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Mesoscale bird distribution pattern in montane phytophysiognomies along an ecotone between two hotspots

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ABSTRACT. Brazil has a high diversity of birds and presents the largest number of threatened bird species in the neotropical region. Even so, there are gaps in the bird knowledge, especially in ecotonal montane regions. Given this panorama, this study aimed to analyse the bird community distribution (richness, composition, and beta diversity between phytophysiognomies) of an ecotonal montane landscape of southeastern Brazil, with the purpose of detecting substitution patterns of bird species on a meso-scale. Using bird data performed during the years 1998 to 2015 in 46 sampling points, we found high bird richness in montane phytophysiognomies along an ecotone between Cerrado and Atlantic Forest hotspots. The composition present species of both domains, with high turnover component. We highlight the field environments and candeais are considered homogeneous and threathened, which would directly affect birds. The present study contributes to future conservation strategies, as it demonstrates ecotonal regions as transition zones and reinforces the need to consider as particular ecological units. These ecotonal regions are key locations for understanding ecological patterns in response to environmental changes or phytophysiognomies. Knowing how partitioning of the composition occurs within an environmental mosaic is essential to understand the limits and distributions of the species and conserve them.

Keywords: biodiversity; beta diversity; composition; conservation.

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Introduction

Brazil has the greatest diversity of birds in the world (Marini & Garcia, 2005; Piacentini et al., 2015; Morelli, Benedetti, Hanson, & Fuller, 2021) with approximately 57% of the species recorded throughout South America (Marini & Garcia, 2005), and 10% of this total are endemic species. This suggests that the Brazilian territory y is a priority for conservation investments (Sick, 1997). In addition, Brazil is the country with the largest number of threatened bird species in the neotropical region (Collar et al., 1992; Piacentini et al., 2015).

The bird community distribution is heterogeneous among biomes (Morelli et al., 2021). Therefore, knowledge about its distribution among Brazilian vegetation physiognomies (Sick, 1997; Gonzaga, Carvalhaes, & Buzzetti, 2007; Vasconcelos, 2008b) and in ecotonal regions is incipient. Ecotonal regions usually have their own characteristics and high ecological complexity resulting from a mixture of adjacent formations. There is ecological tension in biotas which produce high biodiversity because they enable species substitution at different scales (i.e., small mammals in Machado, Gregorin, & Mouallen, 2013; and plants in Machado, Fontes, Santos, Garcia & Farrapo, 2016).

The mountain landscapes of southeastern Brazil are within this ecologically tense context and present highly endemic areas in tropical regions for both flora and fauna (Eiten, 1992; Giulietti, Pirani, & Harley, 1997; Sick, 1997; Stattersfield, Crosby, Long, Wege, & BirdLife International, 1998; Safford, 1999; Silva & Bates, 2002; Gonçalves, Myers, Vilela, & Oliveira, 2007; Thom et al., 2020; Moura, Machado, Mariano, Leite, & Fontes, 2021). To birds in mountains, there are exclusive species directly associated with the vegetation, presenting half of the local species pool. Similar results have been found in research on various mountain ranges such as the Peruvian Andes (Lloyd & Maridem, 2008).

The ecotonal region between the Atlantic Forest-Cerrado of Minas Gerais State stands out for the high occurrence of areas covered by montane fields which are considered the most threatened environments (Stotz, Fitzpatrick, Parker, & Moskovits, 1996; Vasconcelos & Rodrigues, 2010; Moura et al., 2021). And this bird diversity linked to high altitude areas are among the most endangered species (Machado, Fonseca, Machado, Aguiar, & Lins, 1998; Lopes et al., 2009; BirdLife International, 2011). The region's landscape also has areas with other montane phytophysiognomies in addition to the phytophysiognomies of the Cerrado domain, such as Semi-deciduous forests, Cloud Forests and the Candeais. Limited knowledge about the floristic composition and biogeography of the Cloud Forest (Bertoncello, Yamamoto, Meireles, & Sheperd, 2011; Pompeu et al., 2018) and Candeais makes it difficult to implement an effective management plan which focuses on its conservation (Scolforo, Oliveira, Davide, & Camolesi, 2002), and consequently the fauna which use it which is considered threatened (Moura et al., 2021).

The bird distribution on mountain landscapes associated to ecotonal regions are not yet fully resolved and described. For instance, there is little understanding of separated situations [only mountain (Santillán et al., 2020; Thom et al., 2020) or only ecotonal (Gonçalves, Santos, Cerqueira, Juen, & Bispo, 2017; Sementili-Cardoso, Vianna, Gerotti, & Donatelli, 2019)]. Given this panorama, this study aimed to present and analyse the bird richness, composition (by beta diversity), and structure between phytophysiognomies of an ecotonal montane landscape of southeastern Brazil in South America on a meso-scale and in a wide sampling over a decade of ornithological observations and records. Here we hypothesize that the richness is high due to the high number of phytophysiognomies, heterogeneity and complexity of these environments. The structure will have high amplitude. And composition (beta diversity) will have a high component of species substitution due to the specificity of bird diversity with each phytophysiognomy.

Material and methods

Study area

The study area is situated in Carrancas city, South Minas Gerais State, Southeastern Brazil (21° 29' 29.45" S/44° 38' 42.47" W – 1097 m). The landscape corresponds to an ecotonal region between two hotspots, namely the Cerrado and Atlantic Forest (Myers, Mittermeier, Mittermeier, Fonseca, & Kent, 2000), and is composed by montane fields, Cerrado Stricto sensu, riparian forests, montane semi-deciduous forests, cloud forests, anthropic areas (pastures, agricultural areas, *Eucalyptus* forests, hydroelectric dam lake), and Candeais (forests dominated by *Eremanthus erythropappus* (DC.) Macleish). In addition, montane field areas are predominant in the landscape. The climate is mostly CWA type according to the Köppen classification; however it evolves into the CWB type for mountain tops in the areas with the highest elevation (Alvares, Stape, Sentelhas, Gonçalves, & Sparovek, 2013).

We highlight that the high lands of the study area are considered a 'Hotspot' (Drummond, Martins, Greco, & Vieira, 2009), regionally called '*Chapada das Perdizes*', where the landscape is composed of montane phytophysiognomies (Cloud forests, Candeais, upper-montane semi-deciduous forests, and montane fields), with elevations ranging from 1000 to 1600 m. This region also houses the largest remnant of continuous forest in the south of Minas Gerais State, known as '*Mata Triste*' (Oliveira-Filho, Carvalho, Fontes, Van Den Berg, & Carvalho, 2004). In addition, it also contains some of the Capivari River headwaters, a tributary of the Grande River. In turn, the Grande River joins the Paranaíba River, forming the Paraná River, which is the main lotic system of the second largest basin in South America (Pereira, Oliveira-Filho, & Lemos Filho, 2006). The region is strategic for conservation purposes, as it connects two large mountain ranges from two different biodiversity hotspots: the Espinhaço Complex (Cerrado) and the Mantiqueira Montain Range (Atlantic Forest).

Observations and data collections were performed during the years 1998 to 2015 in 46 sampling points which represent all the phytophysiognomies of the study area (Figure 1, Table 1). Each year a sampling was carried out in the hot and humid season, and another in the cold and dry season to reach resident and migratory birds. The semi-deciduous forest has high altitudinal variation, but we decided to separate the '*Mata Triste*' and 'Semi-deciduous Forest' samples for this article to achieve proximity to the bird sampling points. The nomenclature used to identify bird species followed Piacentini et al. (2015).

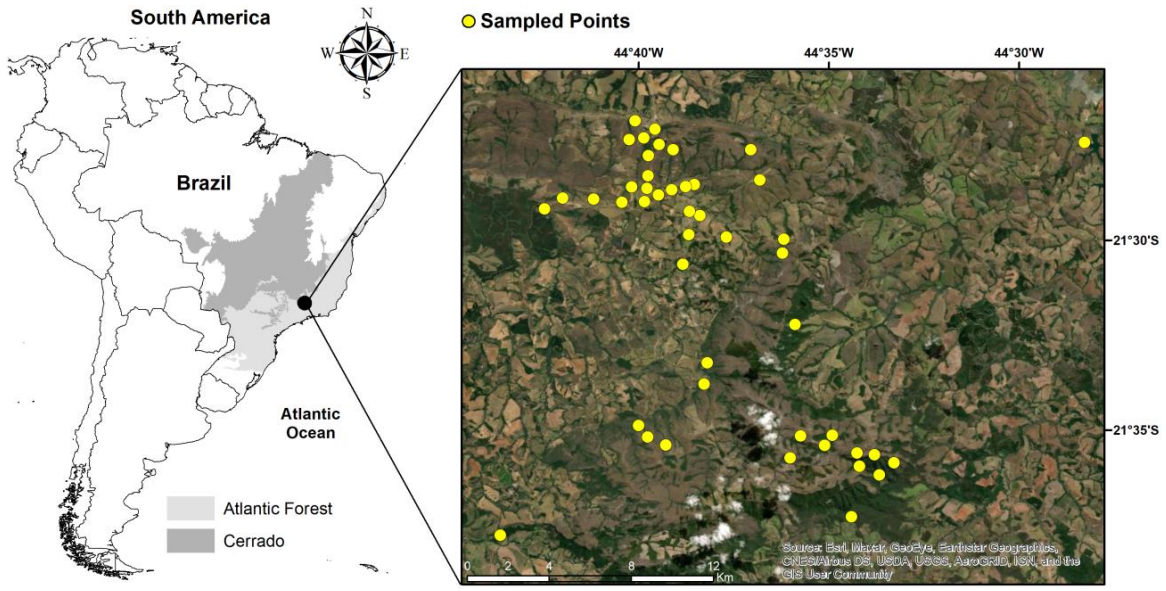

Figure 1. In yellow are the sampling collection points, Carrancas city, South of Minas Gerais State, Brazil.

Table 1. Sampling collection points, Carrancas city, South of Minas Gerais State, Brazil.

N°	Phytophysiognomy	Local name	Coordinates	Altitude	Years
01	Artificial lake	*Fazenda da Toca*	21°28'38.47"S 44°39'50.27"W	1033 m	2006, 2009, 2015
02	Artificial lake	*Lourenço Leme*	21°28'55.35"S 44°41'11.01"W	968 m	1998, 2000, 2007, 2014
03	Artificial lake	*Fazenda Cachoeira*	21°29'55.19"S 44°37'41.46"W	1057 m	1998, 2001
04	Artificial lake	*Camargos*	21°27'26.15"S 44°28'16.90"W	915 m	1998, 2001, 2008, 2014
05	Artificial lake	*Pousada Roda Viva*	21°29'21.27"S 44°38'23.65"W	1053 m	2000, 2002, 2009, 2015
06	Semidecidual forest	*Sítio Maria Moura*	21°27'29.05"S 44°39'27.84"W	1228 m	2000, 2003, 2008, 2010, 2015
07	Semidecidual forest	*Fazenda da Toca*	21°28'48.97"S 44°39'29.07"W	1056 m	2006, 2009, 2010, 2013, 2015
08	Semidecidual forest	*Pousada Mahayana*	21°27'04.87"S 44°39'34.55"W	1201 m	2001, 2003, 2005, 2006, 2009, 2014
09	Semidecidual forest	*Cach. Carniceiro*	21°32'13.45"S 44°35'53.55"W	1096 m	1999, 2003, 2009
10	Semidecidual forest	*Jequitibá Gigante*	21°37'45.40"S 44°43'38.38"W	1049 m	1999, 2001, 2007, 2013
11	Semidecidual forest	*Monte Teta*	21°27'18.77"S 44°39'51.70"W	1203m	1998, 1999, 2001, 2011
12	Cerrado Stricto sensu	*Estrada Fumaça*	21°29'00.14"S 44°40'26.74"W	1078 m	1998, 1999, 2005, 2013
13	Cerrado Stricto sensu	*Fazenda da Toca*	21°28'24.37"S 44°39'48.64"W	1063 m	2001, 2008, 2013
14	Cerrado Stricto sensu	*Serra da Covanca*	21°27'37.67"S 44°37'03.36"W	1266 m	2003, 2011, 2014
15	Cerrado Stricto sensu	*Cach. Esmeralda*	21°28'53.84"S 44°41'59.92"W	968 m	1999, 2001, 2010
16	Cerrado Stricto sensu	*Poço do Turco*	21°29'58.53"S 44°36'10.92"W	1161 m	2001, 2007, 2011
17	Montane field	*Gruta da Cortina*	21°30'20.88"S 44°36'13.13"W	1155 m	2001, 2007, 2010, 2014
18	Montane field	*Chapada Perdizes*	21°35'40.08"S 44°34'06.46"W	1546 m	2000, 2006, 2009, 2011, 2015
19	Montane field	*Grão Mogol*	21°35'03.10"S 44°39'58.83"W	1238 m	1998, 2001, 2003, 2013
20	Montane field	*Poço da Canoa*	21°28'32.28"S 44°38'32.08"W	1064 m	1998, 1999, 2000, 2013

N°	Phytophysiognomy	Local name	Coordinates	Altitude	Years
21	Montane field	*Serra do Moleque*	21°35'23.56"S 44°39'17.55"W	1380 m	2000, 2003, 2013
22	Mata Triste	*Mata Triste*	21°35'38.98"S 44°33'48.24"W	1500 m	2003, 2006, 2008, 2014
23	Mata Triste	*Mata Triste*	21°35'46.80"S 44°33'44.06"W	1399 m	2003, 2006, 2008
24	Mata Triste	*Mata Triste*	21°35'51.12"S 44°33'17.31"W	1228 m	2003, 2006, 2008
25	Mata Triste	*Mata Triste*	21°37'16.38"S 44°34'24.61"W	1047 m	2003, 2006, 2008
26	Riparian forest	*Cach. Zilda*	21°30'38.34"S 44°38'50.45"W	983 m	1998, 2000, 2005, 2015
27	Riparian forest	*Estrada Estação*	21°29'10.69"S 44°42'28.57"W	943 m	1998, 1999, 2001, 2007, 2014
28	Riparian forest	*Bar da Zilda*	21°33'13.61"S 44°38'12.17"W	1043 m	2000, 2005, 2008, 2014
29	Riparian forest	*Coração/ Rio Carrancas*	21°28'37.22"S 44°40'03.52"W	1034m	1998, 1999, 2000, 2014, 2015
30	Riparian forest	*Rio Carrancas*	21°28'40.88"S 44°39'07.96"W	1037 m	1998, 2000, 2012, 2014
31	Montane field	*Serra de Carrancas*	21°26'52.00"S 44°40'05.47"W	1265 m	1999, 2001, 2007, 2013
32	Montane field	*Pico Monte Teta*	21°27'24.90"S 44°39'57.95"W	1234 m	1999, 2006, 2009, 2015
33	Montane field	*Serra das Broas*	21°35'43.80"S 44°36'01.41"W	1445 m	2006, 2008, 2014, 2015
34	Montane field	*Aeroporto*	21°28'25.24"S 44°36'48.92"W	1249 m	2006, 2013, 2015
35	Cloud forest	*Chapada Perdizes*	21°35'35.91"S 44°35'02.28"W	1503 m	2000, 2006, 2008, 2014
36	Cloud forest	*Chapada Perdizes*	21°35'36.24"S 44°34'15.47"W	1536 m	2000, 2006, 2008, 2014
37	Cloud forest	*Broas*	21°35'09.18"S 44°35'44.60"W	1415 m	2000, 2006, 2008, 2014
38	Candeal	*Broas*	21°35'23.75"S 44°35'06.69"W	1473 m	2000, 2006, 2008, 2014
39	Candeal	*Cach. Grão Mogol*	21°34'52.63"S 44°40'.3026"W	1072 m	1998, 2000, 2008, 2013
40	Candeal	*Escorregador Zilda*	21°33'47.31"S 44°38'17.15"W	1063 m	1999, 2001, 2007, 2013
41	Candeal	*Sítio Maria Moura*	21°27'34.25"S 44°39'42.45"W	1161 m	2000, 2003, 2008, 2013, 2015
42	Antropic area	*Carrancas (BNH)*	21°29'14.46"S 44°38'40.17"W	1040 m	1998, 1999, 2009, 2013
43	Antropic area	*Fazenda Toca*	21°28'43.68"S 44°39'50.71"W	1046 m	2001, 2007, 2009
44	Antropic area	*Fazenda Osvaldo*	21°28'35.91"S 44°38'46.07"W	1052 m	2000, 2004, 2013
45	Antropic area	*Sítio Maria Moura*	21°27'35.01"S 44°39'32.66"W	1205 m	2000, 2003, 2008, 2013
46	Antropic area	*Estrada Zilda*	21°29'51.62"S 44°38'40.79"W	1094 m	1999, 2001, 2009, 2013

Data analysis

We initially quantified the richness and bird families of each phytophysiognomy for data analysis in order to assess the specificities of each one. We also evaluated the pattern in the phytophysiognomies, quantifying the species number occurring in one or more phytophysiognomies, and considering all possible combinations for each category. We then obtained a Jaccard dissimilarity matrix from the data for the presence and absence of species in phytophysiognomies in order to make comparisons between phytophysiognomies. We subsequently performed a Principal Coordinate Analysis (PCoA) based on this matrix (Ter Braak, 1995), with the objective of ordering phytophysiognomies and observing possible aggregations and gradients.

Finally, we partitioned the dissimilarity matrix into the Turnover and Nestedness components (Baselga, 2010) and obtained a dendrogram corresponding to each component using UPGMA as a connection method (Gotelli & Ellison, 2016). The partitioning was carried out with the objective of evaluating which component is more significant in differentiating the communities in the phytophysiognomic study set, and if the ecological patterns are different in different perspectives. All analyzes were performed in the R version 3.3.1 (2016) using its default and the 'vegan' (Oksanen et al., 2017) and 'betapart' (Baselga, Orme, Villeger, Bortoli, & Leprieur, 2013) packages.

Results

We found 310 bird species (Supplementary material) allocated in 60 families. The most represented families were Tyrannidae (N = 43), Throchilidae (N = 17), Tamnophilidae, Psittacidae and Picidae (N = 9).

The richness and families was higher for anthropic environments, followed by the semi-deciduous forest, while the lakes and Candeais showed the lowest richness and number of families, with the other phytophysiognomies varying between these extremes (Figure 2).

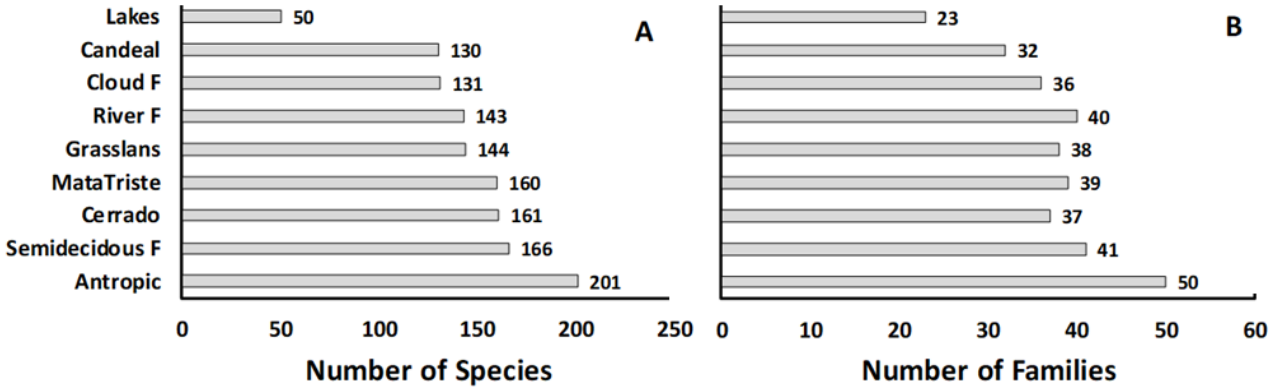

Figure 2. Number of species (A) and families (B) of birds by phytophysiognomy in Carrancas city, South of Minas Gerais State, Brazil.

The 'physiognomy number' refers to physiognomy combinations. In this case, 11 species occur in all nine physiognomies, as along with 28 only occurring in one of the nine physiognomies, among other combinations. Thus, the distribution is relatively heterogeneous with approximately 100 species widely distributed and another approximately 200 species restricted to a few phytophysiognomies (Figure 3).

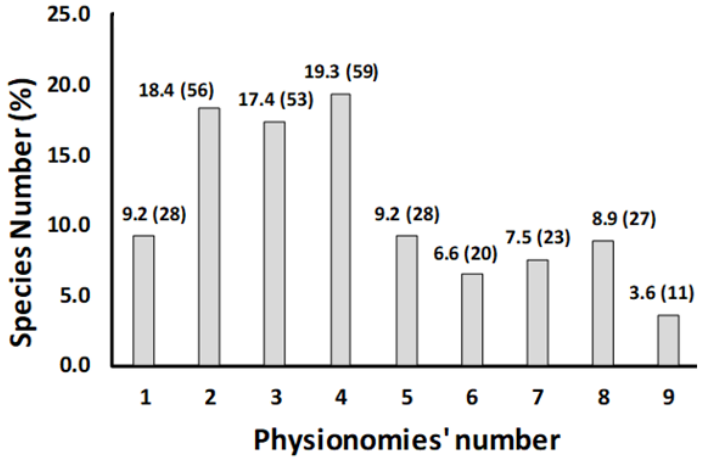

Figure 3. Percentage and richness (in parentheses) of birds occurring for physiognomy combinations in Carrancas city, South of Minas Gerais State, Brazil.

The first two axes of the PCoA together explained 69.4% of the data variation. The PCoA demonstrated a well-defined separation between forest environments: riparian forests, semi-deciduous forests (including '*Mata Triste*'), and cloud forests; non-forest: non-forest phytophysiognomies from Cerrado (as 'Dirt Field' and 'Rupestrian Fields'), mountain fields, anthropic environments; and lake environments. This was a trend for

axis 1, while only the lake environment differed from the other environments for axis 2. The dendrograms showed a pattern similar to the PCoA, with separation of forest and non-forest communities, presenting higher values for turnover in relation to nestedness (Figures 4 and 5).

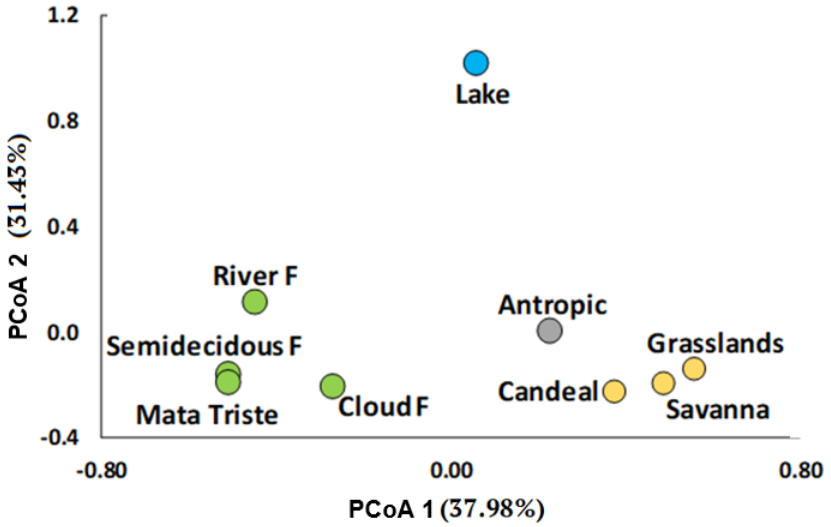

Figure 4. Principal Coordinate Analysis (PCO) using Jaccard of birds by phytophysiognomy in Carrancas city, South of Minas Gerais State, Brazil.

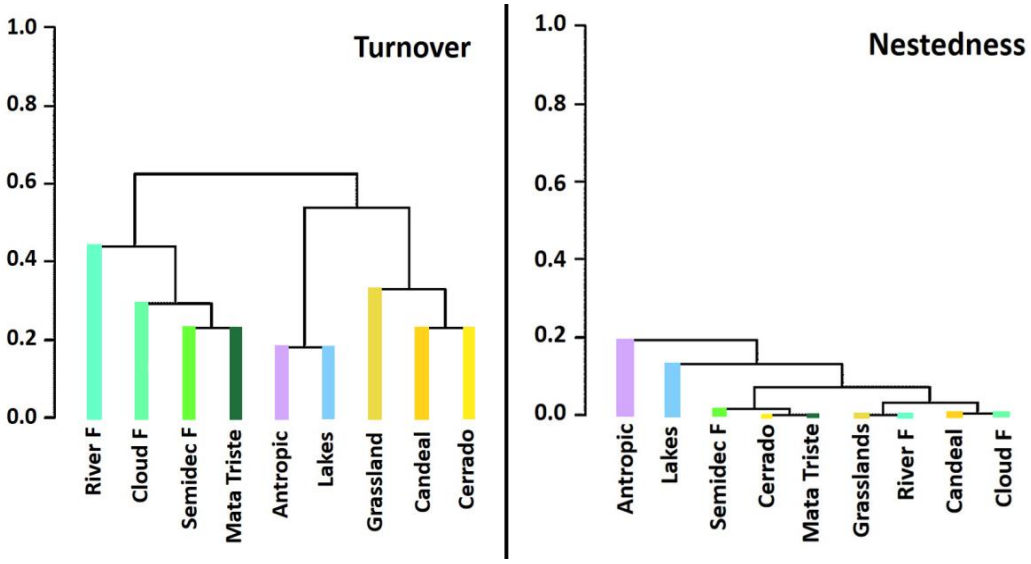

Figure 5. Dendrogram using UPGMA as a binding method and the components of beta diversity by Jaccard (Turnover and Nestedness) for the physiognomic bird community in Carrancas city, Minas Gerais State, Brazil.

Discussion

The richness found in *Chapada das Perdizes* represents 16.05% of the 1919 records for the Brazilian territory (Piacentini et al., 2015), constituting a very high number if we consider the phytophysiognomies which occurred in the two global Hotspot domains were sampled: the Cerrado and Atlantic Forest (Myers et al., 2000). The high representativeness of the Tyrannidae and Tamnophilidae families was already expected, as they are the most represented in Brazil (Sick, 1997; Piacentini et al., 2015; and similar composition to Sementili-Cardoso et al., 2019), and also in studies previously conducted in Southern Minas Gerais State, which found similar results (Lopes, 2006; Lombardi, Vasconcelos, & D'angelo-Neto, 2007; Moura, Correa, Braga, & Gregorin, 2010; Moura, Corrêa, & Machado, 2015; Moura, Machado, Mariano, Souza, & Fontes, 2020).

In relation to the medium and long term studies in the Atlantic and Cerrado domains, the present study presents a high diversity with 310 species when compared to other high altitude (montane) regions of Southeastern Brazil. Vasconcelos & Rodrigues (2010) found 231 species in a survey compiled for mountains (only non-forest phytophysiognomies) in the states of Bahia, Minas Gerais, São Paulo, Rio de Janeiro and

Espírito Santo; Rodrigues et al. (2011) found 151 species for the Serra do Cipó National Park; and Vasconcelos and D'Angelo-Neto (2009) found 206 species for Serra da Mantiqueira. This biodiversity is a research result of many phytophysiognomies at high altitude (similar to Machado et al., 2013 with small mammals) and has a long sampling time.

About composition, a total of eight taxa among the records are threatened, including the species *Urubitinga coronata*, *Spizaetus tyrannus*, *Amazona vinacea*, *Geositta poeciloptera*, *Culicivora caudacuta*, *Alectrurus tricolor*, *Phibalura flavirostris*, *Anthus nattereri* and *Coryphaspiza melanotis* (Fundação Biodiversitas, 2008; International Union for Conservation of Nature [IUCN], 2020; and similar to Sementili-Cardoso et al., 2019). Furthermore, the species *Malacoptila striata*, *Aratinga auricapillus*, *Sarcoramphus papa*, *Platalea ajaja* and *Mycteria americana* are in the almost threatened category (Lopes et al., 2017), thus showing the importance of this region for the conservation of the Brazilian bird community (Moura et al., 2021), and also highlighting the urgency of creating protected areas for wildlife conservation in the studied region (as proposed by Zambaldi, Louzada, Carvalho, & Scolforo, 2011). Mainly by the fragments of wide territorial extension that can be considered reference environments of vital importance for the conservation of the species of birds (Torezan, Calsavara, Bochio, & Anjos, 2021)

In view of the ecotonal characteristics of the two Cerrado and Atlantic hotspot domains, three typical Cerrado species of birds were recorded, namely *Synallaxis spixi*, *Saltatricula atricollis* and *Antilophia galeata*, and 19 typical species from the Atlantic Forest, including *Aramides saracura*, *Florisuga fusca*, *Thalurania glaucopis*, *Baryphthengus ruficapillus*, *Malacoptila striata*, *Campephilus robustus*, *Pyrrhura frontalis*, *Pyriglena leucoptera*, *Conopophaga lineata*, *Ilicura militaris*, *Chiroxiphia caudata*, *Mionectes rufiventris*, *Todirostrum poliocephalum*, *Myiornis auricularis*, *Hemitriccus nidipendulus*, *Knipolegus nigerrimus*, *Hemithraupis ruficapilla*, *Tachyphonus coronatus* and *Sporophila ardesiaca* (Silva, 1995; D'Angelo-Neto, Venturin, Oliveira-Filho, & Costa, 1998; Silva & Santos, 2005; Lopes et al., 2017).

The forest vegetation types presented a similar number of species with some of the greatest richness for the study area due to greater heterogeneity and complexity environmental (Willrich, Lima, & Dos Anjos, 2019) which provides more niches (Johnson, 1975; Terborgh, 1985; Santillán et al., 2020). Two situations deserve to be highlighted, namely the case of montane fields and the anthropic environments. Montane fields showed richness in line with other studies in different natural altitude fields in wildlife conservation areas (Conservation Units – Brasil, 2000) in Southeastern Brazil (e.g., Vasconcelos, 2008b), with 108 species for Cadeia do Espinhaço, and Rodrigues et al. (2011), with 151 species for Serra do Cipó). The high richness of anthropic environments suggests that the heterogeneous conditions caused by human actions in natural environments supplies a large variety of resources to avifauna (Willrich et al., 2019).

The PCO analysis also separated the communities into forest and non-forest environments generated by the aforementioned environmental complexity and heterogeneity (*sensu* August 1983) of the studied region. The beta diversity analysis indicates high turnover of bird species along the sampled environments (similar turnover results to De Deus, Schuchmann, Arieira, Oliveira Tissiani, & Marques, 2020; Gomez, Ponciano, Londoño, & Robinson, 2020), demonstrating the specificity of each phytophysiognomy or environment (Castaño-Villa, Ramos-Valencia, & Fontúrbel, 2014; Gomez et al., 2020). This pattern of beta diversity of the birds in *Chapada das Perdizes* is mainly driven by the local dynamics of phytophysiognomy. These findings indicate that the maintenance of several phytophysiognomies at meso-scale will guarantee a high turnover of species and is the key to the maintenance of a diverse biota (Roos, Giehl, & Hernández, 2021, Adorno, Barros, Ribeiro, Silva, & Hasui, 2021). In addition, flight capacity was not a factor which favored similarity for the ability to migrate between areas, therefore once again we emphasize the need for preservation (as highlighted by Zambaldi et al., 2011 and Moura et al., 2021), and demonstrating that each area can have a unique diversity which is difficult to find in other locations in the south of Minas Gerais or in the southeastern of Brazil.

Another important factor to be mentioned is the proximity of the turnover values of forest environments. This similarity (also expressed in the PCoA and in the richness graph) is an expression of the forest similarity for different areas resulting from soil characteristics and consequently of vegetation (Oliveira-Filho et al., 2004). The altitudinal variation influences the appearance of highly humid areas called cloud forests, which have connections with riparian forests and with large forest fragments such as the '*Mata Triste*' and other semi-deciduous forests. This interconnection by ecological corridors favors an analogous composition of the avifauna community (Correa, Louzada, & Moura, 2012).

The distance between lake environments and other phytophysiognomies in PCoA analysis is due to the presence of species with narrow phenotypic flexibility and highly specific to aquatic environments (e.g., ducks such as *Amazonetta brasiliensis*, *Cairina moschata*, and herons such as *Nycticorax nycticorax*, among others). This specificity is closely linked to fish-eating habits (Paszkowski & Tonn, 2001), which is only possible in this environment.

From a conservationist point of view, cloud forests are a refugee which has yet to be explored, as their occurrence is restricted to high altitude regions above sea level (Carvalho, Fontes, & Oliveira-Filho, 2000; Bertoncello et al., 2011; Pompeu et al., 2018). There are very few locations in Southeast Brazil which present this characteristic, being more commonly found in Serra da Mantiqueira, Ibitipoca and cities of Aiuruoca, Baependí and Itamonte. Biogeographic studies of birds of cloud forests in Brazil are non-existent, and this is the first report which reinforces the high diversity for these environments.

The montane fields are a threatened phytophysiognomy from the expansion of *Brachiaria* sp. exotic grass (as mentioned by Klink & Machado, 2005). The composition of birds found in the montane fields was highly specific with the occurrence of endangered species such as *C. caudacuta*, *A. nattereri* and *C. melanotis*. Taxa such as the abovementioned are closely associated with the fields, and are among the most threatened birds in the Cerrado domain (Machado et al., 1998; Lopes et al., 2009). This group has a high affinity with the environment which is the result of an evolutionarily-shaped interaction (as mentioned by Santillán et al., 2020 when mentions about specifity in evolutionary history). Other studies in the mountain fields from the sampling area demonstrate specificity of other taxonomic groups with open environmens, such as rodents (*Oxymycterus delator*), marsupials (*Monodelphis domestica*) (Machado et al., 2013), and bats (*Desmodus rotundus* and *Histiotus velatus*) (Moras, Bernard, & Gregorin, 2013), among others. Therefore, the loss of grassland environments will lead to a co-extinction, without considering the loss in functional diversity and its respective ecosystem services.

Even though there are forests monodominated by *Eremanthus* ('Candeais') in the studied regions, there is no mention of the bird community in these forests in studies previously conducted (D'Angelo-Neto et al., 1998; Ribon, 2000; Vasconcelos et al., 2002; Vasconcelos, D'angelo-Neto S. & Nemesio, 2005; Lopes, 2006; Lombardi et al., 2007; Vasconcelos, 2008a; Moura & Corrêa, 2012; Moura et al., 2015) probably because they do not perceive this phytophysiognomy as a differentiated unit (similar to Willrich et al., 2019), as in the case of 'Paratudal' (*Tabebuia aurea*) forests in the 'Pantanal', and of the 'Caxeitais' (*Tabebuia cassinoides*) on the Brazilian coast, among others, thus highlighting the importance of these data for the ecology and conservation of the bird community in these forests and even for the phytophysiognomy itself, mainly as natural occurrence are homogeneous and in only high altitudinal elevation, so threathened as other montane phytophysiognomies.

Conclusion

We conclude that the montane phytophysiognomies along an ecotone between Cerrado and Atlantic Forest hotspots present high species richness. The composition present species of both domains, with high turnover component. We highlight the field environments and candeais are considered homogeneous and threathened, which would directly affect birds. The present study contributes to future conservation strategies, as it demonstrates ecotonal regions as transition zones (mixed composition form both domains) and reinforces the need to consider as particular ecological units. These ecotonal regions are key locations for understanding ecological patterns in response to environmental changes or phytophysiognomies. Knowing how partitioning of the composition occurs within an environmental mosaic is essential to understand the limits and distributions of the species and conserve them.

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Supplementary material

Bird species list in Carrancas city, South of Minas Gerais State, Brazil.

Family	Taxon	Common name
Tinamidae	*Crypturellus obsoletus* (Temminck, 1815)	Brown tinamou
	Crypturellus parvirostris (Wagler, 1827)	Small-billed tinamou
	Rhynchotus rufescens (Temminck, 1815)	Red-winged tinamou
	Nothura maculosa (Temminck, 1815)	Spotted nothura
Anatidae	*Dendrocygna viduata* (Linnaeus, 1766)	White-faced whistling duck
	Cairina moschata (Linnaeus, 1758)	Muscovy duck
	Amazonetta brasiliensis (Gmelin, 1789)	Brazilian teal
	Nomonyx dominica (Linnaeus, 1766)	Masked duck
Cracidae	*Penelope superciliaris* Temminck, 1815	Rusty-margined guan
	Penelope obscura Temminck, 1815	Dusky-legged guan
Ciconiidae	*Mycteria americana* Linnaeus, 1758	Wood stork
Phalacrocoracidae	*Nannopterum brasilianus* (Gmelin, 1789)	Neotropic Cormorant
Ardeidae	*Tigrisoma lineatum* (Boddaert, 1783)	Rufescent tiger heron
	Nycticorax nycticorax (Linnaeus, 1758)	Black-crowned night heron
	Butorides striata (Linnaeus, 1758)	Striated heron
	Bubulcus ibis (Linnaeus, 1758)	Western cattle egret
	Ardea cocoi Linnaeus, 1766	Cocoi heron
	Ardea alba Linnaeus, 1758	Great egret
	Syrigma sibilatrix (Temminck, 1824)	Whistling heron
	Egretta thula (Molina, 1782)	Snowy egret
Threskiornithidae	*Mesembrinibis cayennensis* (Gmelin, 1789)	Green ibis
	Theristicus caudatus (Boddaert, 1783)	Buff-necked ibis
	Platalea ajaja Linnaeus, 1758	Roseate spoonbill
Cathartidae	*Cathartes aura* (Linnaeus, 1758)	Turkey vulture
	Coragyps atratus (Bechstein, 1793)	Black vulture
	Sarcoramphus papa (Linnaeus, 1758)	King vulture
Accipitridae	*Leptodon cayanensis* (Latham, 1790)	Gray-headed kite
	Elanus leucurus (Vieillot, 1818)	White-tailed kite
	Harpagus diodon (Temminck, 1823)	Rufous-thighed kite
	Accipiter bicolor (Vieillot, 1817)	Bicolored hawk
	Accipiter striatus Vieillot, 1808	Sharp-shinned hawk
	Ictinia plumbea (Gmelin, 1788)	Plumbeous kite
	Geranospiza caerulescens (Vieillot, 1817)	Crane hawk
	Heterospizias meridionalis (Latham, 1790)	Savanna hawk
	Urubitinga coronata (Vieillot, 1817)	Crowned Eagle
	Rupornis magnirostris (Gmelin, 1788)	Roadside hawk
	Geranoaetus albicaudatus (Vieillot, 1816)	White-tailed hawk
	Geranoaetus melanoleucus (Vieillot, 1819)	Black-chested buzzard-eagle
	Buteo brachyurus Vieillot, 1816	Short-tailed hawk
	Spizaetus tyrannus (Wied, 1820)	Black hawk-eagle
Rallidae	*Aramides cajaneus* (Statius Muller, 1776)	Grey-necked wood rail
	Aramides saracura (Spix, 1825)	Slaty-breasted wood rail
	Laterallus melanophaius (Vieillot, 1819)	Rufous-sided craque
Charadriidae	*Vanellus chilensis* (Molina, 1782)	Southern lapwing
Scolopacidae	*Tringa solitaria* Wilson, 1813	Solitary sandpiper
Jacanidae	*Jacana jacana* (Linnaeus, 1766)	Wattled jacana
Columbidae	*Columbina talpacoti* (Temminck, 1810)	Ruddy ground dove
	Columbina squammata (Lesson, 1831)	Scaled dove
	Columba livia Gmelin, 1789	Rock dove
	Patagioenas picazuro (Temminck, 1813)	Picazuro pigeon
	Patagioenas cayennensis (Bonnaterre, 1792)	Pale-vented pigeon
	Zenaida auriculata (Des Murs, 1847)	Eared dove
	Leptotila verreauxi Bonaparte, 1855	White-tipped dove
	Leptotila rufaxilla (Richard & Bernard, 1792)	Grey-fronted dove
	Geotrygon montana (Linnaeus, 1758)	Ruddy quail-dove
Cuculidae	*Piaya cayana* (Linnaeus, 1766)	Squirrel cuckoo
	Coccyzus melacoryphus Vieillot, 1817	Dark-billed cuckoo
	Crotophaga ani Linnaeus, 1758	Smooth-billed ani
	Guira guira (Gmelin, 1788)	Guira cuckoo
	Tapera naevia (Linnaeus, 1766)	Striped cuckoo
Tytonidae	*Tyto furcata* (Temminck, 1827)	American barn owl
Strigidae	*Megascops choliba* (Vieillot, 1817)	Tropical screech owl

Family	Taxon	Common name
	Bubo virginianus (Gmelin, 1788)	Great horned owl
	Glaucidium brasilianum (Gmelin, 1788)	Ferruginous pygmy owl
	Athene cunicularia (Molina, 1782)	Burrowing owl
	Aegolius harrisii (Cassin, 1849)	Buff-fronted owl
	Asio flammeus (Pontoppidan, 1763)	Short-eared owl
Nyctibiidae	*Nyctibius griseus* (Gmelin, 1789)	Common potoo
Caprimulgidae	*Nyctiphrynus ocellatus* (Tschudi, 1844)	Ocellated poorwill
	Nyctidromus albicollis (Gmelin, 1789)	Pauraque
	Hydropsalis longirostris (Bonaparte, 1825)	Band-winged Nightjar
	Hydropsalis torquata (Gmelin, 1789)	Scissor-tailed nightjar
	Hydropsalis parvula (Gould, 1837)	Little Nightja
	Nannochordeiles pusillus (Gould, 1861)	Least Nighthawk
Apodidae	*Streptoprocne zonaris* (Shaw, 1796)	White-collared swift
	Chaetura meridionalis Hellmayr, 1907	Sick's swift
Trochilidae	*Phaethornis ruber* (Linnaeus, 1758)	Reddish hermit
	Phaethornis pretrei (Lesson & Delattre, 1839)	Planalto hermit
	Phaethornis eurynome (Lesson, 1832)	Scale-throated hermit
	Eupetomena macroura (Gmelin, 1788)	Swallow-tailed hummingbird
	Aphantochroa cirrochloris (Vieillot, 1818)	Sombre hummingbird
	Florisuga fusca (Vieillot, 1817)	Black jacobin
	Colibri serrirostris (Vieillot, 1816)	White-vented violetear
	Anthracothorax nigricollis (Vieillot, 1817)	Black-throated mango
	Chlorostilbon lucidus (Shaw, 1812)	Glittering-bellied emerald
	Thalurania glaucopis (Gmelin, 1788)	Violet-capped woodnymph
	Leucochloris albicollis (Vieillot, 1818)	White-throated hummingbird
	Amazilia versicolor (Vieillot, 1818)	Versicolored emerald
	Amazilia fimbriata (Gmelin, 1788)	Glittering-throated emerald
	Amazilia lactea (Lesson, 1832)	Sapphire-spangled emerald
	Heliothryx auritus (Gmelin, 1788)	Black-eared fairy
	Heliomaster squamosus (Temminck, 1823)	Stripe-breasted starthroat
	Calliphlox amethystina (Boddaert, 1783)	Amethyst woodstar
Trogonidae	*Trogon surrucura* Vieillot, 1817	Surucua trogon
Alcedinidae	*Megaceryle torquata* (Linnaeus, 1766)	Ringed kingfisher
	Chloroceryle amazona (Latham, 1790)	Amazon Kingfisher
Momotidae	*Baryphthengus ruficapillus* (Vieillot, 1818)	Rufous-capped motmot
Galbulidae	*Galbula ruficauda* Cuvier, 1816	Rufous-tailed jacamar
Bucconidae	*Nystalus chacuru* (Vieillot, 1816)	White-eared puffbird
	Malacoptila striata (Spix, 1824)	Crescent-chested puffbird
Ramphastidae	*Ramphastos toco* Statius Muller, 1776	Toco toucan
	Ramphastos dicolorus Linnaeus, 1766	Green-billed toucan
Picidae	*Picumnus cirratus* Temminck, 1825	White-barred piculet
	Melanerpes candidus (Otto, 1796)	White woodpecker
	Veniliornis passerinus (Linnaeus, 1766)	Little woodpecker
	Veniliornis spilogaster (Wagler, 1827)	White-spotted woodpecker
	Colaptes melanochloros (Gmelin, 1788)	Green-barred woodpecker
	Colaptes campestris (Vieillot, 1818)	Campo flicker
	Celeus flavescens (Gmelin, 1788)	Blond-crested woodpecker
	Dryocopus lineatus (Linnaeus, 1766)	Lineated woodpecker
	Campephilus robustus (Lichtenstein, 1818)	Robust woodpecker
Cariamidae	*Cariama cristata* (Linnaeus, 1766)	Red-legged seriema
Falconidae	*Caracara plancus* (Miller, 1777)	Southern crested caracara
	Herpetotheres cachinnans (Linnaeus, 1758)	Laughing falcon
	Micrastur semitorquatus (Vieillot, 1817)	Collared forest falcon
	Falco sparverius Linnaeus, 1758	American kestrel
	Falco femoralis Temminck, 1822	Aplomado falcon
Psittacidae	*Primolius maracana* (Vieillot, 1816)	Blue-winged macaw
	Psittacara leucophthalmus (Statius Muller, 1776)	White-eyed parakeet
	Aratinga auricapillus (Kuhl, 1820)	Golden-capped parakeet
	Eupsittula aurea (Gmelin, 1788)	Peach-fronted parakeet
	Pyrrhura frontalis (Vieillot, 1817)	Maroon-bellied parakeet
	Forpus xanthopterygius (Spix, 1824)	Blue-winged parrotlet
	Brotogeris chiriri (Vieillot, 1818)	Yellow-chevroned parakeet
	Pionus maximiliani (Kuhl, 1820)	Scaly-headed parrot
	Amazona vinacea (Kuhl, 1820)	Vinaceous-breasted amazon
Thamnophilidae	*Dysithamnus mentalis* (Temminck, 1823)	Plain antvireo

Family	Taxon	Common name
	Herpsilochmus atricapillus Pelzeln, 1868	Black-capped antwren
	Thamnophilus ruficapillus Vieillot, 1816	Rufous-capped antshrike
	Thamnophilus caerulescens Vieillot, 1816	Variable antshrike
	Mackenziaena leachii (Such, 1825)	Large-tailed antshrike
	Pyriglena leucoptera (Vieillot, 1818)	White-shouldered fire-eye
	Drymophila ferruginea (Temminck, 1822)	Ferruginous antbird
	Drymophila ochropyga (Hellmayr, 1906)	Ochre-rumped antbird
	Drymophila malura (Temminck, 1825)	Dusky-tailed antbird
Melanopareiidae	*Melanopareia torquata* (Wied, 1831)	Collared crescentchest
Conopophagidae	*Conopophaga lineata* (Wied, 1831)	Rufous gnateater
Rhinocryptidae	*Scytalopus speluncae* (Ménétriès, 1835)	Mouse-coloured tapaculo
	Scytalopus petrophilus Whitney, Vasconcelos, Silveira & Pacheco, 2010	Rock tapaculo
Scleruridae	*Geositta poeciloptera* (Wied, 1830)	Campo miner
Dendrocolaptidae	*Sittasomus griseicapillus* (Vieillot, 1818)	Olivaceous woodcreeper
	Lepidocolaptes angustirostris (Vieillot, 1818)	Narrow-billed woodcreeper
	Lepidocolaptes squamatus (Lichtenstein, 1822)	Scaled woodcreeper
	Xiphocolaptes albicollis (Vieillot, 1818)	White-throated woodcreeper
Xenopidae	*Xenops rutilans* Temminck, 1821	Streaked xenops
Furnariidae	*Furnarius figulus* (Lichtenstein, 1823)	Band-tailed hornero
	Furnarius rufus (Gmelin, 1788)	Rufous hornero
	Lochmias nematura (Lichtenstein, 1823)	Sharp-tailed streamcreeper
	Automolus leucophthalmus (Wied, 1821)	White-eyed foliage-gleaner
	Philydor rufum (Vieillot, 1818)	Buff-fronted foliage-gleaner
	Syndactyla rufosuperciliata (Lafresnaye, 1832)	Buff-browed foliage-gleaner
	Phacellodomus rufifrons (Wied, 1821)	Rufous-fronted thornbird
	Anumbius annumbi (Vieillot, 1817)	Firewood-gatherer
	Certhiaxis cinnamomeus (Gmelin, 1788)	Yellow-chinned spinetail
	Synallaxis ruficapilla Vieillot, 1819	Rufous-capped spinetail
	Synallaxis cinerascens Temminck, 1823	Grey-bellied spinetail
	Synallaxis frontalis Pelzeln, 1859	Grey-bellied spinetail
	Synallaxis albescens Temminck, 1823	Pale-breasted spinetail
	Synallaxis spixi Sclater, 1856	Spix's spinetail
	Geositta poeciloptera (Wied, 1830)	Campo Miner
	Cranioleuca pallida (Wied, 1831)	Pallid spinetail
Pipridae	*Neopelma chrysolophum* Pinto, 1944	Serra do Mar tyrant-manakin
	Ilicura militaris (Shaw & Nodder, 1809)	Pin-tailed manakin
	Chiroxiphia caudata (Shaw & Nodder, 1793)	Blue manakin
	Antilophia galeata (Lichtenstein, 1823)	Helmeted manakin
Tityridae	*Schiffornis virescens* (Lafresnaye, 1838)	Greenish schiffornis
	Pachyramphus polychopterus (Vieillot, 1818)	White-winged becard
	Pachyramphus validus (Lichtenstein, 1823)	Crested becard
Cotingidae	*Phibalura flavirostris* Vieillot, 1816	Swallow-tailed cotinga
	Pyroderus scutatus (Shaw, 1792)	Red-ruffed fruitcrow
Platyrinchidae	*Platyrinchus mystaceus* Vieillot, 1818	White-throated spadebill
Rhynchocyclidae	*Mionectes rufiventris* Cabanis, 1846	Grey-hooded flycatcher
	Leptopogon amaurocephalus Tschudi, 1846	Sepia-capped flycatcher
	Corythopis delalandi (Lesson, 1830)	Southern antpipit
	Phylloscartes eximius (Temminck, 1822)	Southern bristle tyrant
	Phylloscartes ventralis (Temminck, 1824)	Mottle-cheeked tyrannulet
	Tolmomyias sulphurescens (Spix, 1825)	Yellow-olive flatbill
	Todirostrum poliocephalum (Wied, 1831)	Yellow-lored tody-flycatcher
	Todirostrum cinereum (Linnaeus, 1766)	Common tody-flycatcher
	Poecilotriccus plumbeiceps (Lafresnaye, 1846)	Ochre-faced tody-flycatcher
	Myiornis auricularis (Vieillot, 1818)	Eared pygmy tyrant
	Hemitriccus diops (Temminck, 1822)	Drab-breasted bamboo tyrant
	Hemitriccus nidipendulus (Wied, 1831)	Hangnest tody-tyrant
Tyrannidae	*Hirundinea ferruginea* (Gmelin, 1788)	Cliff flycatcher
	Camptostoma obsoletum (Temminck, 1824)	Southern beardless tyrannulet
	Elaenia flavogaster (Thunberg, 1822)	Yellow-bellied elaenia
	Elaenia cristata Pelzeln, 1868	Plain-crested elaenia
	Elaenia chiriquensis Lawrence, 1865	Lesser elaenia
	Elaenia obscura (d'Orbigny & Lafresnaye, 1837)	Highland elaenia
	Suiriri suiriri (Vieillot, 1818)	Suiriri Flycatcher
	Capsiempis flaveola (Lichtenstein, 1823)	Yellow tyrannulet

Family	Taxon	Common name
	Phaeomyias murina (Spix, 1825)	Mouse-colored tyrannulet
	Phyllomyias fasciatus (Thunberg, 1822)	Planalto tyrannulet
	Culicivora caudacuta (Vieillot, 1818)	Sharp-tailed grass tyrant
	Serpophaga nigricans (Vieillot, 1817)	Sooty tyrannulet
	Serpophaga subcristata (Vieillot, 1817)	White-crested tyrannulet
	Legatus leucophaius (Vieillot, 1818)	Piratic flycatcher
	Myiarchus swainsoni Cabanis & Heine, 1859	Swainson's flycatcher
	Myiarchus ferox (Gmelin, 1789)	Short-crested flycatcher
	Myiarchus tyrannulus (Statius Muller, 1776)	Brown-crested flycatcher
	Casiornis rufus (Vieillot, 1816)	Rufous casiornis
	Pitangus sulphuratus (Linnaeus, 1766)	Great kiskadee
	Machetornis rixosa (Vieillot, 1819)	Cattle tyrant
	Myiodynastes maculatus (Statius Muller, 1776)	Streaked flycatcher
	Megarynchus pitangua (Linnaeus, 1766)	Boat-billed flycatcher
	Myiozetetes similis (Spix, 1825)	Social flycatcher
	Tyrannus albogularis Burmeister, 1856	White-throated kingbird
	Tyrannus melancholicus Vieillot, 1819	Tropical kingbird
	Tyrannus savana Daudin, 1802	Fork-tailed flycatcher
	Griseotyrannus aurantioatrocristatus (d'Orbigny & Lafresnaye, 1837)	Crowned slaty flycatcher
	Empidonomus varius (Vieillot, 1818)	Variegated flycatcher
	Colonia colonus (Vieillot, 1818)	Long-tailed tyrant
	Myiophobus fasciatus (Statius Muller, 1776)	Bran-colored flycatcher
	Pyrocephalus rubinus (Boddaert, 1783)	Scarlet flycatcher
	Fluvicola nengeta (Linnaeus, 1766)	Masked water tyrant
	Arundinicola leucocephala (Linnaeus, 1764)	White-headed marsh tyrant
	Gubernetes yetapa (Vieillot, 1818)	Streamer-tailed tyrant
	Alectrurus tricolor (Vieillot, 1816)	Cock-tailed tyrant
	Lathrotriccus euleri (Cabanis, 1868)	Euler's flycatcher
	Contopus cinereus (Spix, 1825)	Tropical pewee
	Knipolegus cyanirostris (Vieillot, 1818)	Blue-billed black tyrant
	Knipolegus lophotes Boie, 1828	Crested black tyrant
	Knipolegus nigerrimus (Vieillot, 1818)	Velvety black tyrant
	Satrapa icterophrys (Vieillot, 1818)	Yellow-browed tyrant
	Xolmis cinereus (Vieillot, 1816)	Grey monjita
	Xolmis velatus (Lichtenstein, 1823)	White-rumped monjita
	Muscipipra vetula (Lichtenstein, 1823)	Shear-tailed grey tyrant
Vireonidae	*Cyclarhis gujanensis* (Gmelin, 1789)	Rufous-browed peppershrike
	Hylophilus amaurocephalus (Nordmann, 1835)	Grey-eyed greenlet
	Vireo chivi (Vieillot, 1817)	Red-eyed vireo
Corvidae	*Cyanocorax cristatellus* (Temminck, 1823)	Curl-crested jay
	Cyanocorax chrysops (Vieillot, 1818)	Plush-crested jay
Hirundinidae	*Pygochelidon cyanoleuca* (Vieillot, 1817)	Blue-and-white swallow
	Alopochelidon fucata (Temminck, 1822)	Tawny-headed swallow
	Stelgidopteryx ruficollis (Vieillot, 1817)	Southern rough-winged swallow
	Progne tapera (Vieillot, 1817)	Brown-chested martin
	Progne chalybea (Gmelin, 1789)	Grey-breasted martin
	Tachycineta albiventer (Boddaert, 1783)	White-winged swallow
	Tachycineta leucorrhoa (Vieillot, 1817)	White-rumped swallow
	Riparia riparia (Linnaeus, 1758)	Sand martin
Troglodytidae	*Troglodytes musculus* Naumann, 1823	Southern House Wren
	Cistothorus platensis (Latham, 1790)	Grass wren
Donacobiidae	*Donacobius atricapilla* (Linnaeus, 1766)	Black-capped donacobius
Turdidae	*Turdus leucomelas* Vieillot, 1818	Pale-breasted thrush
	Turdus rufiventris Vieillot, 1818	Rufous-bellied thrush
	Turdus amaurochalinus Cabanis, 1850	Creamy-bellied thrush
	Turdus albicollis Vieillot, 1818	White-necked thrush
Mimidae	*Mimus saturninus* (Lichtenstein, 1823)	Chalk-browed mockingbird
Motacillidae	*Anthus lutescens* Pucheran, 1855	Yellowish pipit
	Anthus nattereri Sclater, 1878	Ochre-breasted pipit
	Anthus hellmayri Hartert, 1909	Hellmayr's pipit
Passerellidae	*Zonotrichia capensis* (Statius Muller, 1776)	Rufous-collared sparrow
	Ammodramus humeralis (Bosc, 1792)	Grassland sparrow
	Arremon flavirostris Swainson, 1838	Saffron-billed sparrow

Family	Taxon	Common name
Parulidae	*Setophaga pitiayumi* (Vieillot, 1817)	Tropical parula
	Geothlypis aequinoctialis (Gmelin, 1789)	Masked yellowthroat
	Basileuterus culicivorus (Deppe, 1830)	Golden-crowned warbler
	*Myiothlypis flaveola*Baird, 1865	Flavescent Warbler
	Myiothlypis leucoblephara (Vieillot, 1817)	White-rimmed warbler
Icteridae	*Psarocolius decumanus* (Pallas, 1769)	Crested oropendola
	Icterus pyrrhopterus (Vieillot, 1819)	Variable oriole
	Gnorimopsar chopi (Vieillot, 1819)	Chopi blackbird
	Chrysomus ruficapillus (Vieillot, 1819)	Chestnut-capped blackbird
	Pseudoleistes guirahuro (Vieillot, 1819)	Yellow-rumped marshbird
	Molothrus oryzivorus (Gmelin, 1788)	Giant cowbird
	Molothrus bonariensis (Gmelin, 1789)	Shiny cowbird
Thraupidae	*Porphyrospiza caerulescens* (Wied, 1830)	Blue finch
	Pipraeidea melanonota (Vieillot, 1819)	Fawn-breasted tanager
	Stephanophorus diadematus (Temminck, 1823)	Diademed tanager
	Schistochlamys ruficapillus (Vieillot, 1817)	Cinnamon tanager
	Tangara cyanoventris (Vieillot, 1819)	Gilt-edged tanager
	Tangara desmaresti (Vieillot, 1819)	Brassy-breasted tanager
	Tangara sayaca (Linnaeus, 1766)	Sayaca Tanager
	Tangara palmarum (Wied, 1821)	Palm Tanager
	Tangara cayana (Linnaeus, 1766)	Burnished-buff tanager
	Nemosia pileata (Boddaert, 1783)	Hooded tanager
	Conirostrum speciosum (Temminck, 1824)	Chestnut-vented conebill
	Sicalis citrina Pelzeln, 1870	Stripe-tailed yellow finch
	Sicalis flaveola (Linnaeus, 1766)	Saffron finch
	Sicalis luteola (Sparrman, 1789)	Grassland yellow finch
	Haplospiza unicolor Cabanis, 1851	Uniform finch
	Hemithraupis ruficapilla (Vieillot, 1818)	Rufous-headed tanager
	Volatinia jacarina (Linnaeus, 1766)	Blue-black grassquit
	Trichothraupis melanops (Vieillot, 1818)	Black-goggled tanager
	Coryphospingus pileatus (Wied, 1821)	Grey pileated finch
	Tachyphonus coronatus (Vieillot, 1822)	Ruby-crowned tanager
	Tersina viridis (Illiger, 1811)	Swallow tanager
	Dacnis cayana (Linnaeus, 1766)	Blue dacnis
	Coereba flaveola (Linnaeus, 1758)	Bananaquit
	Sporophila lineola (Linnaeus, 1758)	Lined seedeater
	Sporophila nigricollis (Vieillot, 1823)	Yellow-bellied seedeater
	Sporophila ardesiaca (Dubois, 1894)	Dubois's seedeater
	Sporophila caerulescens (Vieillot, 1823)	Double-collared seedeater
	Sporophila leucoptera (Vieillot, 1817)	White-bellied seedeater
	Coryphaspiza melanotis (Temminck, 1822)	Black-masked finch
	Embernagra platensis (Gmelin, 1789)	Pampa finch
	Emberizoides herbicola (Vieillot, 1817)	Wedge-tailed grass finch
	Saltatricula atricollis (Vieillot, 1817)	Black-throated Saltator
	Saltator similis d'Orbigny & Lafresnaye, 1837	Green-winged saltator
	Microspingus cinereus Bonaparte, 1850	Cinereous Warbling-Finch
	Thlypopsis sordida (d'Orbigny & Lafresnaye, 1837)	Orange-headed tanager
	Pyrrhocoma ruficeps (Strickland, 1844)	Chestnut-headed tanager
	Piranga flava (Vieillot, 1822)	Hepatic tanager
	Cyanoloxia brissonii (Lichtenstein, 1823)	Ultramarine Grosbeak
Fringillidae	*Spinus magellanicus* (Vieillot, 1805)	Hooded siskin
	Euphonia chlorotica (Linnaeus, 1766)	Purple-throated euphonia
	Euphonia cyanocephala (Vieillot, 1818)	Golden-rumped euphonia
	Euphonia pectoralis (Latham, 1801)	Golden-rumped eufonia
Estrildidae	*Estrilda astrild* (Linnaeus, 1758)	Common waxbill
Passeridae	*Passer domesticus* (Linnaeus, 1758)	House sparrow