			
<i>Campylorhynchus turdinus</i>	Thrush-like Wren	100%	75%	100%	100%	<b>94%</b>
<i>Ramphocelus carbo</i>	Silver-beaked Tanager	100%	75%	100%	100%	<b>94%</b>
<i>Paroaria capitata</i>	Yellow-billed Cardinal	100%	75%	100%	100%	<b>94%</b>
<i>Hemitriccus margaritaceiventer</i>	Pearly-vented Tody-Tyrant	75%		100%	80%	<b>88%</b>
			100%			
<i>Gnorimopsar chopi</i>	Chopi Brackbird	75%	100%	100%	80%	<b>88%</b>

	Black-bellied Whistling	75%		100%	100%	<b>88%</b>
<i>Dendrocygna autumnalis</i>	Duck		75%			
<i>Melanerpes candidus</i>	White Woodpecker	75%	75%	100%	100%	<b>88%</b>
<i>Veniliornis passerinus</i>	Little Woodpecker	75%	75%	100%	100%	<b>88%</b>
<i>Cyanocorax cyanomelas</i>	Purplish Jay	100%	75%	100%	80%	<b>88%</b>
<i>Egretta thula</i>	Snowy Egret	100%	100%	80%	80%	<b>88%</b>
<i>Ara chloroptera</i>	Red-and-green Macaw	100%	100%	80%	80%	<b>88%</b>
<i>Ara auricollis</i>	Yellow-collared Macaw	100%	100%	80%	80%	<b>88%</b>
<i>Galbula ruficauda</i>	Rufous-tailed Jacamar	100%	75%	100%	80%	<b>88%</b>
	Narrow-billed	100%		100%	80%	<b>88%</b>
<i>Lepidocolaptes angustirostris</i>	Woodcreeper		75%			
<i>Psarocolius decumanus</i>	Crested Oropendula	100%	75%	100%	80%	<b>88%</b>
<i>Rosthramus sociabilis</i>	Snail Kite	100%	50%	100%	100%	<b>88%</b>
<i>Rhea Americana</i>	Rhea	75%	75%	80%	100%	<b>83%</b>
<i>Aratinga leucophthalmus</i>	White-eyed Parakeet	50%	75%	100%	100%	<b>83%</b>
<i>Falco ruficularis</i>	Bat Falcon	75%	100%	80%	80%	<b>83%</b>
<i>Crotophaga major</i>	Greater Ani	75%	100%	80%	80%	<b>83%</b>
<i>Momotus momota</i>	Blue-crowned Motmot	75%	100%	80%	80%	<b>83%</b>
<i>Synallaxis albiflora</i>	White-lored spinetail	75%	100%	80%	80%	<b>83%</b>
<i>Mycteria Americana</i>	Wood Stork	75%	50%	100%	100%	<b>83%</b>
<i>Theristicus caerulescens</i>	Plumbeus Ibis	75%	50%	100%	100%	<b>83%</b>
<i>Myiopsitta monachus</i>	Monk Parakeet	75%	50%	100%	100%	<b>83%</b>
<i>Icterus cayanensis</i>	Epoulet Oriole	75%	50%	100%	100%	<b>83%</b>
<i>Cairina moschata</i>	Muscovy Duck	100%	100%	60%	80%	<b>83%</b>
<i>Theristicus caudatus</i>	Buff-Necked Ibis	100%	75%	80%	80%	<b>83%</b>
<i>Saltator caerulescens</i>	Greyish Saltator	100%	75%	80%	80%	<b>83%</b>
<i>Heterospizias meridionalis</i>	Savannah Hawk	50%	100%	80%	80%	<b>77%</b>
<i>Tachycineta albiventer</i>	White-winged swallow	50%	100%	80%	80%	<b>77%</b>
<i>Crypturellus parvirostris</i>	Small-billed Tinamous	50%	75%	80%	100%	<b>77%</b>
<i>Emberizoides herbicola</i>	Wedge-tailed Grass-Finch	50%	50%	100%	100%	<b>77%</b>
<i>Tyrannus melancholicus</i>	Tropical Kingbird	75%	100%	60%	80%	<b>77%</b>
<i>Camptostoma obsoletum</i>	Southern-Scrub Flycatcher	75%	50%	100%	80%	<b>77%</b>
<i>Cnemotriccus fuscatus</i>	Fuscous Flycatcher	75%	50%	100%	80%	<b>77%</b>
<i>Scardafella squammata</i>	Scale Dove	100%	50%	80%	80%	<b>77%</b>
<i>Picumnus albosquamatus</i>	White-wedged Piculet	25%	75%	100%	80%	<b>72%</b>

<i>Pionus maximiliani</i>	Scale-headed Parrot	50%	75%	80%	80%	<b>72%</b>
<i>Chauna torquita</i>	Southern Screamer	100%	100%	60%	40%	<b>72%</b>
<i>Cyanocorax chrysops</i>	Plush-crested Jay	100%	75%	80%	40%	<b>72%</b>
<i>Basileuterus flaveolus</i>	Golden-crowned Warbler	100%	75%	80%	40%	<b>72%</b>
<i>Rynchops nigra</i>	Black Skimmer	75%	50%	80%	80%	<b>72%</b>
<i>Euphonia chlorotica</i>	Purple-throated Euphonia	75%	50%	80%	80%	<b>72%</b>
<i>Eucometis penicilata</i>	Grey-headed Tanager	75%	25%	80%	100%	<b>72%</b>
<i>Ara nobilis</i>	Red-shouldered Macaw	0%	75%	80%	100%	<b>66%</b>
<i>Chlorostilbon aureoventris</i>	Glittering-bellied Emerald	50%	100%	80%	40%	<b>66%</b>
<i>Leptotilla rufaxilla</i>	Grey-fronted Dove	25%	50%	80%	100%	<b>66%</b>
<i>Aratinga aurea</i>	Peach-fronted Parakeet	25%	50%	100%	80%	<b>66%</b>
<i>Phaethornis pretrei</i>	Planalto Hermit	25%	50%	100%	80%	<b>66%</b>
<i>Busarellus nigricollis</i>	Black-collared Hawk	75%	100%	60%	40%	<b>66%</b>
	Black-crowned Night-	50%		80%	80%	<b>66%</b>
<i>Nycticorax nycticorax</i>	Heron		50%			
	Rufous-browed	100%		60%	40%	<b>66%</b>
<i>Cyclarhis gujanensis</i>	peppershrike		75%			
	White-headed Marsh-	100%		80%	40%	<b>66%</b>
<i>Arundinicola leucocephala</i>	Tyrant		50%			
<i>Turdus rufiventris</i>	Rufous-bellied Thrush	100%	50%	80%	40%	<b>66%</b>
<i>Sterna superciliaris</i>	Yellow-billed Tern	75%	25%	80%	80%	<b>66%</b>
<i>Myiodynastes maculates</i>	Streaked Flycatcher	25%	75%	60%	80%	<b>61%</b>
<i>Nandayus nenday</i>	Nanday Parakeet	75%	75%	60%	40%	<b>61%</b>
<i>Donacobius atricapillus</i>	Black-capped Donacobius	75%	75%	60%	40%	<b>61%</b>
<i>Casiornis rufa</i>	Rufous Casiornis	75%	50%	80%	40%	<b>61%</b>
<i>Aramus guarana</i>	Limpkin	100%	100%	40%	20%	<b>61%</b>
<i>Plegadis chihi</i>	White-faced Ibis	100%	50%	60%	40%	<b>61%</b>
<i>Paroaria coronata</i>	Red-crested Cardinal	0%	75%	60%	80%	<b>55%</b>
<i>Xolmis velata</i>	White-rumped Monjita	50%	75%	60%	40%	<b>55%</b>
<i>Ammodramus humeralis</i>	Grassland Sparrow	50%	50%	80%	40%	<b>55%</b>
<i>Ciconia maguari</i>	Maguari Stork	50%	25%	60%	80%	<b>55%</b>
	Lesser Yellow-Headed	25%		80%	80%	<b>55%</b>
<i>Cathartes burrovianus</i>	Vulture		25%			
<i>Cariama cristata</i>	Red-legged Seriema	25%	25%	80%	80%	<b>55%</b>
<i>Tringa melanoleuca</i>	Greater Yellowlegs	25%	25%	80%	80%	<b>55%</b>

<i>Cyanocorax cristatellus</i>	Curl-crested Jay	25%	25%	60%	100%	<b>55%</b>
<i>Lathrotriccus euleri</i>	Euler's Flycatcher	50%	25%	60%	80%	<b>55%</b>
<i>Scaphidura oryzivora</i>	Giant Cowbird	75%	50%	60%	40%	<b>55%</b>
<i>Notiochelidon cyanoleuca</i>	Blue-and-white Swallow	25%	25%	80%	80%	<b>55%</b>
<i>Nystalus maculates</i>	Spot-backed Puffbird	100%	25%	60%	40%	<b>55%</b>
<i>Pseudoseisura cristata</i>	Caatinga Cacholote	25%	75%	60%	40%	<b>50%</b>
<i>Sittasomus griseicapillus</i>	Olivaceous woodcreeper	0%	25%	80%	80%	<b>50%</b>
<i>Bubulcus ibis</i>	Cattle Egret	50%	50%	60%	40%	<b>50%</b>
<i>Pteroglossus castanotis</i>	Chestnut-eared Aracari	50%	50%	60%	40%	<b>50%</b>
<i>Thraupis sayaca</i>	Sayaca Tanager	50%	50%	60%	40%	<b>50%</b>
<i>Serpophaga subscristata</i>	White-crested Tyrannulet	25%	25%	60%	80%	<b>50%</b>
<i>Falco sparverius</i>	American Krestel	25%	25%	60%	80%	<b>50%</b>
<i>Tapera naevia</i>	Striped Cuckoo	25%	25%	40%	100%	<b>50%</b>
<i>Tachybaptus dominicus</i>	Least Grebe	75%	75%	40%	20%	<b>50%</b>
<i>Ictinia plumbea</i>	Plumbeous Kite	75%	75%	40%	20%	<b>50%</b>
<i>Myiarchus ferox</i>	Short-crested Flycatcher	75%	50%	40%	40%	<b>50%</b>
<i>Pyrocephalus rubinus</i>	Vermilion Flycatcher	25%	25%	60%	80%	<b>50%</b>
<i>Glaucidium brasilianum</i>	Ferruginous Pigmy-Owl	75%	25%	60%	40%	<b>50%</b>
<i>Hylocharis chrysura</i>	Gilded Hummingbird	75%	25%	60%	40%	<b>50%</b>
<i>Celeus flavescens</i>	Blond-crested Woodpecker	25%	75%	40%	40%	<b>44%</b>
<i>Dendrocolaptes platyrostris</i>	Planalto Woodcreeper	0%	50%	20%	100%	<b>44%</b>
<i>Charadrius collaris</i>	Collared Plover	0%	25%	60%	80%	<b>44%</b>
<i>Claravis pretiosa</i>	Blue-ground Dove	0%	25%	60%	80%	<b>44%</b>
<i>Myiophobus fasciatus</i>	Bran-colored Flycatcher	0%	25%	60%	80%	<b>44%</b>
<i>Polioptila dumicola</i>	Masked Gnatcatcher	25%	25%	80%	40%	<b>44%</b>
<i>Tringa flavipes</i>	Lesser Yellowlegs	50%	75%	40%	20%	<b>44%</b>
<i>Certhiaxis cinnamomea</i>	Yellow-chinned Spinetail	50%	75%	20%	40%	<b>44%</b>
<i>Celeus lugubris</i>	Pale-crested Woodpecker	50%	50%	40%	40%	<b>44%</b>
<i>Turdus leucomelas</i>	Pale-breasted Thrush	50%	50%	40%	40%	<b>44%</b>
<i>Nyctidromus albicollis</i>	Paraque	50%	25%	60%	40%	<b>44%</b>
<i>Sporophila caerulescens</i>	Double-collared Seed eater	50%	25%	60%	40%	<b>44%</b>
<i>Egretta caerulea</i>	Little Blue Heron	75%	50%	40%	20%	<b>44%</b>
<i>Amblyramphus holosericeus</i>	Scarlet-headed Blackbird	75%	25%	60%	20%	<b>44%</b>
<i>Campylorhamphus trochilirostris</i>	Red-billed Scythebill	100%		40%	20%	<b>44%</b>
			25%			

<i>Tringa solitaria</i>	Solitary Sandpiper	25%	75%	40%	20%	<b>38%</b>
<i>Ara ararauna</i>	Blue-and Yellow Macaw	25%	50%	40%	40%	<b>38%</b>
<i>Colaptes campestris</i>	Campo Flicker	25%	50%	40%	40%	<b>38%</b>
<i>Xiphorhynchus guttatus</i>	Buff-throated Woodcreeper	25%	50%	40%	40%	<b>38%</b>
<i>Columbina talpacoti</i>	Ruddy-ground Dove	25%	25%	60%	40%	<b>38%</b>
<i>Basileuterus culicivorus</i>	Golden-crowned Warbler	0%	25%	40%	80%	<b>38%</b>
<i>Saltator similes</i>	Green-winged Saltator	0%	25%	40%	80%	<b>38%</b>
<i>Pandion halietus</i>	Osprey	50%	75%	20%	20%	<b>38%</b>
<i>Rhynchotus rufescens</i>	Red-winged Tinamous	50%	50%	40%	20%	<b>38%</b>
<i>Tityra inquisitor</i>	Black-crowned Tityra	50%	50%	40%	20%	<b>38%</b>
<i>Columbina minuta</i>	Blue-eyed Ground Dove	50%	25%	40%	40%	<b>38%</b>
<i>Thraupis palmarum</i>	Palm Tanager	50%	25%	60%	20%	<b>38%</b>
<i>Sporophila collaris</i>	Rusty-collared Seedeater	75%	25%	40%	20%	<b>38%</b>
	Green-and-rufous	0%		40%	40%	<b>33%</b>
<i>Chloroceryle inda</i>	Kingfisher		50%			
<i>Piculus chrysochloros</i>	Golden-green Woodpecker	0%	25%	60%	40%	<b>33%</b>
<i>Formicivora rufa</i>	Rusty-backed Antwren	0%	25%	60%	40%	<b>33%</b>
<i>Coryphospingus cucullatus</i>	Red-crested Finch	25%	50%	40%	20%	<b>33%</b>
<i>Crypturellus soui</i>	Little Tinamous	25%	25%	40%	40%	<b>33%</b>
<i>Micrastor semitorquatus</i>	Collared Forest-Falcon	25%	25%	40%	40%	<b>33%</b>
<i>Tolmomyias sulphurescens</i>	Yellow-olive Flycatcher	25%	25%	60%	20%	<b>33%</b>
<i>Anthus lutescens</i>	Yellowish Pipit	25%	25%	60%	20%	<b>33%</b>
<i>Otus choliba</i>	Tropical Screech-Owl	25%	25%	40%	40%	<b>33%</b>
<i>Caprimulgus parvulus</i>	Little nightjar	25%	25%	40%	40%	<b>33%</b>
<i>Buteogallus urubitinga</i>	Great Black Hawk	50%	50%	20%	20%	<b>33%</b>
<i>Antilophia galeata</i>	Helmeted Manakin	50%	25%	40%	20%	<b>33%</b>
<i>Progne chalibea</i>	Grey-breasted Martin	50%	25%	40%	20%	<b>33%</b>
<i>Elaenia flavogaster</i>	Yellow-bellied Elaenia	50%	25%	20%	40%	<b>33%</b>

## Appendix II

Species with $\geq 100$ contacts	English common name	TI	IPA
<i>Himantopus himantopus</i>	Black-necked Stilt	4338	1,631
<i>Ardea alba</i>	Great Egret	2610	0,981
<i>Dendrocygna viduata</i>	White-faced Whistling Duck	1707	0,642
<i>Ortalis canicollis</i>	Chaco Chacalaca	1660	0,624
<i>Aratinga acuticaudata</i>	Blue-crowned Parakeet	1374	0,517
<i>Egretta thula</i>	Snowy Egret	1089	0,409
<i>Brotogeris chiriri</i>	Canary-winged Parakeet	1052	0,395
<i>Amazona aestiva</i>	Blue-fronted Parrot	1018	0,383
<i>Phaetusa simplex</i>	Large-billed Tern	928	0,349
<i>Phalacrocorax brasilianus</i>	Brasilian Cormorant	846	0,318
<i>Dendrocygna autumnalis</i>	Black-bellied Whistling Duck	732	0,275
<i>Aburria pipile</i>	Blue-throated Piping Guan	700	0,263
<i>Leptotila verreauxi</i>	White-tipped Dove	696	0,262
<i>Guira guira</i>	Guira Cuckoo	690	0,259
<i>Ramphocelus carbo</i>	Silver-beaked Tanager	686	0,258
<i>Jacana jacana</i>	Jacana	664	0,250
<i>Ceryle torquata</i>	Ringed Kingfisher	662	0,249
<i>Columba picazuro</i>	Picazuro Pigeon	655	0,246
<i>Tachybaptus dominicus</i>	Least Grebe	597	0,224
<i>Crax fasciolata</i>	Bare-faced Currasow	574	0,216
<i>Phimosus infuscatus</i>	Bare-faced Ibis	567	0,213
<i>Crotophaga major</i>	Greater Ani	566	0,213
<i>Thryothorus leucotis</i>	Buff-necked Wren	566	0,213
<i>Cyanocorax cyanomelas</i>	Purplish Jay	564	0,212
<i>Pitangus sulphuratus</i>	Great Kiskadee	562	0,211
<i>Vanellus chilensis</i>	Southern Lapwing	550	0,207
<i>Rynchops nigra</i>	Black Skimmer	512	0,192
<i>Crypturellus undulatus</i>	Undulated Tinamous	509	0,191
<i>Anhinga anhinga</i>	Anhinga	503	0,189
<i>Tringa melanoleuca</i>	Greater Yellowlegs	501	0,188
<i>Chloroceryle amazona</i>	Amazon Kingfisher	501	0,188
<i>Paroaria capitata</i>	Yellow-billed Cardinal	496	0,186
<i>Hoploxypterus cayanus</i>	Pied Plover	425	0,160
<i>Ardea cocoi</i>	White-faced Heron	417	0,157
<i>Butorides striatus</i>	Striated Heron	381	0,143
<i>Crotophaga ani</i>	Smooth-billed Ani	367	0,138
<i>Stelgidopteryx ruficollis</i>	Southern Rough-winged Swallow	357	0,134
<i>Platalea ajaja</i>	Roseate Spoonbill	330	0,124
<i>Furnarius leucopus</i>	Pale-legged Hornero	313	0,118
<i>Amazonetta brasiliensis</i>	Brasilian Teal	283	0,106
<i>Tringa flavipes</i>	Lesser Yellowlegs	262	0,098
<i>Ara auricollis</i>	Yellow-collared Macaw	258	0,097
<i>Aratinga leucophthalmus</i>	White-eyed Parakeet	246	0,092

<i>Gnorimopsar chopi</i>	Chopi Blackbird	237	0,089
<i>Coragyps atratus</i>	Black Vulture	233	0,088
<i>Psarocolius decumanus</i>	Crested Oropendula	224	0,084
<i>Cacicus solitarius</i>	Solitary cacique	218	0,082
<i>Paroaria coronata</i>	Red-crested Cardinal	210	0,079
<i>Aratinga aurea</i>	Peach-fronted Parakeet	208	0,078
<i>Cercomacra melanaria</i>	Mato Grosso Antbird	205	0,077
<i>Furnarius rufus</i>	Rufous Hornero	197	0,074
<i>Chloroceryle americana</i>	Green Kingfisher	193	0,073
<i>Pitangus lictor</i>	Lesser Kiskadee	192	0,072
<i>Ara chloroptera</i>	Red-and-green-Macaw	190	0,071
<i>Ramphastos toco</i>	Toco Toucan	187	0,070
<i>Columba cayennensis</i>	Pale-vented Pigeon	179	0,067
<i>Eucometis penicilata</i>	Grey-headed Tanager	177	0,067
<i>Taraba major</i>	Great Antshrike	172	0,065
<i>Aramides cajanea</i>	Grey-necked Wood-Rail	163	0,061
<i>Thamnophilus doliatus</i>	Barred Antshrike	160	0,060
<i>Cyanocorax chrysops</i>	Plush-crested Jay	156	0,059
<i>Cairina moschata</i>	Moscovy Duck	153	0,058
<i>Mesembrinibis cayennensis</i>	Green Ibis	149	0,056
<i>Campylorhynchus turdinus</i>	Thrus-like Wren	143	0,054
<i>Syrigma sibilatrix</i>	Whistling Heron	136	0,051
<i>Tigrisoma lineatum</i>	Rufescent Tiger Heron	135	0,051
<i>Saltator coerulescens</i>	Greyish Saltator	130	0,049
<i>Galbula ruficauda</i>	Rufous-tailed Jacamar	122	0,046
<i>Cyclarhis gujanensis</i>	Rufous-browed Peppershrike	121	0,045
<i>Myiarchus tyrannulus</i>	Brown-crested Flycatcher	118	0,044
<i>Ara nobilis</i>	Red-shouldered Macaw	117	0,044
<i>Theristicus caudatus</i>	Buff-necked Ibis	116	0,044
<i>Synallaxis albilora</i>	White-lored Spinetail	114	0,043
<i>Nandayus nenday</i>	Nanday Parakeet	114	0,043
<i>Trogon curucui</i>	Blue-crowned Trogon	113	0,042

## **CAPTIONS – tables and figures**

**Table 1: richness, abundance, diversity and evenness of the birds' community at fazenda rio negro between 2001 and 2004 (wet season in gray)**

**Table 2: diversity and evenness indexes of the birds' community in each habitat at fazenda rio negro between 2001 and 2004 (dry season in black; wet season in gray; \*\* after fire)**

**Table 3. Number of contacts (records of sightings and songs/calls) for the most abundant species (>100 individuals) during quantitative censuses from 2001 to 2004, Fazenda Rio Negro, Aquidauana, Mato Grosso do Sul, Brazil.**

**Table 4: Most common migratory bird species (>100 records) and number of individuals recorded at Fazenda Rio Negro from 2001 to 2004, Aquidauana, Mato Grosso do Sul, Brazil.**

**Table 5: Distribution of Frequency of Occurrence (FO) percentage classes and number of species for bird communities at Fazenda Rio Negro, 2001 to 2004, Aquidauana, Mato Grosso do Sul, Brazil.**

**Table 6. Significance / application of the Bird project to conservation in the Pantanal and to management of partner fazendas and private reserves (RPPNs).**

**Figure 1 - Annual variation of the diversity in distinct habitats in the Pantanal from 2001 to 2004**

**Figure 2 – Annual variation of the evenness in distinct habitats in the Pantanal from 2001 to 2004**

**Appendix I. Annual and multi-annual (Total) Frequency of Occurrence (FO) of resident bird species ( $\geq 33\%$ ) recorded at Fazenda Rio Negro from 2001 to 2004. Number of expeditions for each year and over 4 years is in parentheses.**

**Appendix II. The total number of individuals (TI) observed, and the Index of Point Abundance (IPA) for species with  $\geq 100$  contacts, 2001 to 2004, Fazenda Rio Negro, Aquidauana, Mato Grosso do Sul, Brazil. Total number of contacts = 45,979 in 2,660 samples, average=17,3 contacts/sample; qualitative censuses (exhaustive) registered 388 species at Fazenda Rio Negro, plus 23 species registered on neighboring fazendas; total number of species = 411.**