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Bird community distribution in a Cerrado-Caatinga transition area, Piauí, Brazil

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RESUMO: Distribuição das comunidades de aves em uma área de transição Cerrado-Caatinga, Piauí, Brasil. Eu estudei a distribuição das espécies de aves ao longo de um área de transição entre o Cerrado e a Caatinga no centro-sul do Piauí, afim de avaliar se as avifauna destes dois biomas seguem as três predições da hipótese de homogeneização. A distribuição das espécies de aves foi estudada com base em estudos de campo, complementados por registros da literatura e de espécimens em museus. Espécies encontradas na área de estudo são amplamente distribuídas (69.7%), embora algumas (30.3%) reconheçam a borda entre o Cerrado e a Caatinga. A presença de espécies que são sensíveis a borda não apoiam a primeira predição da hipótese de homogeneização. A avifauna da Caatinga não é um subconjunto da fauna do Cerrado, pois ambas regiões apresentam espécies endêmicas. Espécies que tem seus centro de distribuição no Cerrado ou na Caatinga não são encontradas nos mesmos *sites* ao longo da área de transição, indicando que ocupam diferentes paisagens Por conseguinte, a distribuição das espécies de aves ao longo da transição entre o Cerrado e a Caatinga não dão suporte para as três maiores predições da hipótese de homogeneização.

PALAVRAS-CHAVE: Aves, estado do Piauí, Biogeografia.

ABSTRACT: I study the ranges of bird species along a transition area between Cerrado and Caatinga in south central Piaui to evaluate if the avifauna of this biomes follow three predictions of the homogenisation hypothesis. Species' ranges were studied based on fieldwork, literature survey and collection data made available for this study. Although most of species found in the study area are widespread (69.7%), there are several species (30.3%) that do recognize the boundaries between Cerrado and Caatinga. The presence of species that are boundary-sensitive does not support the first prediction of the hypothesis of homogeneization. The avifauna of the Caatinga is not a subset of the Cerrado's because both regions harbor endemic species. Species that have their centers of distribution in Cerrado or Caatinga are not found at the same sites along the transition area, indicating that they occupy different landscapes. Therefore, the distribution of the avian species along a transition area between Cerrado and Caatinga does not support any of the three major predictions of the homogenization hypothesis.

KEY-WORDS: Birds, Piaui state, Biogeography.

The major Brazilian morphoclimatic domains can be classified in environments dominated by forest and open vegetation (Ab'Saber 1977a). The domains mainly covered by forest represent Amazonian and Atlantic forest. These domains are separated by an extensive corridor of open vegetation including Caatinga, Cerrado and Chaco domains (Vanzolini 1963, Ab'Saber 1973).

Currently it is known that morphoclimatic domains have never been static as well as the areas are believed to have drifted during the glacial periods at Quaternary (Ab'Saber 1977a, Ab'Saber 1982). During the glacial periods, South American climate remained dry and cold favouring Caatinga and Chaco expansion on the peripheral depressions of the intertropical plateaus as well as the retraction of formations such as Cerrado, Amazonian and Atlantic forests to the ecological refuges located either on the Chapadões of Central Brazil (for Cerrado) or on the slopes of the plateaus and Andean hills (for forests). Meanwhile, during interglacial periods the climate became wetter and hotter as a result of Cerrado, Atlantic and Amazonian forest expansions from the refuges and recovered the areas that had been lost for the xeric vegetation. These formations withdrew towards the depressions of Northeast of Brazil (Caatinga) or South American central depressions (Chaco) (Ab'Saber 1977b, Vanzolini 1981, Bigarella and Andrade-Lima 1982).

Traditionally, palaeoecological dynamic of Quaternary has been addressed as the main cause of recent diversification of South American biota (Whitmore and Prance 1987), even though this hypothesis was very criticised (Cracraft 1985, Silva 1995a, Silva 1995b). Differently to the traditional vision, Muller (1973) and Vanzolini (1976) used pelaeoecolgical dynamic of Quaternary to explain the homogenisation instead of the diversification of amphibian and lizard fauna from South American open formations. According to Vanzolini (1976), palaeoecological cycles would promote a "turbulent mixing" of Caatinga and Cerado faunas leading to the exchange of species and inhibiting any differentiation process. As a result of this, the biota is devoid of any homogenisation process in these regions.

Recently the homogenisation hypothesis of Caatinga and Cerrado biota due to palaeoecological dynamic has been discussed. Rodrigues (1988), by reviewing the genus *Tropidurus,* claims that different of what was expected by the homogenisation hypothesis, Caatinga do possesses several endemic lizard species. Despite this, Vanzolini (1988) states: *"In spite of the existence of many forms narrowly restricted to particular environments, and a few species limited to one of the domains, it cannot be said that either the cerrado or the caatinga has a characteristic lizard fauna".* Mares *et al.* (1985), by studying mammalian biogeography of Caatinga, hypothesised that if Caatinga was a xeric refuge during some Pleistocene phases it would be expected that many species from this group demonstrate a pronounced level of physiological adaptation to harsh environments as a consequence of long periods of isolation in these environments. Mares *et al.* (1985) found only one species exclusive from Caatinga, *Kerodon rupestris* and no evidence of physiological adaptation in mammals to xeric environments. Based on these results, the authors suggested that: (a) mammals present in Caatinga developed in wetter environments, therefore, they are not adapted to xeric regions and (b) mammals of Caatinga are simply a subset of mammalian fauna from Cerrado. Fonseca *et al.* (2000), also working with mammals, suggested that this group is very similar for Caatinga, Cerrado and Chaco. However, apart from Mares *et al.* (1985), the authors indicate that Caatinga does not possess an endemism since *Kerodon rupestris,* which was listed by Mares *et al.* (1985) as endemic, was also registered in Cerrado. The lack of endemic mammal species in Caatinga is explained as a consequence of Pleistocene climatic events that mainly favoured the most versatile species that occupied various types of habitats instead of the ones adapted to open formations. Finally, Cartelle (2000), analysing the fauna of mammal fossils corroborated the information of Fonseca *et al.* (2000) and suggested that a percentage of endemism higher than current data has already been registered in Cerrado. He argues that Pleistocene was marked by great extinction rates mainly among mammalian species adapted to landscapes.

No similar analysis to that performed with reptilian, amphibian and mammalian was elaborated for the most diversified terrestrial vertebrate group: the birds. On the other hand, available information on avifauna from these biomes indicates a pattern inconsistent with the biotic homogenisation hypothesis of Cerrado and Caatinga as proposed by Vanzolini (1976), since both regions present distinct bird community. For instance, about 759 species of birds that breed in Cerrado were registered (Silva 1995a, Silva 1995b), of which 29 (3,8%) are restricted to this biome (Silva 1995b). For Caatinga, Silva *et al.* (2004) recorded 510 species and Pacheco and Bauer (2000) recorded 19 endemic or maintain strong relationships with xeric environments (Stotz *et al.* 1996). The presence of avian endemic elements in both environments let Cerrado and Caatinga be identified as two important and distinct endemism areas for South American birds (Cracraft 1985, Haffer 1985, Silva 1997).

According to Vanzolini (1976), the homogenisation hypothesis of Caatinga and Cerrado fauna might be better assessed in a transition area between both biomes, since the means of contact in mosaics and interdigitations would facilitate biotic mixture. The aim of this paper is to evaluate the distribution of bird species along a contact zone between Caatinga and Cerrado in order to verify whether avifauna from these two biomes follows the predictions of homogenisation hypothesis. If this hypothesis is valid for birds, we expect to find the following patterns in the contact zone between biomes: (a) fauna present in Caatinga and Cerrado will comprise species with widespread distribution and with no or little differentiation in their composition; (b) Caatinga's fauna will only represent a subset of Cerrado's fauna; (c) elements with distribution centre in Cerrado and Caatinga will be found in the same habitat in the transition area of both environments.

STUDY AREA

The Biomes: Cerrado and Caatinga

Cerrado is mainly located in the Brazilian central plateau representing the second higher Brazilian vegetal formation. This biome ranges from 5° to 20° of latitude southward and from 45° to 60° of longitude westward with an area around 1,7 to 1,9 millions of km^2 (Ab'Saber 1983). Cerrado is present in 16 Brazilian states as well as to the east of Paraguay and Northeast of Bolivia (Ferri 1977). The climate is seasonal with two well defined seasons: one dry that lasts from five to six months and the other wet with six or seven relatively rainy months (Ab'Saber 1983). Mean annual precipitation is of 1.500 mm ranging from 750 to 2.000 mm (Nimer 1972, Emperaire 1983).

Vegetation is variable in structure and composition ranging from open formations to more closed ones. Eiten (1972) recognised five physiognomic types of Cerrado: (a) cerradão; (b) cerrado *sensu stricto;* (c) campo cerrado; (d) campo sujo, and (e) campo limpo.

Caatinga occupies great part of Brazilian Northeast, covering an area around 800.000 km^2 (Ab'Saber 1974, Fernandes 1999). This region stretches from 2°54'S to 17°21'S (Andrade-Lima 1981). The climate has great influence on the Caatinga since one of the most extreme meteorological values were recorded for this biome: the strongest insulation and the lowest nebulosity; the highest thermal averages (26°-29°C) and the lowest relative humidity percentages; the most elevated evaporation rates and, above all, the most exiguous and irregular pluvial precipitation (250-800 mm per year), that are extremely seasonal and limited to a short period of the year (2 to 3 months) (Nimer 1972, Reis 1976).

Caatinga's flora exerts different defence mechanisms from those presented by Cerrado's flora when analysed under a viewpoint of selective adaptation of its plants to respective environments (Ferri 1977). While Cerrado developed a scleromorphism as a result of the large amount of carbohydrates from photosynthetic activity, the Caatinga is highlighted by elevated caducifoly of the floristic components at the dry period. This occurs due to water limitation and suspension of photosynthetic activity at the dry period (Fernandes 1999). Rizzini (1979) identified five main physiognomic types for the Caatinga: (a) caatinga agrupada; (b) caatinga arbustiva esparsa; (c) caatinga arbustiva densa; (d) caatinga arbustiva com suculentas, and (e) caatinga arbórea.

South Centre Transition of Piauí

Between the Caatinga and Cerrado domains there is a broad transition area that stretches from north centre of Piauí sate through the north of Bahia to the northeast of Minas Gerais (Eiten 1972). Especially in the south centre of Piauí state, these two biomes maintain a long contact zone, ecologically marked by the isohyets of 1.000 mm (Nimer 1972, Ab'Saber 1974). In some patches, the transition is gradual. At first one can see the Cerradão to the west until the end of the arboreal strata. Then, the landscape is composed by cactaceae and bromeliaceae species. Following this, the vegetation reaches shrubby and fully deciduous caatinga eastward (Eiten 1972). In other areas, patches of Caatinga are found beside patches of Cerrado forming complex mosaics associated with soil and landscape conditions (Brasil 1973, Emperaire 1983). Thus,

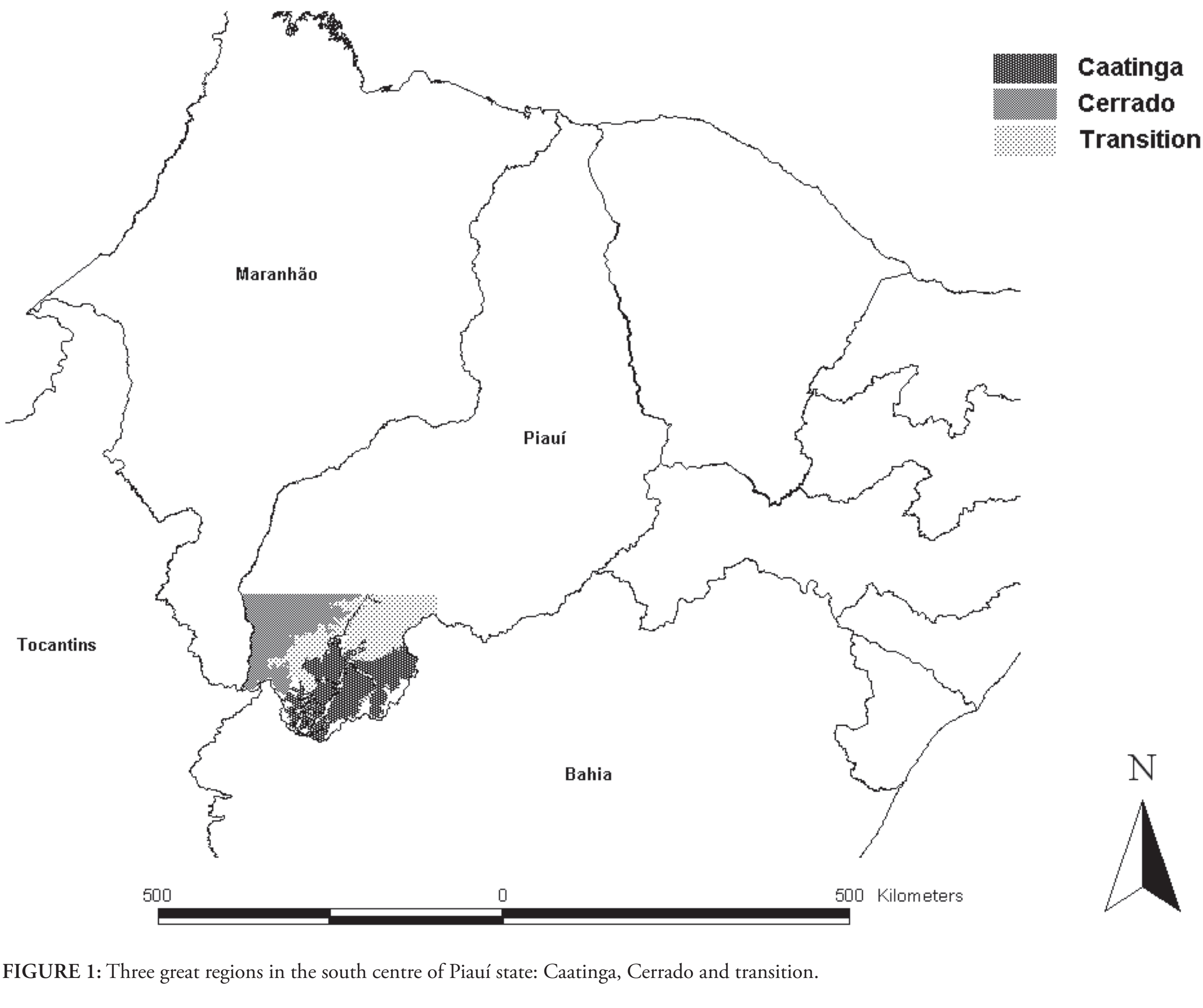

FIGURE 1: Three great regions in the south centre of Piauí state: Caatinga, Cerrado and transition.

four basic contact types between these two vegetation formation can be identified: mixing (Caatinga species can be observed together with Cerrado species), sharp contact (Caatinga and Cerrado vegetation form a visible line that separates both regions), encraves (Cerrado and Caatinga spots or the contrary) as well as interpenetrations (portions of Cerrado penetrating into the Caatinga or portions of Caatinga penetrating into the Cerrado) (Eiten 1972, Ab'Saber 1973, Brasil 1973, Emperaire 1983).

The south centre of Piauí state still maintains a natural and conserved cover, despite recent anthropic pressures caused by the expansion of soy plantations in the north region of the Cerrado domain (CEPRO 1984, Alho and Martins 1995). In spite of these constraints, the region of chapadas from the extreme south of Piauí and Maranhão is currently regarded as one of the best areas for conservation in the Brazilian Cerrado domains. It was considered as one of the priority areas for the conservation of the Cerrado biome with native vegetation cover estimated up to 60% (MMA 1999).

MATERIALS AND METHODS

Landscape Classification

The transition zone between Caatinga and Cerrado can be divided into three great compartments: Cerrado, transition and Caatinga (Figure 1). In order to identify the unites of landscapes present in each of these compartments, a phytoecological map elaborated by Brasil (1973) was utilised. This map recognises 6 vegetation classes for the study area. Of these, 3 occur in Cerrado, 5 in the transition and 3 in the Caatinga. Each of these classes will be described according to the classification proposed by Brasil (1973) as follows:

(a) **Arboreal Caatinga (EA):** forest physiognomy with trees whose canopies are linked and do not let the inferior strata be seen. The vegetation during the dry period is Caducifolious type, mainly represented by *Schnopsis brasiliensis, Astronium urundeuva, Ziziphus joazeiro* and *Caesalpinia pyramidalis.*

(b) **Shrubby Caatinga (EU):** it is characterised by the shrubby strata uniformity, associated with thorny plants such as cactaceae and bromeliaceae. The most representative species are *Mimosa acustipula, Leocereus squamosus, Anadenanthera macrocarpa, Bromelia laciniosa, Pilocereus gounellii* and *Caesalpinia microphylla.*

(c) **Mixing area (SEM):** Cerrado trees and Caatinga scrubs found side by side.

(d) **Cerradão (SC):** arboreal uniform formation with trees up to 5 m tall densely organised and intercalated by grass without a clear scrub substrate. The main vegetal species found in this class are: *Parkia platycephala, Anacardium nanum, Caryocar coriaceum, Magonia pubescens* and *Salvertia convallariodora.*

(e) **Campo Cerrado (SR):** arboreal shrubby formation presenting trees ranging from 2 to 5 metres tall and organised sparsely over a grass stratum continuous with low shrubs mainly represented by the species: *Curatella americana, Dimorphandra mollis, Stryphnodendron barbitimao, Qualea* sp., *Byrsonima* sp. *Caryocar* sp.

(f) **Parque (SP):** characterised by great field extensions of grass formation with few trees of variable height very sparsely organised. In this case the capim do agreste *Diectonis fastigiata* predominates.

By combining the region with the vegetation class, 11 types of landscapes were identified: Caatinga-EA, Caatinga-EU, Caatinga-SR, Transição-EA, Transição-EU, Transição-SEM, Transição-SC, Transição-SP, Cerrado-SC, Cerrado-SR and Cerrado-SP.

The different types of landscapes were demarcated and localised in field by using G.P.S. (Global Positioning System) and Brazil's map (1973).

Species List

The list of species recorded for the study area was obtained from the combination of three main data source: (a) field source, (b) bibliography and (c) data obtained from scientific collections.

For the species survey was performed by the method of points counts with fixed-radius (Bibby *et al.* 1992). On the basis of the state of conservation and access, three sampling areas were selected for each type of landscape diagnosed in the region. This resulted in a total of 33 areas. At each area, 30 counting points were established being separated 200 m from each other and analysed for two consecutive days. Each counting lasted 10 minutes being performed between 6 and 10:30 p.m. All birds recorded within and out a fixed radius of 25 m were counted. On each day, 15 points were sampled by draw. Fieldwork was conducted from 20 April 2000 to 17 September 2000 starting by Caatinga, through all the transition until Cerrado region. Field works were developed in this sequence with the aim to adjust data collection to rainfall and, consequently, breeding period of birds in the region. Rains in the Caatinga region begin from November-December to March-April with the breeding period of most species in this biome. In the Cerrado region, the breeding period of birds starts around September-October until December-January.

The following works provide information on bird community of the study area and were utilised to elaborate the list of species: Reiser (1910), Reiser (1924), Hellmayr (1929) e Naumburg (1935). From each work, a list of species was taken comprising those that were recorded for the localities within the delimited study area.

A list containing all specimens collected by Emil Kaempfer in the south centre of Piauí was also utilised to produce a list of species for the study area. The specimens were deposited in the Americam Museum of Natural History (AMNH), New York, United States. L. Short elaborated a list of specimens on the purpose of the project on "Zoogeography of birds from Chaco".

The co-ordinates of the collection localities mentioned in literature and visited by E. Kempfer were obtained from Paynter and Traylor (1991), Vanzolini (1992a) and Vanzolini (1992b). Totally, the distributions of species were analysed for 66 localities along the study area.

The species are organised according to the taxonomic sequence of CBRO (2008). In the analyses, all species belonging to these families Podicipedidae, Phalacrocoracidae, Anhigidae, Ardeidae, Cochleariidae, Ciconiidae, Anatidae, Aramidae, Rynchopidae and Alcedinidae were excluded. The species belonging to these families generally present broad distribution and maintain little or no relationship with forest or field environments in the study area. Besides these families, those species of migratory birds that do not breed in the south centre of Piauí were excluded.

Potencial Distribution

The potential distribution of the species in the contact zone between Cerrado and Caatinga was determined by adopting the methodology proposed by Jennings (2000) and Boone and Krohn (2000). The method consists of two steps. The first one is to identify the landscapes in which the species was recorded. This was undertaken by occupying the punctual distribution for each species with the maps of landscapes identified for the region. The second step is to extrapolate the species presence to patches where the species was not recorded, but these patches present the same landscape to the places where it was found. All these procedures were conducted with the aid of ARCVIEW 3.2. Program.

Ecological Classification of Species

To evaluate the species dependence degree in relation to forest environments in the region, the species were classified into three categories: (1) independent- those which occur in open vegetation (campo limpo, campo sujo, campo cerrado, cerrado *sensu strictu,* caatinga arbustiva esparsa, caatinga arbustiva com suculentas); (2) semi-dependent – those which occur either in open vegetation or forests; and (3) dependent – species which essentially occurs in forest environments (cerradão, gallery forests, arboreal caatinga).

Distribution Patterns

According to the species potential distribution in the study area, the distribution patterns can be classified into two major categories: (a) broadly distributed species which occur in all three regions (Cerrado, transition and Caatinga) and, therefore, are not limited by the edges of the habitats; and (b) species with the distribution limited by one or more edges in the study area. The second category can be divided into four subcategories: (a) Cerrado-species only recorded for Cerrado region; (b) Cerrado-transition – species that are present in the Cerrado region and also in the transition; (c) Caatinga- species only recorded for Caatinga region; and (d) Caatinga-transition-species which are present in the Caatinga and also in the transition.

Statistics

To verify if the number of species recorded for bird community families did not significantly differ among regions, Kolmogorov-Smirnov (KS) test was used to make comparisons with Cerrado and Caatinga, Cerrado and transition as well as Caatinga and transition.

Chi-square test (adherent test) was used to compare the number of species per biogeographical pattern categories. Chi-square test (homogeneity test for two independent samples) was also used to compare the regions concerning the proportion of species classified by the two biogeographical pattern categories.

In order to verify if there were differences in the distribution of the number of bird species in the three categories of habitat use per region, the G test (homogeneity test for two independent samples) was used. The same test was used to compare the distribution of bird species classified as to having distribution limited by the categories of habitat use. In the last case, some cells had values less than 5. Then, in order to violate one of the basic assumptions of this type of statistic test, when the number of one cell was less than 5, the number of species of dependent and semi dependent categories were summed and compared with the number of species classified as independent.

RESULTS

Species Richness and Composition

A total of 285 bird species comprising 48 families was recorded for the study area. Of these, 265 species are registered in the Cerrado, 218 in the Caatinga and 226 in the transition. The Cerrado presented 46 exclusive species, while the Caatinga presented only 13. No species was exclusive of the transition (Appendix 1). Of the 510 bird species recorded for the Caatinga by Silva *et al.* (2004), 206 (66.8%) were recorded for the study area. Of the 795 bird species (aquatic and migratory excluded) recorded for the Cerrado by Silva (1995b), only 235 (29,5%) were registered for the study area.

The families with greater richness were: Tyrannidae (49 spp), Emberizidae (19 spp), Psittacidae (17 spp), Accipitridae (15 spp), Thraupidae (15 spp) and Thamnophilidae (12 spp). All families are at least represented by one species for each region. The number of species per family was not different among regions: Cerrado x Caatinga (Kolmogorov-Smirnov: Dmax = 0.128; $p > 0.05$); Cerrado x Transition (Dmax = 0.102; $p > 0.05$); Caatinga x Transition (Dmax = .0.051; p > 0.05).

Habitat Use

The majority of bird species recorded for the study area is forest independent (39.7%), followed by semi dependent (32.9%) and dependent (27.4%). There is no significant difference when the proportion of species into the three categories of habitat use is compared among regions (Table 1). Cerrado x Caatinga (G = 4.59; gl = 2; $p > 0.05$), Cerrado x Transition (G = 3.51; gl = 2; $p > 0.05$) e Caatinga x Transition (G = 0.086; gl = 2, $p > 0.05$).

Distribution Patterns

The majority of species (69,6%) occurs in all the three regions instead of being limited (30,4%) to only one or two regions (Table 2). This difference is significant (χ^2 = 43,5; gl = 1; $p < 0{,}001$). This proportion is not different from the one found when only the forest independent species are analysed (χ^2 = 0.012, gl = 1, $p > 0{,}05$), but is very different when the forest semi dependent (χ^2 = 6,1; gl = 1; $p < 0{,}05$) and dependent species (χ^2 = 7,6; gl = 1; $p < 0{,}001$) are analysed isolated (Table 2). The reasons for theses differences are, however, distinct: while among semi dependent species the number of broadly distributed species is higher than is expected, among the species dependent on the forest, this category of distribution is represented by less species than what is expected.

A total of 21 species occurs in the Cerrado and transition, while only 7 species occurred in Caatinga and transition (Table 2). When the distributions of these species are overlapped it is possible to verify that the species classified in these two biogeographical categories are not observed in the same area within the transition, namely, they segregate spatially in the study area.

The bird species regarded as exclusive of Cerrado (Table 2) are preferably dependent on forest (61.4%), while the species encountered in both Cerrado and transition are essentially independent of forest formations (66.7%). This difference is statistically significant (G = 6.326; gl = 1; $p < 0.05$). In contrast (Table 2) most species restricted to Caatinga are independent of forests (83,4%), while the ones, which occupy the Caatinga and the transition area, are in their majority (71,4%), semi dependent. This difference, on the other hand, is not significant (G = 0.5148; gl = 1; $p > 0.05$).

Of the 30 species considered as endemic in Cerrado by Silva (1995b) and Silva e Santos (2005), only 8 species were recorded for the study area. Of these, 3 occurred

TABLE 1: Number of species recorded for the south centre of Piauí, separated by regions and habitat use categories.

	GENERAL	CERRADO	TRANSITION	CAATINGA
Independent	111 (39.7%)	98 (37.8%)	91 (41.3%)	89 (41.7%)
Semi-dependent	92 (32.9%)	87 (33.6%)	82 (37.4%)	81 (38.2%)
Dependent	76 (27.4%)	74 (28.6%)	47 (21.3%)	43 (20.1%)

TABLE 2: Number of species recorded for the south centre of Piauí, separated by geographic distribution patterns and habitat use categories.

	INDEPENDENT	SEMI-DEPENDENT	DEPENDENT
Restrict Distribution (30.4%)			
Cerrado	8 (18.2%)	9 (20.4%)	27 (61.4%)
Cerrado-transition	14 (66.7%)	1 (4,6%)	6 (28.7%)
Caatinga	10 (83.4%)	0 (0.0%)	2 (16.6%)
Caatinga-transition	2 (28.6%)	5 (71.4%)	0 (0.0%)
General distribuition (69.6%)	77 (39.5%)	77 (39.5%)	41 (21.0%)

exclusively in Cerrado (*Amazona xanthops, Herpsilochmus longirostris, Antilophia galeata*), and 5 are present in Cerrado and transition (*Melanopareia torquata, Cyanocorax cristatellus, Charitospiza eucosma, Saltator atricollis* and *Porphyrospiza caerulescens*). Of the 19 species pointed by Stotz *et al.* (1996) as endemic for Caatinga, 11 were recorded for the region. Of this total, 3 were encountered in Caatinga and transition (*Penelope jacucaca, Picumnus pygmaeus* and *Paroaria dominicana*), and only 8 in the Caatinga (*Caprimulgus hirundinaceus, Phaethornis gounelei, Xiphocolaptes falcirostris, Gyalophylax hellmayri, Megaxenops parnaguae, Sakesphorus cristatus, Herpsilochmus sellowi* and *Hylopezus ochroleucus*).

DISCUSSION

Three predictions were derived from the homogenisation hypothesis of Cerrado and Caatinga biota in the manner that was originally proposed by Vanzolini (1976). These predictions represent a guiding axis for the discussion of the results obtained from the study of bird distribution along a contact zone between these two biomes in south centre of Piauí, Brazil.

The first prediction is that bird communities present in the Caatinga and Cerrado will be composed of species broadly distributed, having no or little differentiation in composition among them. In turn, most species recorded for the study area (69,6%) were classified as having broad distribution. They occur in the three regions (Caatinga, Cerrado and Transition) without being limited by the edges among them. There is, on the other hand, a number of species (30,4%) that is somehow limited by one or more edges in the study area. These are the species more sensitive to alterations in habitat structure and composition, which characterise Cerrado and Caatinga biota conferring a certain degree of fauna identity. The general proportion of broadly distributed species vs. limited distributed ones is only maintained when forest independent species are analysed separately, but not the forest semi dependent and dependent species. The semi dependent species tend to be more broadly distributed, while the forest dependent ones tend to present more limited distributions. As these differences can not be attributed to differences among regions and the number of species recorded in several bird families found in the study area, one can conclude that an important part of the heterogeneity of species in the Caatinga and Cerrado is due to the lack of capacity of forest dependent bird species (mainly from Cerrado, see Table 1) to cross over the edges of both regions. The results indicate that there are differences in bird composition of Cerrado and Caatinga in the study area, with a set of species, which possesses distribution limited by the edge of these biomes. Thus, the first prediction of the homogenisation hypothesis cannot be supported.

The second prediction of the homogenisation hypothesis is that Caatinga fauna would only be a subset of Cerrado's fauna. According to the definition of Abe and Papavero (1991), a sub conjunct X can only be considered a sub conjunct of the conjunct Y just in case X in contained in Y ($X \subset Y$) and Y has at least one element that is not present in X (namely, $Y \neq X$). In biogeographic terms, this is the same to say that the species of X should be present in Y, but Y should necessarily possess one or more species that are not present in X. This is not the case of Caatinga and Cerrado bird community both at a continental and regional scale. At a continental scale, both Caatinga and Cerrado possess endemic bird species what provides a basis to reject the hypothesis that Caatinga bird community is not a sub set of Cerrado. At a regional scale, these endemic species do not mix themselves as predicted by the homogenisation hypothesis. So that, each biome possesses a unique set of species. The prediction that the Caatinga fauna is a sub set of Cerrado fauna is not valid neither to lizards nor to mammals. To lizards, Rodrigues (1988) clearly demonstrated that Caatinga possesses several endemic species of *Tropiduridae.* Rodrigues (1991a, b, c) observed that various new species of lizards endemic to the region belong to several genera. Current data presented by Vanzolini (1988: 333) are important to refute this prediction because of the 20 species listed as occurring in Cerrado and Caatinga, only 8 (40%) occur in both biomes (*Briba brasiliana, Phyllopezus pollicaris, Iguana iguana, Tapinurus semitaeniatus, Mabuya heathi, Ameiva ameiva, Cnemidophorus ocellifer, Micrablepharus maximiliani*). A total of 7 (35%) species only occurs in Cerrado (*Gymnodactylus geckoides, Lygodactylus wetzeli, Anolis meridionalis, Hoplocercus spinosus, Mabuya frenata, Gymnophthalmus rubricauda, Kentropyx paulensis*), and 5 (25%) are listed only for Caatinga (*Hemidactylus agrius, Lygodactylus klugei, Phyllopezus periosus, Polychrus acutirostris, Gymnophthalmus multiscutatus*). Concerning the mammals, Fonseca *et al.* (2000) indicate that the similarity (using Simpson index) between Caatinga and Cerrado mammalian fauna is of 55%. This value means that not all species of mammals present in Caatinga are present in Cerrado (Examples: *Centronycteris maximiliani, Artibeus concolor, Lichonycteris mordax, Mimon crenulatum* and *Dasyprocta prymnolopha*) (Fonseca *et al.* 1996). Therefore, Caatinga's mammalian fauna cannot be regarded as a subset of Cerrado's.

The third prediction of the homogenisation hypothesis concerns the species with distribution centre in the Cerrado and Caatinga would be encountered in the same habitat in the transition zone between the two biomes. Many bird species were recorded for Cerrado-transition or Caatinga-transition. This indicates that the transition between Caatinga and Cerrado is not only dominated by versatile species which are able to live in the two environments; on the contrary, several endemic bird species from both biomes were also recorded for the transition. In the transition areas, characteristic species from one or another biome were not found in the same habitat. These species segregate spatially and occupy distinct ecological compartments in the area. Normally, the typical elements of Cerrado are, in the transition, isolated on the top of residual chapadas covered by Cerrado sensu stricto. This fact accounts for that most species, which occurs in Cerrado and transition, is composed of forest independent species instead of dependent ones as in the pattern for the domain as a whole (Sick 1966, Silva 1995b) or for the Cerrado region in the study area (Table 1). In contrast to the species from Cerrado, the species from Caatinga mainly occupy the inter plateaus depressions covered by arboreal caatinga since many species from Caatinga that live in the transition are considered forest semi dependent species. In the landscape, where there is a mixing of the two environments (transition-SEM) as well as in the portions of Cerrado localised in the inter plateaus depressions of the transition, the recorded bird community is completely dominated by versatile and broadly distributed species without the characteristic elements of any biome. Purportedly, Caatinga species occupy more the transition than those from Cerrado. This can be a reflex of environmental availability for the two groups of species in this region, but also it can be due to the historical dynamics between these two biomes. In the current geomorphological process, the plateaus are being eroded and substituted by peripheral depressions. Thus, the Cerrado has yielded space for Caatinga in the transition area between both biomes (Cole 1986). The pattern observed for birds is what one can expect for the current stage of landscape development: the birds from Caatinga in expansion, following the aperture of the depression, and the birds from Cerrado being restricted to the residual plateaus that were maintained isolated on the depressions.

None of the three predictions based on the biotic homogenisation hypothesis of Caatinga and Cerrado, due to palaeoecological cycles of Quaternary, was supported bird geographic and ecological distribution in a contact area between both biomes in the south centre of Piauí. Regarding the differences in proportion of endemic species, the pattern found for bird community is very similar to that recorded for vascular plants than to that found for other vertebrate groups studied to date. Under a floristic viewpoint, the Cerrado and Caatinga are very different (Rizzini 1979, Andrade-Lima 1981), and characterised by a great number of endemic species (Heringer *et al.* 1977, Rizzini 1979, Ferri 1980, Andrade-Lima 1981, Fernandes and Bezerra 1990, Fernandes 1999). It is known that birds possess unique specialisations and apparently respond, differently from other vertebrate group, to the transformations in environment structure and composition (MacArthur 1964, MacArthur *et al.* 1966, Karr and Roth 1971, Wiens and Rotenberry 1981, Askins *et al.* 1987, Sick 1997). Wiens (1989) suggested that the landscapes in mosaics with abrupt transitions and with the presence of very different biotypes to short distances, let bird community of a restricted area be rich of specialist birds. These specialist species are adapted to diverse types of landscapes, although some generalist birds are capable of reaching several environments in relatively short flights. Moreover, it is known that every bird species is restricted, in a array of levels, to the colonisation of environments that they do not occupy their distribution centres. This gives rise to a greater segregation in the bird community distribution in complex landscape areas (Negret 1983, Haffer 1985, 1987, Wiens 1989).

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APPENDIX 1

List of the bird species recorded in transition area Cerrado-Caatinga in south-center Piaui, Brazil. Habitat use: 1) forest independent species; 2) forest semi-dependent species; 3) forest dependent species. Source: R) Reiser (1910); K) Kaempfer (AMNH); S) Santos (this paper).

Taxon	Habitat Use	Cerrado	Caatinga	Transition	Source
Rheidae Bonaparte, 1849					
Rhea americana (Linnaeus, 1758)	1	X	X	X	S
Tinamidae Gray, 1840					
Crypturellus undulatus (Temminck, 1815)	3	X			R
Crypturellus noctivagus (Wied, 1820)	3	X	X	X	R;S
Crypturellus parvirostris (Wagler, 1827)	1	X	X	X	S
Crypturellus tataupa (Temminck, 1815)	3	X	X	X	R;S
Rhynchotus rufescens (Temminck, 1815)	1	X	X	X	R;S
Nothura boraquira (Spix, 1825)	1		X		K;S
Cracidae Rafinesque, 1815					
Penelope superciliaris Temminck, 1815	3	X	X	X	R;K;S
Penelope jacucaca Spix, 1825	2		X	X	R;K;S
Threskiornithidae Poche, 1904					
Theristicus caudatus (Boddaert, 1783)	1	X	X	X	R;K;S
Cathartidae Lafresnaye, 1839					
Cathartes aura (Linnaeus, 1758)	1	X	X	X	S
Coragyps atratus (Bechstein, 1793)	1	X	X	X	S
Sarcoramphus papa (Linnaeus, 1758)	2	X	X	X	S
Accipitridae Vigors, 1824					
Leptodon cayanensis (Latham, 1790)	3	X	X	X	R
Elanoides forficatus (Linnaeus, 1758)	1	X	X	X	S
Gampsonyx swainsonii Vigors, 1825	1	X	X	X	R;S
Elanus leucurus (Vieillot, 1818)	1	X	X	X	S
Rostrhamus sociabilis (Vieillot, 1817)	1	X	X	X	R
Accipiter superciliosus (Linnaeus, 1766)	3	X			R
Accipiter bicolor (Vieillot, 1817)	3	X	X	X	R
Geranospiza caerulescens (Vieillot, 1817)	2	X	X	X	R
Buteogallus urubitinga (Gmelin, 1788)	2	X	X	X	R;S
Heterospizias meridionalis (Latham, 1790)	1	X	X	X	R;S
Busarellus nigricollis (Latham, 1790)	1	X	X	X	R
Rupornis magnirostris (Gmelin, 1788)	1	X	X	X	K;S
Buteo albicaudatus Vieillot, 1816	1	X	X	X	S
Buteo melanoleucus (Vieillot, 1819)	1	X	X	X	S
Buteo nitidus (Latham, 1790)	2	X	X	X	R
Falconidae Leach, 1820					
Ibycter americanus (Boddaert, 1783)	3	X			R
Caracara plancus (Miller, 1777)	1	X	X	X	R;S
Milvago chimachima (Vieillot, 1816)	1	X	X	X	R;K;S
Herpetotheres cachinnans (Linnaeus, 1758)	2	X	X	X	R;K;S
Micrastur ruficollis (Vieillot, 1817)	3	X	X	X	R;S
Micrastur gilvicollis (Vieillot, 1817)	3	X	X	X	S
Micrastur semitorquatus (Vieillot, 1817)	2	X	X	X	S
Falco sparverius Linnaeus, 1758	1	X	X	X	K;S
Falco rufigularis Daudin, 1800	3	X	X	X	R
Falco deiroleucus Temminck, 1825	2	X	X	X	R
Falco femoralis Temminck, 1822	1	X	X	X	R;S
Rallidae Rafinesque, 1815					
Aramides ypecaha (Vieillot, 1819)	2	X	X	X	R
Aramides cajanea (Statius Muller, 1776)	2	X	X	X	S
Laterallus melanophaius (Vieillot, 1819)	2	X	X	X	R
Cariamidae Bonaparte, 1850					
Cariama cristata (Linnaeus, 1766)	1	X	X	X	R;K;S

Taxon	Habitat Use	Cerrado	Caatinga	Transition	Source
Charadriidae Leach, 1820					
Vanellus chilensis (Molina, 1782)	1	X	X	X	R;K;S
Scolopacidae Rafinesque, 1815					
Gallinago paraguaiae (Vieillot, 1816)	1	X	X	X	R
Columbidae Leach, 1820					
Columbina minuta (Linnaeus, 1766)	1	X	X	X	S
Columbina talpacoti (Temminck, 1811)	1	X	X	X	S
Columbina squammata (Lesson, 1831)	1	X	X	X	K;S
Columbina picui (Temminck, 1813)	1	X	X	X	R;S
Claravis pretiosa (Ferrari-Perez, 1886)	2	X	X	X	S
Uropelia campestris (Spix, 1825)	1	X			R;K
Patagioenas picazuro (Temminck, 1813)	2	X	X	X	R;K;S
Zenaida auriculata (Des Murs, 1847)	1	X	X	X	R;K;S
Leptotila verreauxi Bonaparte, 1855	2	X	X	X	R;K;S
Leptotila rufaxilla (Richard and Bernard, 1792)	3	X	X	X	S
Psittacidae Rafinesque, 1815					
Anodorhynchus hyacinthinus (Latham, 1790)	2	X			R;K;S
Ara ararauna (Linnaeus, 1758)	2	X	X	X	R;S
Ara chloropterus Gray, 1859	3	X	X	X	R;S
Orthopsittaca manilata (Boddaert, 1783)	2	X			R
Primolius maracana (Vieillot, 1816)	2	X	X	X	R;K;S
Diopsittaca nobilis (Linnaeus, 1758)	3	X			R;K
Aratinga acuticaudata (Vieillot, 1818)	2	X	X	X	R;K;S
Aratinga leucophthalma (Statius Muller, 1776)	2	X	X	X	R
Aratinga jandaya (Gmelin, 1788)	2	X	X	X	R;K;S
Aratinga aurea (Gmelin, 1788)	1	X	X	X	R;K;S
Aratinga cactorum (Kuhl, 1820)	2	X	X	X	R;K;S
Forpus xanthopterygius (Spix, 1824)	1	X	X	X	K;S
Brotogeris chiriri (Vieillot, 1818)	2	X	X	X	K;S
Alipiopsitta xanthops (Spix, 1824)	1	X			R;K;S
Pionus maximiliani (Kuhl, 1820)	2	X			R;K
Amazona aestiva (Linnaeus, 1758)	3	X	X	X	R;K;S
Amazona amazonica (Linnaeus, 1766)	3	X			R;S
Cuculidae Leach, 1820					
Piaya cayana (Linnaeus, 1766)	2	X	X	X	R;K;S
Coccyzus melacoryphus Vieillot, 1817	2	X	X	X	R
Crotophaga major Gmelin, 1788	2	X	X	X	R;S
Crotophaga ani Linnaeus, 1758	1	X	X	X	K;S
Guira guira (Gmelin, 1788)	1	X	X	X	R;S
Tapera naevia (Linnaeus, 1766)	1	X	X	X	R;K;S
Dromococcyx phasianellus (Spix, 1824)	3	X	X	X	R
Strigidae Leach, 1820					
Megascops choliba (Vieillot, 1817)	2	X	X	X	S
Strix huhula Daudin, 1800	3	X			R
Glaucidium brasilianum (Gmelin, 1788)	2	X	X	X	R
Athene cunicularia (Molina, 1782)	1	X	X	X	R;K;S
Nyctibiidae Chenu and Des Murs, 1851					
Nyctibius griseus (Gmelin, 1789)	2	X			K
Caprimulgidae Vigors, 1825					
Podager nacunda (Vieillot, 1817)	1	X	X	X	K;S
Nyctidromus albicollis (Gmelin, 1789)	2	X	X	X	R;K;S
Caprimulgus parvulus Gould, 1837	1	X	X	X	R
Caprimulgus hirundinaceus Spix, 1825	1		X		R;S
Hydropsalis torquata (Gmelin, 1789)	1	X	X	X	K;S
Apodidae Olphe-Galliard, 1887					
Streptoprocne biscutata (Sclater, 1866)	1	X	X	X	R
Chaetura meridionalis Hellmayr, 1907	2	X			R

Taxon	Habitat Use	Cerrado	Caatinga	Transition	Source
Tachornis squamata (Cassin, 1853)	1	X	X	X	R;K;S
Trochilidae Vigors, 1825					
Anopetia gounellei (Boucard, 1891)	1		X		R;S
Phaethornis pretrei (Lesson and Delattre, 1839)	2	X	X	X	R;K;S
Eupetomena macroura (Gmelin, 1788)	3	X		X	S
Aphantochroa cirrochloris (Vieillot, 1818)	1	X	X	X	K;S
Colibri serrirostris (Vieillot, 1816)	2	X	X	X	S
Chrysolampis mosquitus (Linnaeus, 1758)	1	X	X	X	R;K;S
Chlorostilbon lucidus (Shaw, 1812)	2	X	X	X	R;K;S
Thalurania furcata (Gmelin, 1788)	2	X			R;K
Amazilia versicolor (Vieillot, 1818)	3	X			R
Amazilia fimbriata (Gmelin, 1788)	2	X	X	X	R;K
Heliothryx auritus (Gmelin, 1788)	1	X		X	R;S
Calliphlox amethystina (Boddaert, 1783)	2	X	X	X	R;K
Trogonidae Lesson, 1828					
Trogon viridis Linnaeus, 1766	3	X			K
Trogon curucui Linnaeus, 1766	3	X	X	X	R;K;S
Momotidae Gray, 1840					
Momotus momota (Linnaeus, 1766)	3	X			R
Galbulidae Vigors, 1825					
Galbula ruficauda Cuvier, 1816	2	X	X	X	K;S
Bucconidae Horsfield, 1821					
Nystalus chacuru (Vieillot, 1816)	1	X			R
Nystalus maculatus (Gmelin, 1788)	2	X	X	X	K;S
Nonnula rubecula (Spix, 1824)	3	X			K;S
Chelidoptera tenebrosa (Pallas, 1782)	2	X			R;K
Ramphastidae Vigors, 1825					
Ramphastos toco Statius Muller, 1776	2	X			R;K;S
Ramphastos vitellinus Lichtenstein, 1823	3	X			R
Picidae Leach, 1820					
Picumnus pygmaeus (Lichtenstein, 1823)	2		X	X	R;K;S
Melanerpes candidus (Otto, 1796)	2	X	X	X	R;S
Veniliornis passerinus (Linnaeus, 1766)	2	X	X	X	R;K;S
Piculus chrysochloros (Vieillot, 1818)	3	X	X	X	R;K;S
Colaptes melanochloros (Gmelin, 1788)	2	X	X	X	K;S
Colaptes campestris (Vieillot, 1818)	1	X	X	X	K;S
Celeus flavescens (Gmelin, 1788)	3	X	X	X	R;K
Dryocopus lineatus (Linnaeus, 1766)	2	X	X	X	S
Campephilus melanoleucos (Gmelin, 1788)	3	X	X	X	K;S
Melanopareiidae Irestedt, Fjeldså, Johansson and Ericson, 2002					
Melanopareia torquata (Wied, 1831)	1	X		X	R;S
Thamnophilidae Swainson, 1824					
Taraba major (Vieillot, 1816)	2	X	X	X	R;K;S
Sakesphorus cristatus (Wied, 1831)	1		X		S
Thamnophilus capistratus Lesson, 1840	2	X	X	X	R;K;S
Thamnophilus torquatus Swainson, 1825	1	X	X	X	R
Thamnophilus pelzelni Hellmayr, 1924	3	X	X	X	R;K;S
Myrmorchilus strigilatus (Wied, 1831)	2		X	X	R;K;S
Herpsilochmus sellowi Whitney and Pacheco, 2000	1		X		R;S
Herpsilochmus atricapillus Pelzeln, 1868	3	X	X	X	R;S
Herpsilochmus longirostris Pelzeln, 1868	3	X			R
Formicivora grisea (Boddaert, 1783)	2	X	X	X	R;K;S
Formicivora melanogaster Pelzeln, 1868	2	X	X	X	R
Formicivora rufa (Wied, 1831)	1	X		X	R;K;S
Grallariidae Sclater and Salvin, 1873					
Hylopezus ochroleucus (Wied, 1831)	1		X		S
Dendrocolaptidae Gray, 1840					

Taxon	Habitat Use	Cerrado	Caatinga	Transition	Source
Sittasomus griseicapillus (Vieillot, 1818)	3	X	X	X	R;K;S
Xiphocolaptes falcirostris (Spix, 1824)	3		X		R;K
Dendrocolaptes platyrostris Spix, 1825	3	X	X	X	R;K;S
Dendroplex picus (Gmelin, 1788)	2	X	X	X	R;K;S
Lepidocolaptes angustirostris (Vieillot, 1818)	1	X	X	X	R;K;S
Lepidocolaptes wagleri (Spix, 1824)	3	X			R
Campylorhamphus trochilirostris (Lichtenstein, 1820)	3	X	X	X	R;K;S
Furnariidae Gray, 1840					
Furnarius figulus (Lichtenstein, 1823)	1	X	X	X	K;S
Furnarius leucopus Swainson, 1838	2	X	X	X	R;K
Synallaxis frontalis Pelzeln, 1859	3	X	X	X	K;S
Synallaxis albescens Temminck, 1823	1	X	X	X	R;K;S
Synallaxis scutata Sclater, 1859	2	X	X	X	R;S
Gyalophylax hellmayri (Reiser, 1905)	1		X		S
Cranioleuca vulpina (Pelzeln, 1856)	1		X		R;K;S
Certhiaxis cinnamomeus (Gmelin, 1788)	1	X	X	X	R;S
Phacellodomus rufifrons (Wied, 1821)	2	X	X	X	R;K;S
Pseudoseisura cristata (Spix, 1824)	2	X	X	X	S
Berlepschia rikeri (Ridgway, 1886)	3	X			S
Xenops rutilans Temminck, 1821	3	X	X	X	R;K;S
Megaxenops parnaguae Reiser, 1905	3		X		R;K;S
Tyrannidae Vigors, 1825					
Leptopogon amaurocephalus Tschudi, 1846	3	X	X	X	S
Hemitriccus striaticollis (Lafresnaye, 1853)	2	X			R;S
Hemitriccus margaritaceiventer (d'Orbigny and Lafresnaye, 1837)	2	X	X	X	R;K;S
Todirostrum cinereum (Linnaeus, 1766)	2	X	X	X	K;S
Phyllomyias reiseri Hellmayr, 1905	3	X			R;K;S
Phyllomyias fasciatus (Thunberg, 1822)	2	X	X	X	R;S
Myiopagis caniceps (Swainson, 1835)	3	X			S
Myiopagis viridicata (Vieillot, 1817)	3	X	X	X	R;S
Elaenia flavogaster (Thunberg, 1822)	2	X	X	X	R;K;S
Elaenia cristata Pelzeln, 1868	1	X		X	R;S
Camptostoma obsoletum (Temminck, 1824)	1	X	X	X	R;K;S
Suiriri suiriri (Vieillot, 1818)	1	X	X	X	R;K
Serpophaga subcristata (Vieillot, 1817)	2	X	X	X	R
Phaeomyias murina (Spix, 1825)	1	X	X	X	R;S
Euscarthmus meloryphus Wied, 1831	2	X	X	X	K;S
Euscarthmus rufomarginatus (Pelzeln, 1868)	1	X		X	S
Stigmatura budytoides (d'Orbigny and Lafresnaye, 1837)	1		X		R
Sublegatus modestus (Wied, 1831)	2	X	X	X	R;K
Tolmomyias sulphurescens (Spix, 1825)	3	X			R;K;S
Tolmomyias flaviventris (Wied, 1831)	3	X	X	X	R;K;S
Platyrinchus mystaceus Vieillot, 1818	3	X			S
Myiophobus fasciatus (Statius Muller, 1776)	1	X	X	X	R;S
Myiobius barbatus (Gmelin, 1789)	3	X	X	X	R;S
Hirundinea ferruginea (Gmelin, 1788)	2	X	X	X	R;K;S
Lathrotriccus euleri (Cabanis, 1868)	3	X			K
Cnemotriccus fuscatus (Wied, 1831)	3	X	X	X	R;K;S
Contopus cinereus (Spix, 1825)	3	X		X	K;S
Pyrocephalus rubinus (Boddaert, 1783)	1	X		X	R;K;S
Satrapa icterophrys (Vieillot, 1818)	1	X	X	X	K;S
Xolmis cinereus (Vieillot, 1816)	1	X		X	R;K;S
Xolmis velatus (Lichtenstein, 1823)	1	X			R;K
Xolmis irupero (Vieillot, 1823)	1		X		S
Fluvicola pica (Boddaert, 1783)	1	X			K
Fluvicola nengeta (Linnaeus, 1766)	1		X	X	R;K;S
Colonia colonus (Vieillot, 1818)	3	X			S

Taxon	Habitat Use	Cerrado	Caatinga	Transition	Source
Machetornis rixosa (Vieillot, 1819)	1	X	X	X	R;K;S
Myiozetetes similis (Spix, 1825)	2	X	X	X	R;K;S
Pitangus sulphuratus (Linnaeus, 1766)	1	X	X	X	K;S
Philohydor lictor (Lichtenstein, 1823)	3	X	X	X	S
Myiodynastes maculatus (Statius Muller, 1776)	3	X	X	X	R;K;S
Megarynchus pitangua (Linnaeus, 1766)	2	X	X	X	R;K;S
Empidonomus varius (Vieillot, 1818)	2	X	X	X	S
Tyrannus melancholicus Vieillot, 1819	1	X	X	X	R;K;S
Tyrannus savana Vieillot, 1808	1	X	X	X	S
Sirystes sibilator (Vieillot, 1818)	3	X			K
Casiornis fuscus Sclater and Salvin, 1873	3	X	X	X	R;K;S
Myiarchus swainsoni Cabanis and Heine, 1859	1	X	X	X	S
Myiarchus ferox (Gmelin, 1789)	2	X	X	X	K;S
Myiarchus tyrannulus (Statius Muller, 1776)	2	X	X	X	R;K;S
Pipridae Rafinesque, 1815					
Neopelma pallescens (Lafresnaye, 1853)	3	X		X	S
Antilophia galeata (Lichtenstein, 1823)	3	X			R;S
Tityridae Gray, 1840					
Tityra inquisitor (Lichtenstein, 1823)	3	X	X	X	R;S
Tityra cayana (Linnaeus, 1766)	3	X			R;K;S
Pachyramphus viridis (Vieillot, 1816)	2	X	X	X	K;S
Pachyramphus polychopterus (Vieillot, 1818)	2	X	X	X	R;S
Pachyramphus validus (Lichtenstein, 1823)	3	X	X	X	R;S
Xenopsaris albinucha (Burmeister, 1869)	1		X		S
Vireonidae Swainson, 1837					
Cyclarhis gujanensis (Gmelin, 1789)	2	X	X	X	K;S
Vireo olivaceus (Linnaeus, 1766)	3	X	X	X	S
Hylophilus amaurocephalus (Nordmann, 1835)	3	X		X	S
Corvidae Leach, 1820					
Cyanocorax cristatellus (Temminck, 1823)	1	X		X	R;K;S
Cyanocorax cyanopogon (Wied, 1821)	2	X	X	X	S
Hirundinidae Rafinesque, 1815					
Pygochelidon cyanoleuca (Vieillot, 1817)	1	X			R
Stelgidopteryx ruficollis (Vieillot, 1817)	1	X	X	X	R;K;S
Progne chalybea (Gmelin, 1789)	1	X	X	X	R
Tachycineta albiventer (Boddaert, 1783)	1	X			R
Troglodytidae Swainson, 1831					
Troglodytes musculus Naumann, 1823	1	X	X	X	K;S
Cantorchilus leucotis (Lafresnaye, 1845)	3	X			R;K;S
Cantorchilus longirostris (Vieillot, 1819)	2		X	X	R;S
Donacobiidae Aleixo and Pacheco, 2006					
Donacobius atricapilla (Linnaeus, 1766)	1	X	X	X	K;S
Polioptilidae Baird, 1858					
Polioptila plumbea (Gmelin, 1788)	2		X	X	R;K;S
Turdidae Rafinesque, 1815					
Turdus rufiventris Vieillot, 1818	1	X	X	X	S
Turdus leucomelas Vieillot, 1818	2	X	X	X	R;K;S
Turdus amaurochalinus Cabanis, 1850	2	X	X	X	R;S
Mimidae Bonaparte, 1853					
Mimus saturninus (Lichtenstein, 1823)	1	X	X	X	R;K;S
Coerebidae d'Orbigny and Lafresnaye, 1838					
Coereba flaveola (Linnaeus, 1758)	2	X	X	X	R;K;S
Thraupidae Cabanis, 1847					
Schistochlamys ruficapillus (Vieillot, 1817)	1	X		X	R;S
Neothraupis fasciata (Lichtenstein, 1823)	1	X		X	R;S
Compsothraupis loricata (Lichtenstein, 1819)	2	X	X	X	R;K;S
Nemosia pileata (Boddaert, 1783)	3	X	X	X	R;K;S

Taxon	Habitat Use	Cerrado	Caatinga	Transition	Source
Thlypopsis sordida (d'Orbigny and Lafresnaye, 1837)	2	X	X	X	K;S
Cypsnagra hirundinacea (Lesson, 1831)	1	X		X	R;S
Piranga flava (Vieillot, 1822)	1	X	X	X	R;K;S
Tachyphonus rufus (Boddaert, 1783)	3	X	X	X	R;S
Ramphocelus carbo (Pallas, 1764)	2	X		X	R;K;S
Thraupis sayaca (Linnaeus, 1766)	2	X	X	X	R;K;S
Thraupis palmarum (Wied, 1823)	2	X	X	X	R;K;S
Tangara cayana (Linnaeus, 1766)	1	X	X	X	K;S
Dacnis cayana (Linnaeus, 1766)	2	X	X	X	R;K;S
Hemithraupis guira (Linnaeus, 1766)	3	X	X	X	R;K;S
Conirostrum speciosum (Temminck, 1824)	3	X	X	X	R;K;S
Emberizidae Vigors, 1825					
Zonotrichia capensis (Statius Muller, 1776)	1	X	X	X	R;K;S
Ammodramus humeralis (Bosc, 1792)	1	X	X	X	R;S
Porphyrospiza caerulescens (Wied, 1830)	1	X		X	R;K;S
Sicalis citrina Pelzeln, 1870	1	X			R
Sicalis columbiana Cabanis, 1851	1	X	X	X	K;S
Sicalis flaveola (Linnaeus, 1766)	1	X	X	X	R;K;S
Emberizoides herbicola (Vieillot, 1817)	1	X	X	X	S
Volatinia jacarina (Linnaeus, 1766)	1	X	X	X	R;S
Sporophila plumbea (Wied, 1830)	1	X			S
Sporophila lineola (Linnaeus, 1758)	1	X	X	X	R;S
Sporophila nigricollis (Vieillot, 1823)	1	X	X	X	S
Sporophila albogularis (Spix, 1825)	1	X	X	X	S
Sporophila leucoptera (Vieillot, 1817)	1	X	X	X	R;S
Sporophila bouvreuil (Statius Muller, 1776)	1	X	X	X	S
Sporophila angolensis (Linnaeus, 1766)	1	X	X	X	R;K;S
Arremon taciturnus (Hermann, 1783)	3	X			R;K;S
Charitospiza eucosma Oberholser, 1905	1	X		X	R;K;S
Coryphospingus pileatus (Wied, 1821)	2	X	X	X	K;S
Paroaria dominicana (Linnaeus, 1758)	1		X	X	K;S
Cardinalidae Ridgway, 1901					
Saltator maximus (Statius Muller, 1776)	3	X			K
Saltator coerulescens Vieillot, 1817	2	X	X	X	R;K;S
Saltator similis d'Orbigny and Lafresnaye, 1837	2	X	X	X	K;S
Saltator atricollis Vieillot, 1817	1	X		X	R;K;S
Cyanoloxia brissonii (Lichtenstein, 1823)	3	X	X	X	S
Parulidae Wetmore, Friedmann, Lincoln, Miller, Peters, van Rossem, Van Tyne and Zimmer 1947					
Parula pitiayumi (Vieillot, 1817)	3	X	X	X	R;S
Basileuterus culicivorus (Deppe, 1830)	3	X		X	R;S
Basileuterus flaveolus (Baird, 1865)	3	X	X	X	R;K;S
Icteridae Vigors, 1825					
Psarocolius decumanus (Pallas, 1769)	3	X		X	S
Procacicus solitarius (Vieillot, 1816)	2	X			S
Cacicus cela (Linnaeus, 1758)	3	X			S
Icterus cayanensis (Linnaeus, 1766)	2	X	X	X	R;K;S
Icterus jamacaii (Gmelin, 1788)	2	X	X	X	R;K;S
Gnorimopsar chopi (Vieillot, 1819)	1	X	X	X	S
Chrysomus ruficapillus (Vieillot, 1819)	1	X	X	X	S
Molothrus bonariensis (Gmelin, 1789)	1	X	X	X	S
Fringillidae Leach, 1820					
Carduelis magellanica (Vieillot, 1805)	1	X	X	X	R;K;S
Euphonia chlorotica (Linnaeus, 1766)	2	X	X	X	R;K;S