Revista Brasileira de Ornitologia, 21(4), 243-256
December 2013

ARTICLE

Avian composition and distribution in a mosaic of cerrado habitats (RPPN Parque Ecológico João Basso) in Rondonópolis, Mato Grosso, Brazil

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Received on 1 July 2013. Accepted on 16 July 2013.

ABSTRACT: The birds of cerrado in Mato Grosso are poorly studied and although the RPPN Parque Ecológico João Basso is a natural cerrado remnant, there are no studies of fauna in this area. Thus, we conducted the first bird survey in this area to describe the avifauna composition and to analyze the spatial distribution among three habitats (gallery forest, cerradão and cerrado *stricto sensu*). We adopted the transect method (100 m) in 56 h of sampling. We recorded 191 species (2.865 contacts). The Shannon-Wiener index was 4,258 and equity 0,819. We detected only two endangered species, five endemic species to the cerrado, and 31 migratory species. We recorded 101 species in gallery forests (29 only in this habitat), 107 in cerradão (22 exclusive) and 115 in cerrado *stricto sensu* (50 exclusive). The cerradão was intermediate between gallery forest and cerrado *stricto sensu* in terms of both horizontal and vertical distribution of species, being slightly more similar to the gallery forest and the cerrado *stricto sensu.* High indices of richness and evenness detected among bird communities of different habitat types reinforce the importance of the study area for the conservation of the cerrado avifauna.

KEY-WORDS: bird community; conservation; habitat selection; savanna; vertical and horizontal distribution.

INTRODUCTION

The cerrado domain is a mosaic of vegetation ranging from grassland (savanna) to forested environments, such as cerradão, riparian vegetation and gallery forest (Coutinho 2006, Batalha 2011). This heterogeneity in the cerrado increases the species richness and provides high biodiversity (Klink & Machado 2005). However, it has been one of the most modified biomes by human actions (Myers *et al*. 2000, Goldstein *et al*. 2008). With regards to the Mato Grosso state, the native cerrado vegetation has been quickly replaced by monocultures, particularly soybean and cotton plantations due to the fertile soil and favorable topography. As a result, the remaining cerrado is now largely fragmented and isolated. In this way, the relictual biodiversity of cerrado can be found only in these fragments (Vialou 2006, Durigan *et al*. 2007).

The cerrado in Mato Grosso has been little studied in relation to birds. There have been only short periods studies performed by Naumburg (1930), Willis (1976), Allen (1981, 1982, 1983a e b), Silva & Oniki (1988), Willis & Oniki (1990), Silveira & D'Horta (2002), Vasconcelos *et al*. (2008) and Lopes *et al*. (2009). As noted, more extensive studies on birds in the remaining areas in Mato Grosso are needed, particularly in protected areas where there are best oportunities for bird conservation (Rylands & Brandon 2005). In addition, there are no studies focused on the spatial distribution on birds of cerrado in the Mato Grosso state.

Thus, we conducted this study to describe the composition of the local avifauna and to analyze their horizontal and vertical distributions on three distinct vegetation types occurring at the study site (cerradão, gallery forest and cerrado *stricto sensu*).

MATERIALS AND METHODS

Study site

Although the RPPN Parque Ecológico João Basso (hereafter JB) is a protected area of cerrado, no wildlife studies have been conducted there. The JB (16º31'40.48 "S; 54º49'56.80" W) is located 71 km

from Rondonopolis / MT and has 3,624.57 ha (Figure 1). Its relief in form of ruins lies in a valley located between plateaus with sandstones and siltstones from the Devonian Furnas Formation. The soil is predominantly made of sandstone-quartz (Nardes 2005). The climate is tropical, with annual temperatures and rainfall averages of 25C º and 1000 to 2000 mm, respectively (Sette 2000). Two major rivers (Vermelho and Ribeirão Ponte de Pedra) limit the JB in its northeastern portion, with several streams occurring within the area (Figure 1). The altitude varies between 200 and 600 m with plateaus at various locations (Nardes 2005).

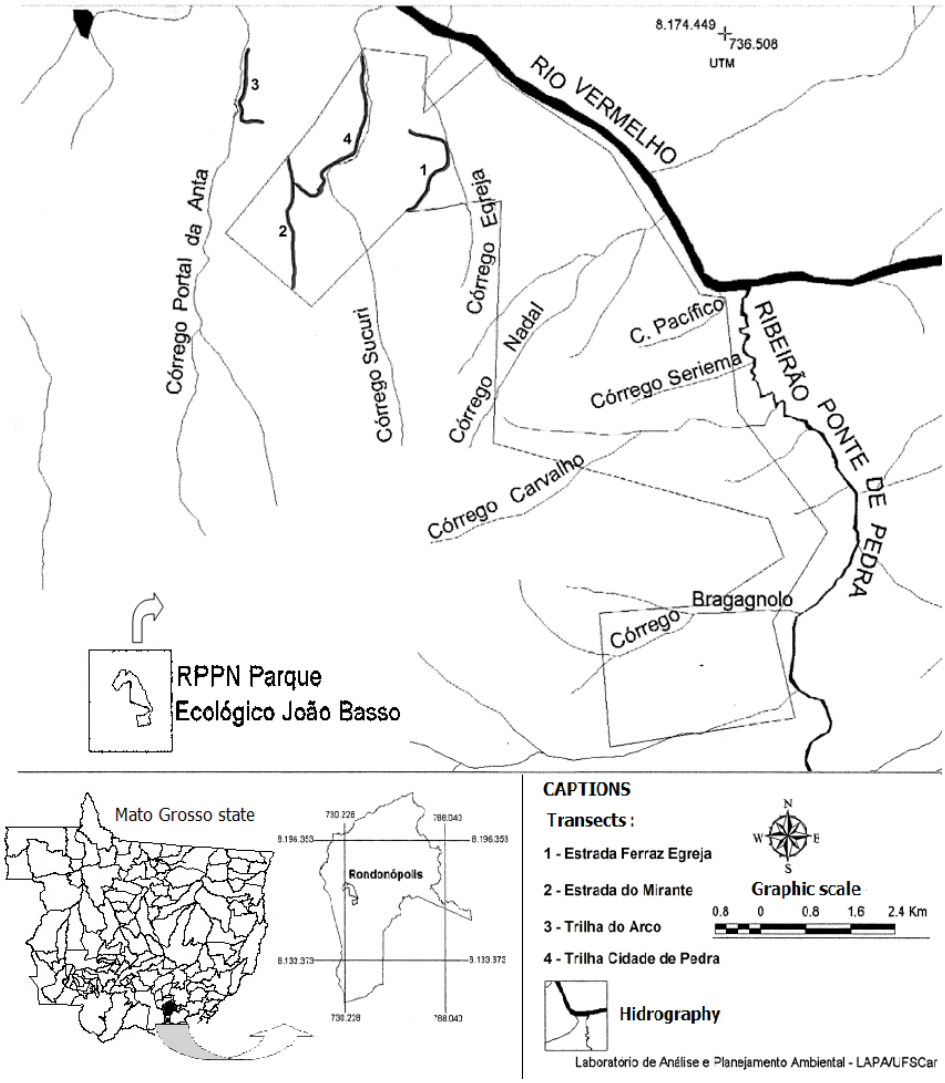

FIGURE 1. Map with location, boundaries and hydrography of RPPN Parque Ecológico João Basso (modified from Nardes, 2005), with the locations of transects sampled (bold and numbered lines: 1, 2, 3 e 4).

According to Batalha's (2011) definition, there are two main habitats in the cerrado *sensu lato*: a) semideciduous forest: cerradão and gallery forests at lower altitudes and; b) savanna: cerrado *stricto sensu* in the intermediate altitudes and cerrado campo sujo (scrubs) in the higher altitude areas ("chapadões"). Thus, we sampled four pre-existing paths (Figure 1) for each of the following habitats: a) cerrado *stricto sensu*: Ferraz Egreja and Mirante; and b) cerradão and gallery forests: Cidade de Pedra (córrego da Sucuri) and Arco (córrego Portal da Anta), the latter outside the legal boundaries of JB (Nardes 2005).

Bird surveys

The study was conducted from November 2006 to October 2007, except February and April 2007 when we did not have access to the study area because of intense rainfall. We used linear transects (Bibby *et al.* 1992) with a radius of 100 m on each side and two hours of uninterrupted observations for each survey. The sampling units (replicated surveys) were four trails (see Fig. 1), with trails 1 and 2 located in the savanna (cerrado *stricto sensu*) and trails 3 and 4 cutting the semideciduous forest types (cerradão and gallery forest). We run a total

of 28 transects surveys during 56 h distributed in the following sampling units: seven transect surveys in each trails 3 and 4 (12 h during the dry season and 16 h in the wet season), and seven transect surveys in each trails 1 and 2 (16 h during the dry period and 12 h in the wet season). Birds were counted only if detected in a specific habitat (cerradão, gallery forest and cerrado *stricto sensu*). Flying over birds were not counted, except for the Apodiformes.

We analyzed bird community distribution according to habitat type (cerradão, gallery forest and cerrado *stricto sensu*), and also vertical distribution (whether primarily associated with the ground, understory and canopy) at each habitat type. Birds were considered canopy dwellers if they were detected within or at terminal branches of tree crowns. Birds detected on or close (less than 0.5 m) to the ground were considered ground dwellers. Finally, birds often recorded above 0.5 m off the ground and bellow the tree crowns were treated as understory dwellers.

The data on migratory birds were determined consulting Sick (1997) for migrant birds within Brazil and Luna *et al*. (2003) within the South America.

Data analysis

We calculated the Shannon-Wiener index (H ') and the parameters that affect this index such as richness, relative abundance, frequency of occurrence (FO), and evenness (*sensu* Anjos *et al*. 2010). Differences in species richness among the three main habitats surveyed (cerradão, gallery forest, and cerrado *stricto sensu*, i.e., dependent variables) were calculated with the Student's t test. In addition, the sampling effort (number of samples) in different environments was evaluated by using cumulative curves of species estimated by the program PAST version 2.0 (Hammer *et al*. 2001).

The Sorensen similarity index was used to compare the avifauna among the sampled habitats. We performed the Pearson index to assess the correlation between richness and relative abundance in each habitat studied. These parameters were obtained by the software SYSTAT® 11th version (Wilkinson 2004) and we adopted the level of significance of ≤ .005.

We used an analysis of similarity (ANOSIM) to test for differences in bird species composition among transects of the habitat types sampled. The ANOSIM procedure uses Monte Carlo randomization of observed data to assess whether rank similarities within groups (transects) are greater than between groups (habitat types). The Bray-Curtis index was used to express similarities and 10.000 Monte Carlo permutations were conducted to generate a random test statistic. If the ANOSIM was significant, we conducted a non-metric multidimensional scaling (NMDS) ordination. This technique was also based on the Bray-Curtis similarity measure between any two sites. We performed this analysis to further explore within – and between – habitat differences in community structure at the level of transect. The abundance measure used in the ordination was the number of individuals observed at each transect. Transects from a given habitat type were thus positioned in ordination space according to their bird species composition and abundance.

RESULTS

We recorded 191 species, 101 in gallery forest (29 recorded only in this habitat), 107 in cerradão (22 exclusive) and 115 in cerrado *stricto sensu* (50 exclusive). Forty-two species were found in all habitats (Appendix), 25 between only gallery forest and cerradão, 18 between cerradão and cerrado *stricto sensu* and only five species between gallery forest and cerrado *stricto sensu*. Despite the richness variation observed among habitat types, bird species richness exhibited no significant difference among habitats (t = - 0099, df = 222, p = 092) (Figure 2). Rarefaction curves (Figure 3) for the three habitats / sites indicate a tendency towards stability within the 95% confidence interval.

We contacted 2,865 birds, including 937 in gallery forest, 950 in cerradão and 978 in cerrado *stricto sensu*. *Ara ararauna* showed the highest relative abundance (88 contacts; AI = 0.045), followed by *Ramphocelus carbo* (72; 0.037), *Turdus leucomelas* (65; 0.033), *Basileuterus flaveolus* (55; 0.028), *Pitangus sulphuratus* (53; 0.027), *Gnorimopsar chopi* (50; 0.026) and *Crypturellus undulatus* (44; 0.022) (Appendix).

The following species were more frequent: *T. leucomelas* (FO = 71.42); *B. flaveolus* (67.85); *P. sulphuratus* (60.71); *Thamnophilus pelzeni* (57.13), *C. undulatus* and *Leptotila verreauxi* (53.57); *A. ararauna*, *Cyclarhis gujanensis*, *R. carbo* and *G. chopi* (46.42); *Patagioenas picazuro*, *Piaya cayana*, *T. amaurochalinus* and *Momotus momota* (42.85) (Appendix).

We recorded 31 migratory species (Appendix), with 13 regarded as austral migrants (e.g., *Hirundinea ferruginea*, *Elaenia spectabilis*, *Serpophaga subcristata*, *Myiarchus swainsoni*, *Myiodynastes maculatus*, *Pyrocephalus rubinus*, *Tyrannus savanna*, and *T. melancholicus*), whereas *Vireo olivaceus* migrates throughout the Americas.

The Shannon-Wiener index (H') of the studied area was 4258 and evenness (J') 0819. The Sorensen Similarity Index (ISS) between semideciduous forest (gallery forest and cerradão) and savanna (cerrado *stricto sensu*) was 0519, being 0798 between gallery forest and cerradão, 0571 between cerradão and cerrado *stricto sensu* and 0390 between gallery forest and cerrado *stricto sensu*.

Differences in bird species composition were higher between than within habitats classes (ANOSIM, r = 054, P < 0004). This result reflected the coherence of

transect dispersion in the ordination plot according to bird species composition in each habitat type (Figure 4). Some species were entirely restricted to a given habitat type, which shared different complements of its avifauna with other sites (Appendix). The most marked contrast in species composition was therefore between the bird assemblages of cerrado *stricto sensu* and gallery forest with only 47 species in common (Appendix). These observations are supported by the NMDS ordination (stress = 0163, Figure 4). It is clear that cerrado *stricto sensu* and gallery forest diverged considerably in their bird assemblage composition, being distinctly separated

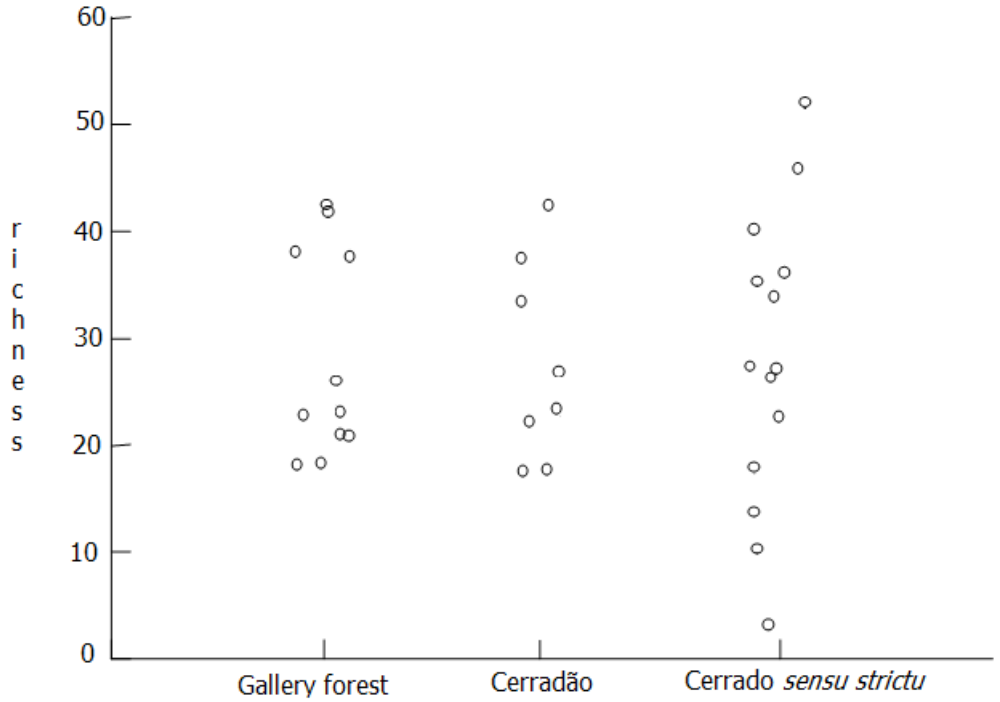

FIGURE 2. Richness distribution of survey samples obtained in gallery forest, cerradão and cerrado *stricto sensu* habitats of the RPPN Parque Ecológico João Basso.

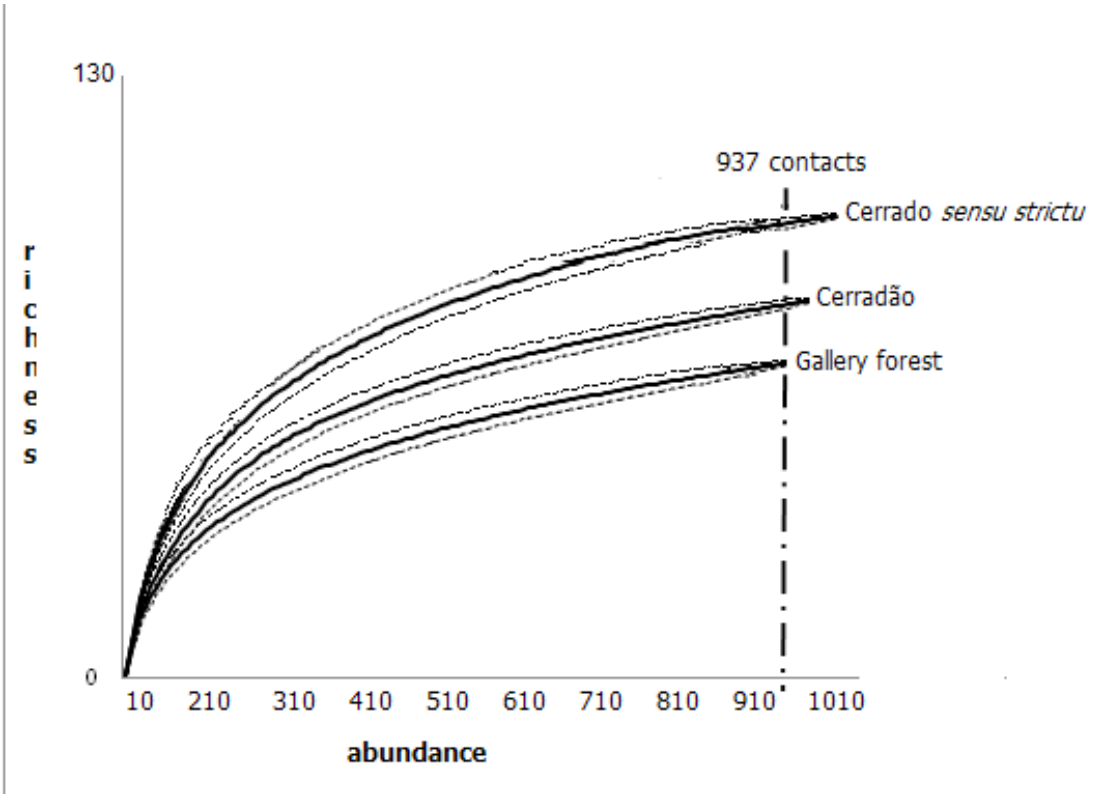

FIGURE 3. Rarefaction curves plotting species richness against the cumulative number of contacts obtained in gallery forest, cerradão and cerrado *stricto sensu* habitats of the RPPN Parque Ecológico João Basso. Confidence intervals (95%) are denoted with dashed lines.

at opposite ends of the ordination diagram. The cerradão sites were similarly distinct, with 85 species in common with gallery forest and/or cerrado *stricto sensu* (Appendix), appearing to cluster between cerrado *stricto sensu* and gallery forest (Figure 4).

Differences in bird species composition also emerged according to vertical distribution of bird species in the habitat types, which were greater between than within habitat classes (ANOSIM, r = 088, P < .00001). According to vertical distribution, transect groups were highly coherent, so that canopy and ground bird assemblages were positioned in opposite extremes of the ordination plot (NMDS, stress = 020, Figure 5). Also in this case, gallery forest and cerrado *stricto sensu* diverged substantially in respect to either canopy or ground bird assemblages (Figure 5). As expected, the dense cerradão, which shared traits with both habitat types, figured as intermediate between ground and canopy assemblages. Understory assemblages of both cerradão and gallery forest, besides being very similar, equally diverged from canopy and ground assemblages, mainly due to the presence of several insectivorous bird species.

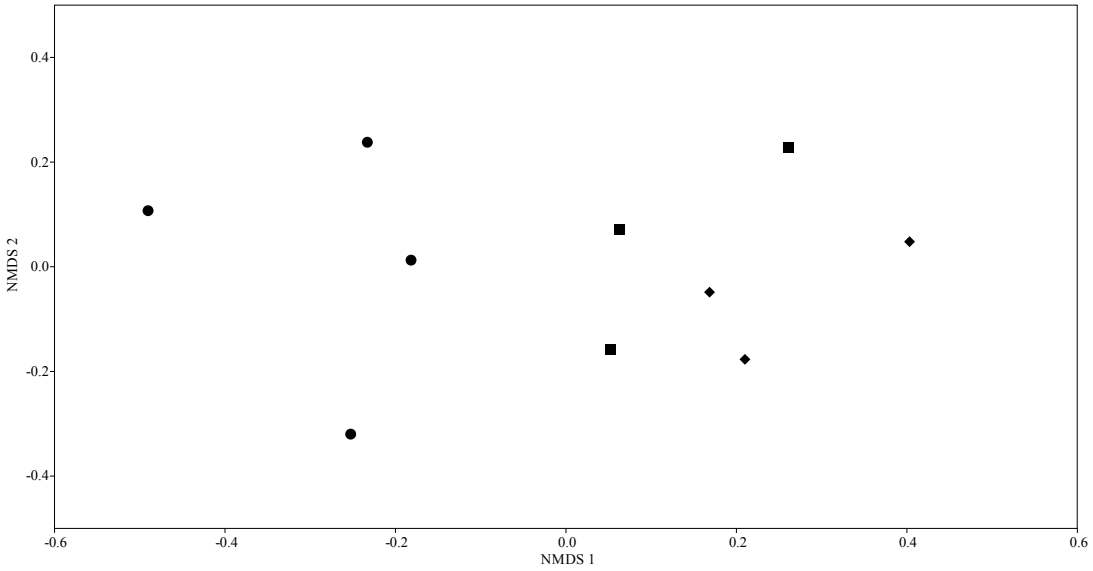

FIGURE 4. Non-metric multi-dimensional scaling (NMDS; stress = 0.163) ordination of horizontal (inter-habitat) distribution of the bird communities recorded along transects in cerrado *stricto sensu* (circles), cerradão (squares) and gallery forest (diamonds), in the RPPN João Basso.

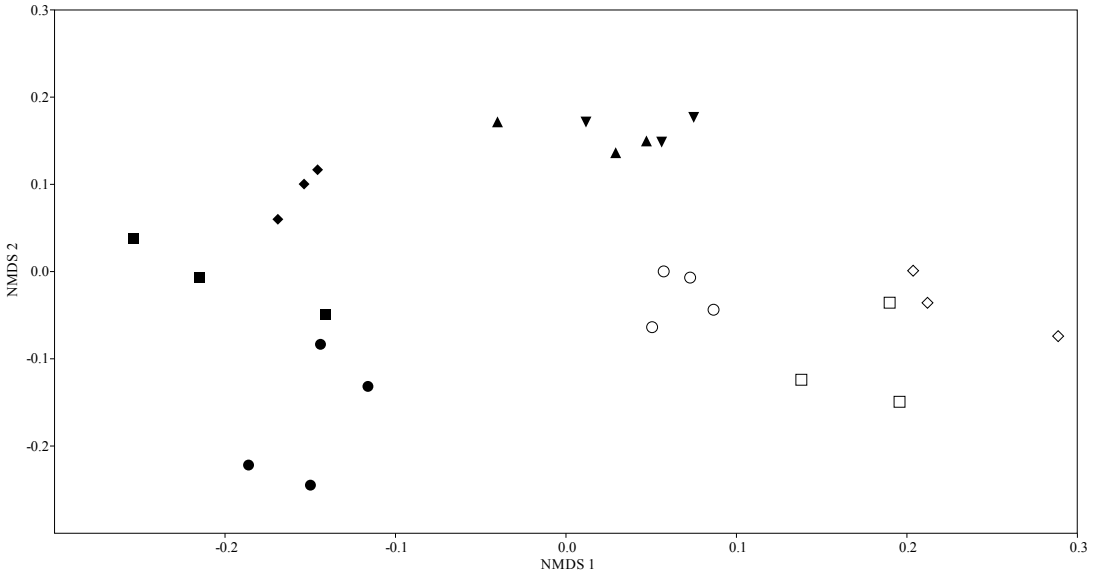

FIGURE 5. Non-metric multi-dimensional scaling (NMDS; stress = 0.200) ordination of vertical (preferential foraging stratum) distribution of bird communities recorded along transects in cerrado *stricto sensu*, cerradão, and gallery forest in the RPPN João Basso. Avifauna of cerrado *stricto sensu*: ground = full circles, understory = open circles; Avifauna of cerradão: ground = full squares, understory = full triangles, canopy = open squares; Avifauna of gallery forest: ground = full diamonds, understory = full upside-down triangles, canopy = open diamonds.

DISCUSSION

Avifauna composition

According to Silva (1995), 837 species are found in the cerrado biome, so the species recorded at JB correspond to 22,82% of the cerrado avifauna. In addition, the Shannon-Wiener index points out towards a high avian diversity. This is probably due to the fact that the JB is a recently isolated area by extensive monocultures, and also to the presence of riparian and gallery forests, which connect this area with other fragments, allowing a wider range species movement. In this respect, about 23% of birds occurring in the cerrado are threatened (Silva 1995), and only 4% endemic (Myers *et al*. 2000). From the 191 species recorded during this study, only two are endangered (IUCN 2010): *Primolius maracana* and *Rhea americana* and five are endemic to the cerrado: *Herpsilochmus longirostris*, *Saltatricula atricollis*, *Basileuterus leucophrys*, *Antilophia galeata*, and *Cyanocorax cristatellus* (Silva & Bates 2002).

The high relative abundance recovered for *A. ararauna* might be explained by the presence of dormitories and nesting places of this species in the study area (S. R. Posso, *pers. obs.*). On the other hand, the relative high abundance of other species potentially mirrors the ability to exploit wide niches (Gregory & Gaston 2000), as seems to be the case of *T. leucomelas* and *P. sulphuratus*. Moreover, some birds show frequent and loud vocalizations (*C. undulatus*) and/or are gregarious (*Brotogeris chiriri*, *C. chrysops, R. carbo* and *G. chopi*), which increase their detection index. However, it is important to remember that relative abundance does not necessarily reflect true abundance (Anjos *et al*. 2010).

About 10% of birds occurring in the cerrado are migratory (Silva 1995), so a total of 16.23% species recorded during the study were migratory, with 6.8% of all species considered austral migrants. These percentages indicate the importance of the JB for migratory species, particularly those from southern South America. The remaining migrants (13,1%) are mostly passerines, with the predominance of austral flycatchers, a well-known migratory group (Sick 1997).

The data above suggest that the JB harbors a rich avifauna, presumably as consequence of reduced anthropization, in spite of being located within a highly disturbed Brazilian region due to intensive agriculture. This reinforces the importance of this cerrado mosaic for birdlife conservation.

Spatial distribution

Animal diversity is directly affected by the heterogeneity of the local vegetation (Veech & Crist 2007). According to Tubelis & Cavalcanti (2001) the bird species composition of the cerrado is associated with the floristic and structural characteristics of the habitat. Structurally complex environments have a richer variety of niches and more possibilities for resource exploitation, enabling the existence of a higher diversity of species (Poulsen 2002).

The most pronounced difference in species composition between habitats was that between cerrado *stricto sensu* and gallery forest. This is not surprising given the spatial configuration of the gallery forest, which formed a narrow corridor across the cerradão matrix, and includes dense and evergreen trees along a major perennial river (Figure 1). On the other hand, the cerrado *stricto sensu* is a semi-open habitat in which trees are interspersed with open grassy areas. In fact, gallery forest transects exhibited enhanced coherence in comparison with cerrado *stricto sensu* transects in which were present a highly diverse avifauna ranging from the large *Rhea americana* to small canopy species such as *Elaenia cristata*. This result is well within the environmental heterogeneity hypothesis (Poulsen 2002). The contrasting structural and seasonal differences between dense and semi-open habitats are expressed in richness patterns observed throughout the year (Cavalcanti 1992). For example, the higher densities of tree trunks on which they forage, might explain the higher richness of Dendrocolaptidae in the cerradão and gallery forests. According to the vertical distribution, both cerradão and gallery forest shared a high number of understory insectivorous bird species (Figure 5). Often, understory insectivorous birds are less prone to travel across open areas due to the reduced variability in arthropods availability they prey upon (Yabe & Marques 2001). This is particularly consistent in dense woodland and forest corridors that support higher richness and abundance of arthropods (Ramirez-Alborez 2006). Tubelis & Cavalcanti (2000) observed that the increase in floristic composition results in a higher number of associated invertebrates, which allows the establishment of insectivorous birds.

Nevertheless, in addition to an abundant and perennial water supply, gallery forests also harbors specific foods items associated to the occurrence of birds dependent on this habitat, such as *Chloroceryle amazona*, *Megaceryle torquata, Eurypyga helias*, *A. galeata* and *B. leucophrys*. According to Tubelis *et al*. (2004), the particular seasonal and structural traits of the gallery forest favor a rich bird community in spite of the reduced area in comparison to the other cerrado habitats. Therefore, denser habitats such as gallery forests and cerradão seem to play a very important role in maintaining high levels of bird richness throughout the seasonal cycle.

ACKNOWLEDGEMENTS

We thank the Agropecuária Basso, especially Sr. Nadal, by the logistic support and for allowing us to study the JB area. We thank to the UFMT Rondonópolis by the transportation and to Prof[a.] Dra. Antonia Marília

M. Nardes by authorizing the use of Figure 1. We also thank Patrick Thomaz for the English version and finally to the reviewers for improving this article.

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Associate Editor: Alexander C. Lees.

APPENDIX.

Check-list of bird species recorded at the RPPN Parque Ecológico João Basso, Rondonópolis, Mato Grosso, between 2006 and 2007. Systematics and nomenclature follow CBRO (2011).

Species	Total of contacts	AI(Pi)[1]	FO[2]	Habitat	Status of Migration
Struthioniformes Latham, 1790					
Rheidae Bonaparte, 1849					
Rhea americana (Linnaeus, 1758)	6	0,0031	7,14	CS	-
Tinamiformes Huxley, 1872					
Tinamidae Gray, 1840					
Crypturellus soui (Hermann, 1783)	2	0,001	7,14	C, GF	-
Crypturellus obsoletus (Temminck, 1815)	11	0,0057	28,57	C, CS	-
Crypturellus undulatus (Temminck, 1815)	44	0,0229	53,57	C/ GF, CS	-
Crypturellus parvirostris (Wagler, 1827)	10	0,0052	28,57	C, CS	-
Rhynchotus rufescens (Temminck, 1815)	5	0,0026	14,28	CS	-
Nothura maculosa (Temminck, 1815)	1	0,0005	3,37	CS	-
Galliformes Linnaeus, 1758					
Cracidae Rafinesque, 1815					
Penelope superciliaris Temminck, 1815	20	0,0104	28,57	C/ GF, CS	-
Pelecaniformes Sharpe, 1891					
Ardeidae Leach, 1820					
Syrigma sibilatrix (Temminck, 1824)	1	0,0005	3,57	CS	-
Threskiornithidae Poche, 1904					
Mesembrinibis cayennensis (Gmelin, 1789) [*A]	4	0,002	7,14	CS	-
Theristicus caudatus (Boddaert, 1783)	14	0,0073	25	CS	-
Cathartiformes Seebohm, 1890					
Cathartidae Lafresnaye, 1839					
Cathartes aura (Linnaeus, 1758)	8	0,0041	7,14	C, CS	-
Cathartes burrovianus Cassin, 1845	5	0,0026	7,14	CS	-
Coragyps atratus (Bechstein, 1793)	29	0,0151	35,71	C/ GF, CS	-
Sarcoramphus papa (Linnaeus, 1758)	5	0,0026	17,85	C, CS	-
Accipitriformes Bonaparte, 1831					
Accipitridae Vigors, 1824					
Elanoides forficatus (Linnaeus, 1758)	8	0,0041	14,28	CS	-
Gampsonyx swainsonii Vigors, 1825	1	0,0005	3,57	C	-
Ictinia plumbea (Gmelin, 1788)	2	0,001	7,14	C, CS	-
Rupornis magnirostris (Gmelin, 1788)	4	0,002	14,28	CS	-
Pseudastur albicollis (Latham, 1790)	4	0,002	10,71	GF	-
Falconiformes Bonaparte, 1831					
Falconidae Leach, 1820					
Caracara plancus (Miller, 1777)	5	0,0026	3,57	CS	-
Milvago chimachima (Vieillot, 1816)	3	0,0015	10,71	CS	-

Species	Total of contacts	AI(Pi)[1]	FO[2]	Habitat	Status of Migration
Herpetotheres cachinnans (Linnaeus, 1758)	4	0,002	14,28	GF, CS	-
Falco rufigularis Daudin, 1800	1	0,0005	3,57	CS	-
Falco femoralis Temminck, 1822[*B]	2	0,001	7,14	CS	-
Eurypygiformes Furbringer, 1888					
Eurypygidae Selby, 1840					
Eurypyga helias (Pallas, 1781)	3	0,0015	7,14	GF	-
Gruiformes Bonaparte, 1854					
Rallidae Rafinesque, 1815					
Porzana albicollis (Vieillot, 1819)	2	0,001	7,14	GF	-
Cariamiformes Furbringer, 1888					
Cariamidae Bonaparte, 1850					
Cariama cristata (Linnaeus, 1766)	15	0,0078	21,42	CS	-
Charadriiformes Huxley, 1867					
Charadriidae Leach, 1820					
Vanellus chilensis (Molina, 1782)	12	0,0062	14,28	CS	-
Columbiformes Latham, 1790					
Columbidae Leach, 1820					
Columbina talpacoti (Temminck, 1811)	41	0,0214	25	C,CS	-
Columbina squammata (Lesson, 1831)	29	0,0151	17,85	C, CS	-
Claravis pretiosa (Ferrari-Perez, 1886) [*A]	4	0,002	10,71	C, GF, CS	R
Patagioenas speciosa (Gmelin, 1789)	7	0,0036	14,28	C, GF	-
Patagioenas picazuro (Temminck, 1813) [*A]	30	0,0156	42,85	C, GF, CS	-
Patagioenas cayennensis (Bonnaterre, 1792)	2	0,001	7,14	GF	-
Zenaida auriculata (Des Murs, 1847)	13	0,0067	14,28	CS	
Leptotila verreauxi Bonaparte, 1855	24	0,0125	53,57	C/ GF, CS	-
Leptotila rufaxilla (Richard & Bernard, 1792)	18	0,0093	28,57	C/ GF, CS	-
Psittaciformes Wagler, 1830					
Psittacidae Rafinesque, 1815					
Ara ararauna (Linnaeus, 1758)	88	0,0459	46,42	C/ GF, CS	-
Ara severus (Linnaeus, 1758)	1	0,0005	3,57	C	-
Primolius maracana (Vieillot, 1816)	23	0,012	21,42	C, GF, CS	-
Primolius auricollis (Cassin, 1853)	10	0,0052	17,85	C, GF	-
Diopsittaca nobilis (Linnaeus, 1758)	32	0,0167	25	C, GF	-
Aratinga acuticaudata (Vieillot, 1818)	2	0,001	3,57	C	-
Aratinga leucophthalma (Statius Muller, 1776)	27	0,014	28,57	C, GF, CS	-
Aratinga aurea (Gmelin, 1788)	38	0,0198	21,42	C, GF, CS	-
Pyrrhura snethlageae Joseph & Bates, 2002	8	0,0041	7,14	C,GF	-
Myiopsitta monachus (Boddaert, 1783)	10	0,0052	10,71	CS	-
Forpus xanthopterygius (Spix, 1824)	12	0,0062	3,57	C, GF	-
Brotogeris versicolurus (Statius Muller, 1776)	41	0,0214	32,14	C, GF, CS	-
Amazona aestiva (Linnaeus, 1758)	10	0,0052	10,71	C/ GF, CS	-

Species	Total of contacts	AI(Pi)[1]	FO[2]	Habitat	Status of Migration
Cuculiformes Wagler, 1830					
Cuculidae Leach, 1820					
Piaya cayana (Linnaeus, 1766)	14	0,0073	42,85	C/ GF, CS	-
Crotophaga ani Linnaeus, 1758	18	0,0093	7,14	CS	-
Guira guira (Gmelin, 1788)	12	0,0062	7,14	CS	-
Tapera naevia (Linnaeus, 1766)	2	0,001	7,14	C	-
Dromococcyx phasianellus (Spix, 1824)	8	0,0041	25	C, CS	-
Strigiformes Wagler, 1830					
Strigidae Leach, 1820					
Megascops choliba (Vieillot, 1817)	1	0,0005	3,57	CS	-
Glaucidium brasilianum (Gmelin, 1788)	4	0,002	14,28	C, CS	-
Athene cunicularia (Molina, 1782)	2	0,001	3,57	CS	-
Caprimulgiformes Ridgway, 1881					
Caprimulgidae Vigors, 1825					
Hydropsalis albicollis (Gmelin, 1789)	15	0,0078	25	C, GF CS	-
Apodiformes Peters, 1940					
Apodidae Olphe-Galliard, 1887					
Panyptila cayennensis (Gmelin, 1789)	28	0,0146	3,57	CS	-
Trochilidae Vigors, 1825					
Phaethornis pretrei (Lesson & Delattre, 1839)	6	0,0031	10,71	C, GF	-
Eupetomena macroura (Gmelin, 1788)	2	0,001	7,14	CS	-
Anthracothorax nigricollis (Vieillot, 1817) [*B]	5	0,0026	14,28	CS	-
Chlorostilbon lucidus (Shaw, 1812)	5	0,0015	10,71	C,GF	-
Trogoniformes A. O. U., 1886					
Trogonidae Lesson, 1828					
Trogon surrucura Vieillot, 1817	4	0,002	14,28	C, GF	-
Trogon curucui Linnaeus, 1766	12	0,0062	35,71	C, GF	-
Coraciiformes Forbes, 1844					
Alcedinidae Rafinesque, 1815					
Megaceryle torquata (Linnaeus, 1766)	1	0,0005	3,57	GF	-
Chloroceryle americana (Gmelin, 1788)	1	0,0005	3,57	GF	-
Momotidae Gray, 1840					
Momotus momota (Linnaeus, 1766)	19	0,0099	42,85	C, GF	-
Galbuliformes Fürbringer, 1888					
Galbulidae Vigors, 1825					
Brachygalba lugubris (Swainson, 1838)	1	0,0005	3,57	C, GF	-
Galbula ruficauda Cuvier, 1816	8	0,0041	14,28	C, GF	-
Bucconidae Horsfield, 1821					
Bucco tamatia Gmelin, 1788	1	0,0005	3,57	GF	-
Nystalus chacuru (Vieillot, 1816)	2	0,001	7,14	C, CS	-
Nystalus maculatus (Gmelin, 1788)	1	0,0005	3,57	CS	-

Species	Total of contacts	AI(Pi)[1]	FO[2]	Habitat	Status of Migration
Monasa nigrifrons (Spix, 1824)	31	0,0162	39,28	GF, CS	-
Chelidoptera tenebrosa (Pallas, 1782)	19	0,0099	21,42	C/ GF, CS	-
Piciformes Meyer & Wolf, 1810					
Ramphastidae Vigors, 1825					
Ramphastos toco Lichtenstein, 1823	1	0,0005	3,57	GF	-
Ramphastos vitellinus Lichtenstein, 1823	1	0,0005	3,57	C	-
Pteroglossus castanotis Gould, 1834	7	0,0036	14,28	C, GF, CS	-
Picidae Leach, 1820					
Veniliornis passerinus (Linnaeus, 1766)	8	0,0041	21,42	C, GF, CS	-
Colaptes campestris (Vieillot, 1818)	17	0,0088	10,71	CS	-
Celeus lugubris (Malherbe, 1851)	4	0,002	7,14	C	-
Dryocopus lineatus (Linnaeus, 1766)	2	0,001	7,14	GF	-
Passeriformes Linné, 1758					
Thamnophilidae Swainson, 1824					
Formicivora rufa (Wied, 1831)	3	0,0015	7,14	CS	-
Herpsilochmus longirostris Pelzeln, 1868	2	0,001	3,57	C, GF	-
Thamnophilus doliatus (Linnaeus, 1764)	12	0,0062	21,42	C/ GF, CS	-
Thamnophilus pelzeni (Hellmayr, 1924)	36	0,0187	57,13	C/ GF, CS	-
Thamnophilus caerulescens Vieillot, 1816	5	0,0026	14,28	C, GF, CS	-
Taraba major (Vieillot, 1816)	2	0,001	3,57	CS	-
Cercomacra melanaria (Ménétriès, 1835)	1	0,0005	3,57	GF	-
Dendrocolaptidae Gray, 1840					
Sittasomus griseicapillus (Vieillot, 1818)	22	0,0114	50	C, GF, CS	-
Xiphorhynchus guttatus (Lichtenstein, 1820)	10	0,0052	14,28	C, GF	-
Dendroplex picus (Gmelin, 1788)	1	0,0005	3,57	GF	-
Lepidocolaptes angustirostris (Vieillot, 1818)	13	0,0067	32,14	C, CS	-
Dendrocolaptes picumnus Lichtenstein, 1820	3	0,0015	10,71	C, GF	-
Dendrocolaptes platyrostris Spix, 1825	1	0,0005	3,57	C	-
Xiphocolaptes albicollis (Vieillot, 1818)	1	0,0005	3,57	GF	-
Furnariidae Gray, 1840					
Xenops rutilans Temminck, 1821	1	0,0005	3,57	GF	-
Furnarius rufus (Gmelin, 1788)	8	0,0041	7,14	CS	-
Hylocryptus rectirostris (Wied, 1831)	1	0,0005	3,57	GF	-
Syndactyla dimidiata (Pelzeln, 1859)	1	0,0005	3,57	GF	-
Phacellodomus ruber (Vieillot, 1817)	1	0,0005	3,57	GF	-
Certhiaxis cinnamomeus (Gmelin, 1788)	1	0,0005	3,57	GF	-
Synallaxis frontalis Pelzeln, 1859	5	0,0026	14,28	C, CS	-
Pipridae Rafinesque, 1815					-
Pipra fasciicauda Hellmayr, 1906	1	0,0005	3,57	GF	-
Antilophia galeata (Lichtenstein, 1823)	22	0,0114	32,14	GF	-

Species	Total of contacts	AI(Pi)[1]	FO[2]	Habitat	Status of Migration
Tityridae Gray, 1840					
Tityra inquisitor (Lichtenstein, 1823)	4	0,002	7,14	GF	-
Tityra cayana (Linnaeus, 1766)	6	0,0031	10,71	GF	-
Tityra semifasciata (Spix, 1825)	4	0,002	10,71	GF	-
Pachyramphus viridis (Vieillot, 1816)	3	0,0015	10,71	GF	-
Pachyramphus marginatus (Lichtenstein, 1823)	2	0,001	3,57	GF	-
Insertae sedis					
Platyrinchus mystaceus Vieillot, 1818	1	0,0005	3,57	C	-
Rynchocyclidae Berlepsch, 1907					
Leptopogon amaurocephalus Tschudi, 1846	1	0,0005	3,57	C	-
Tolmomyias sulphurescens (Spix, 1825)	1	0,0005	3,57	C/ GF	-
Poecilotriccus latirostris (Pelzeln, 1868)	14	0,0073	17,85	C, GF	-
Hemitriccus margaritaceiventer (d'Orbigny & Lafresnaye, 1837)	13	0,0067	25	C	-
Tyrannidae Vigors, 1825					
Hirundinea ferruginea (Gmelin, 1788)	9	0,0046	17,85	CS	A
Camptostoma obsoletum (Temminck, 1824)	5	0,0026	14,28	CS	-
Elaenia flavogaster (Thunberg, 1822) [*A]	2	0,001	7,14	CS	A
Elaenia spectabilis Pelzeln, 1868	1	0,0005	3,57	CS	A
Elaenia cristata Pelzeln, 1868	2	0,001	7,14	C, CS	-
Myiopagis gaimardii (d'Orbigny, 1839)	1	0,0005	3,57	C	-
Myiopagis viridicata (Vieillot, 1817)	1	0,0005	3,57	C	-
Phaeomyias murina (Spix, 1825)	1	0,0005	3,57	C, GF	-
Serpophaga subcristata (Vieillot, 1817)	5	0,0026	7,14	CS	A
Attila phoenicurus Pelzeln, 1868	1	0,0005	3,57	C	A
*Legatus leucophaius (*Vieillot, 1818)	1	0,0005	3,57	C	-
Myiarchus swainsoni Cabanis & Heine, 1859	3	0,0015	7,14	CS	A
Myiarchus ferox (Gmelin, 1789)	15	0,0078	28,57	C, GF, CS	-
Myiarchus tyrannulus (Statius Muller, 1776) [*A, B]	7	0,0036	21,42	C, GF, CS	A
Sirystes sibilator (Vieillot, 1818) [*B]	11	0,0057	14,28	C	A
Pitangus sulphuratus (Linnaeus, 1766)	53	0,0276	60,71	C, GF, CS	-
Machetornis rixosa (Vieillot, 1819*)* [*A, B]	1	0,0005	3,57	CS	A
Myiodynastes maculatus (Statius Muller, 1776)	18	0,0093	31,24	C, GF, CS	A
Megarynchus pitangua (Linnaeus, 1766) [*B]	14	0,0073	39,28	C, GF, CS	A
Myiozetetes cayanensis (Linnaeus, 1766) [*A]	10	0,0052	17,85	GF	A
Myiozetetes similis (Spix, 1825) [*A]	11	0,0057	21,42	C, CS	A
Tyrannus melancholicus Vieillot, 1819	4	0,002	10,71	C, GF, CS	A
Tyrannus savana Vieillot, 1808	1	0,0005	3,57	CS	A
*Colonia colonus (*Vieillot, 1818) [*A, B]	2	0,001	7,14	GF	A
Pyrocephalus rubinus (Boddaert, 1783)	1	0,0005	3,57	CS	A
Cnemotriccus fuscatus (Wied, 1831*)*	5	0,0026	7,14	CS	-
Lathrotriccus euleri (Cabanis, 1868) [*B]	6	0,0031	21,42	C, CS	A

Species	Total of contacts	AI(Pi)[1]	FO[2]	Habitat	Status of Migration
Contopus cinereus (Spix, 1825) [*A]	2	0,001	7,14	C	A
Xolmis velatus (Lichtenstein, 1823) [*A]	1	0,0005	3,57	CS	A
Vireonidae Swainson, 1837					
Cyclarhis gujanensis (Gmelin, 1789)	41	0,0214	46,42	C, GF, CS	-
Vireo olivaceus (Linnaeus, 1766)	19	0,0099	35,71	C, GF, CS	N
Hylophilus hypoxanthus Pelzeln, 1868	6	0,0031	17,85	GF, CS	-
Corvidae Leach, 1820 (1,5%)					
Cyanocorax cyanomelas (Vieillot, 1818)	4	0,002	14,28	C, CS	-
Cyanocorax cristatellus (Temminck, 1823)	7	0,0036	7,14	CS	-
Cyanocorax chrysops (Vieillot, 1818)	38	0,0198	35,71	C, GF, CS	-
Troglodytidae Swainson, 1831					
Troglodytes musculus Naumann, 1823	6	0,0031	17,85	CS	-
Pheugopedius genibarbis Swainson, 1838	16	0,0083	25	GF	-
Polioptilidae Baird, 1858					
Polioptila plumbea (Gmelin, 1788)	2	0,001	3,57	CS	-
Polioptila dumicola (Vieillot, 1817)	1	0,0005	3,57	CS	-
Turdidae Rafinesque, 1815					
Turdus leucomelas Vieillot, 1818[*A]	65	0,0339	71,42	C, GF, CS	A
Turdus amaurochalinus Cabanis, 1850	25	0,013	42,85	C, GF, CS	A
Turdus fumigatus Lichtenstein, 1823	1	0,0005	3,57	CS	
Mimidae Bonaparte, 1853					
Mimus saturninus (Lichtenstein, 1823)	1	0,0005	3,57	CS	-
Coerebidae d'Orbigny & Lafresnaye, 1838					
Coereba flaveola (Linnaeus, 1758)	3	0,0015	10,71	C, GF, CS	-
Thraupidae Cabanis, 1847					
Saltator coerulescens Vieillot, 1817	7	0,0036	10,71	C	-
Saltator similis d'Orbigny & Lafresnaye, 1837	18	0,0093	39,28	C	-
Saltatricula atricollis Vieillot, 1817	6	0,0031	7,14	CS	-
Tachyphonus rufus (Boddaert, 1783)	11	0,0057	25	GF, CS	-
Ramphocelus carbo (Pallas, 1764)	72	0,0375	46,72	C, GF	-
Lanio luctuosus d'Orbigny & Lafresnaye, 1837	3	0,0015	7,14	GF, CS	-
Lanio cucullatus (Statius Muller, 1776)	19	0,0099	28,57	C, CS	-
Lanio penicillatus (Spix, 1825)	3	0,0015	10,71	C, GF	-
Tangara schrankii (Spix, 1825)	1	0,0005	3,57	GF	-
Tangara sayaca (Linnaeus, 1766)	9	0,0046	14,28	C, GF, CS	-
Tangara palmarum (Wied, 1823)	6	0,0031	10,71	C, GF	-
Tangara cayana (Linnaeus, 1766)	3	0,0015	3,57	C, GF, CS	-
Paroaria capitata (d'Orbigny & Lafresnaye, 1837)	1	0,0005	3,57	GF	-
Dacnis cayana (Linnaeus, 1766)	11	0,0057	21,42	C/ GF, CS	-
Cyanerpes cyaneus (Linnaeus, 1766)	1	0,0005	3,57	GF	-
Hemithraupis guira (Linnaeus, 1766)	2	0,001	7,14	C, CS	-

Species	Total of contacts	AI(Pi)[1]	FO[2]	Habitat	Status of Migration
Emberizidae Vigors, 1825					
Zonotrichia capensis (Statius Muller, 1776)	12	0,0062	25	CS	-
Volatinia jacarina (Linnaeus, 1766)	6	0,0031	17,85	CS	A
Cardinalidae Ridgway, 1901					
Piranga flava (Vieillot, 1822)	2	0,001	3,57	C	-
Parulidae Wetmore, Friedmann, Lincoln, Miller, Peters, van Rossem, Van Tyne & Zimmer 1947					
*Parula pitiayum*i (Vieillot, 1817)	1	0,0005	3,57	C	-
Basileuterus culicivorus (Deppe, 1830)	2	0,001	7,14	C	-
Basileuterus hypoleucus Bonaparte, 1830	3	0,0015	3,57	C	-
Basileuterus flaveolus (Baird, 1865)	55	0,028	67,85	C/ GF	-
Basileuterus leucophrys Pelzeln, 1868	3	0,0015	10,71	GF	-
Icteridae Vigors, 1825					
Cacicus cela (Linnaeus, 1758)	5	0,0026	14,28	C, GF	-
Gnorimopsar chopi (Vieillot, 1819)	50	0,0261	46,42	CS	-
Molothrus bonariensis (Gmelin, 1789)	12	0,0062	3,57	CS	-
Fringillidae Leach, 1820					
Euphonia chlorotica (Linnaeus, 1766)	9	0,0046	25	C, GF, CS	-
Euphonia violacea (Linnaeus, 1758)	1	0,0005	3,57	C, GF, CS	-

Captions: [1] Abundance Index (AI; calculated after Anjos *et al*. 2010) ; **[2] Frequency of occurrence (FO;** calculated after Anjos *et al*. 2010); **Habitat**: Cerradão (C), gallery forest (GF), and *cerrado stricto sensu* (CS); Status of **Migration:** (N) Neotropical - species arriving from North, Central and northern South America; (A) Austral- species arriving from southern South America.