

Do bird communities of neotropical monodominant forests have their own identity? The case of *Eremanthus erythropappus* forests

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ECOLOGY

ABSTRACT

Background: Monodominant *Eremanthus erythropappus* forests are dispersed in neotropical montane regions of southeastern and northeastern Brazil, forming ecotonal areas among other high altitude phytophysionomies, with no information from their fauna communities and how these communities vary between phytophysionomies adjacent. We examined the bird community of three preserved and three managed *E. erythropappus* forests, and compared them two other coexisting phytophysionomies (cloud forests and montane fields), being three samples of each, in an ecotonal region between two biodiversity hotspot domains (Cerrado and Atlantic Forest), in southeastern Brazil (1300 to 1570m high).

Results: The bird community of the natural *E. erythropappus* forests was shared with other vegetation, while the managed *E. erythropappus* forests presented the lowest species richness. However, even though managed *E. erythropappus* forests has almost no exclusive elements, their community caused a balanced variation (a set of very similar species, only changing the representativeness), suggesting that the abundance of the registered species varies along these phytophysionomies.

Conclusion: The species associated with the natural *E. erythropappus* forests represented 50% of the total species, in contrast to the remaining 50% associated with the areas of cloud forests and montane fields, and their sharing behaves as an ecotonal community, since its community coincides with elements which are also present in the avifauna of the other two sampled phytophysionomies. The composition of the avifauna from managed *E. erythropappus* forests was more similar to the community registered in the montane fields.

Keywords: *Candeia*, montane ecosystems, conservation.

HIGHLIGHTS

The composition in bird community in montane landscapes at Chapada das Perdizes is unique.

The bird community in montane landscapes has threatened species.

The composition of the avifauna from managed *E. erythropappus* forests was more similar to the community registered in the montane fields.

The bird community in the ecotonal region (Cerrado and Atlantic Forest) needs to be preserved because they have faunal elements from the two morphoclimatic domains.

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INTRODUCTION

Avifauna can have a great capacity to be dispersed among the landscape, and ample knowledge on them have grounded classical theories such as the island biogeography theory (MacArthur and Wilson, 1967) and the optimal foraging theory (MacArthur and Pianka, 1966). However, the bird community may also have a very low dispersion capacity, with their distribution being restricted by barriers such as mountain ranges, agricultural areas, large rivers (Cracraft, 1985; Haffer, 1992; Rahbek, 1997; Hayes and Sewlal, 2004; Silva *et al.*, 2005; Ribas *et al.*, 2009), and also narrow roads (Develey and Stouffer, 2001). Thus, a species' dispersion capacity on both local and regional scales seems to influence the avifauna community composition (Cracraft, 1985; Rahbek, 1997).

The natural montane region landscape of the Atlantic Forest-Cerrado ecotone constitutes two biogeographic regions which are considered biodiversity hotspots (Myers *et al.*, 2000), houses vegetation types which coexist and vary in a short geographical space, and have high diversity and richness of plant species (Oliveira-Filho *et al.*, 2004; Souza *et al.*, 2020), with emphasis on rupestrian fields (Vasconcelos *et al.*, 2011; Moura *et al.*, 2020) and cloud forests (Oliveira-Filho *et al.*, 2004). There is also vegetation with a low number of plant species in this ecotonal region in the midst of fields and forests, such as the monodominant forests with trees of the *Eremanthus* genus of the Asteraceae family (Araújo 1944) (from now on *Eremanthus* forests). Although these forests occur abundantly in the southeastern region of Brazil (Pedralli *et al.*, 1997) and are well studied by studies involving forest management (Scolforo *et al.*, 2002; Araújo *et al.*, 2018), studies involving the bird community which frequent this type of vegetation are incipient (Carrara and Faria, 2012). The management of monodominant *Eremanthus erythropappus* and *Eremanthus incanus* forests was legally instituted in the state of Minas Gerais, Brazil, in 2007 (Ordinance No. 01, of January 5, 2007 from the State Forestry Institute of the state of Minas Gerais), however knowledge about the impacts of forest management on avifauna are incipient due to the lack of studies which have investigated the avifauna which frequent these forests (Carrara and Faria, 2012).

There are some incipient studies which have evaluated the avifauna composition which frequents monodominant montane forests in the Neotropical region (Lloyd and Marsden, 2008; Gareca *et al.*, 2010; Carrara and Faria, 2012). However, due to the low diversity of tree species in monodominant forests, they run the risk of not being considered important for conservation policies and are neglected by research, including in well-sampled regions (Mariano *et al.*, 2019), and even today new types of these forests can be described (Fonty *et al.*, 2011).

Thus, in order to create bases for the conservation of monodominant neotropical forests, subsidize conservation strategies for montane ecosystems of the Atlantic Forest-Cerrado ecotone, and subsidize the forest management of *Eremanthus* forests, this study aimed to

investigate whether monodominant *E. erythropappus* forests have a unique bird community in relation to other types of adjacent vegetation along a montane ecosystem in an ecotonal Atlantic Forest-Cerrado in Brazil, and to compare the avifauna of preserved and managed monodominant *E. erythropappus* forests. In order to achieve our main objectives, we compared the richness, structure and composition of the bird community of the preserved and managed *E. erythropappus* forests with the bird communities of the adjacent vegetation (i.e. rupestrian fields and cloud forests).

MATERIAL AND METHODS

Study area

The montane ecosystem where the study was conducted is located in an ecotonal region between the Atlantic Forest and the Cerrado (Lima *et al.*, 2011), constituted as two biodiversity hotspots (Myers *et al.*, 2000) as it is in an area of high biodiversity (Drummond *et al.*, 2009), and named Chapada das Perdizes (21° 35' 37" S and 44° 34' 14" W), southeastern Brazil. The landscape is composed of a complex mosaic of different vegetation types which vary on a short spatial scale, which includes areas of rupestrian fields (predominant in the landscape), cloud forests, monodominant *Eremanthus* forests (popularly known as "*Candeias*") and seasonal semi-deciduous forests. It is worth noting that these types of vegetation have sharp edges between themselves, and that this vegetation mosaic is therefore an excellent place to study the effects of vegetation on the animal community.

Eremanthus erythropappus forests in Chapada das Perdizes characteristically occur either as patches within the forest matrix or as narrow belts located at the interface between forests and fields, and have only one vertical stratum predominated by *E. erythropappus* (Oliveira-Filho *et al.*, 2004), in addition to the presence of grass species. The managed *E. erythropappus* forests have lower density, basal area and average tree height in relation to natural *E. erythropappus* forests, and grass species are more abundant. Cloud forests occur on mountain tops, usually associated with streams and have greater structural complexity with two defined strata, canopy and understory. Finally, the rupestrian fields correspond to mountain pastures associated with quartzite outcrops (Vasconcelos *et al.*, 2011).

The relief of Chapada das Perdizes is quite varied and has altitudes ranging from 1310 to 1530 m in altitude. The region's climate is Cwb for mountain tops according to the Köppen-Geiger classification, with an average annual rainfall of 1529.7 mm and an average annual temperature of 19.4°C (Alvares *et al.*, 2013).

Data collection

We sampled 12 areas throughout our study area to assess the bird community: three preserved *Eremanthus erythropappus* forest areas, three managed

E. erythropappus forest areas, three rupestrian field areas and three cloud forest areas (Figure 1). Each sampled area was visited during a wet and hot season (March 2018) and another in a dry and cold season (August 2018). Each sampling period in the season had twelve days in order to register both resident birds and species which perform seasonal migrations.

The observations in each sampling area lasted five hours (from 6 am to 11 am and/or from 12 am to 5 pm) in each station, with the order of the observations of the areas between the stations being inverted in order to sample all the areas in both periods of the day (morning and afternoon). A total of 60 hours of observations per season and 120 hours of total observations, where the records within a variable detection radius were considered (as in Anjos et al., 2004; Uezu et al., 2005; Alexandrino et al., 2016), but only considering valid records of birds heard or seen inside each sampled area. We used the cumulative number of contacts (meaning each of the auditory or visual records of distinct individuals) of each species and in each area, which were considered as a measure of abundance (Bibby et al., 2000; Anjos et al., 2004; Vielliard et al., 2010; Alexandrino et al., 2016). The records were obtained using Nikon 8x40 binoculars, and the nomenclature used followed the Brazilian Ornithological Records Committee according to Piacentini et al. (2015), and the food preference of the most viewed species were classified according to Sick (1997).

Data analysis

We first evaluated the species shared between the habitats and unique species of each habitat from the occurrence data and number of species views at each of the sampling points. Next, we performed a Non-Metric Multidimensional Scaling (NMDS) using Bray-Curtis as a distance measure from the number of views as an abundance synthesis. The obtained result was subjected to a Similarity Analysis (ANOSIM) (Clarke, 1993) at the 5% significance level to test whether the habitats are home to different bird communities. The Bray-Curtis matrix between sampled areas was further partitioned into the components of "balanced variation of abundance" and "gradient of abundance" (Baselga, 2013) in order to identify which process is responsible for possible variations in dissimilarity between habitats. Finally, we separated the species which corresponded to 50% of the views of each of the three habitats and evaluated how their representativeness in number of views changes along the vegetation mosaic. All analyzes were performed using the R Studio (2018) software using the *vegan* (Oksanen et al., 2018) and *betapart* (Baselga et al., 2013) packages. In addition, we have described the feeding habits of the five bird species with the highest number of records in each of the four sampled habitats. It is important to note that we did not use preserved and managed *Eremanthus erythropappus* forests in all analyzes. This only occurred when the objective was to assess the effects of management on the *E. erythropappus* forests bird community.

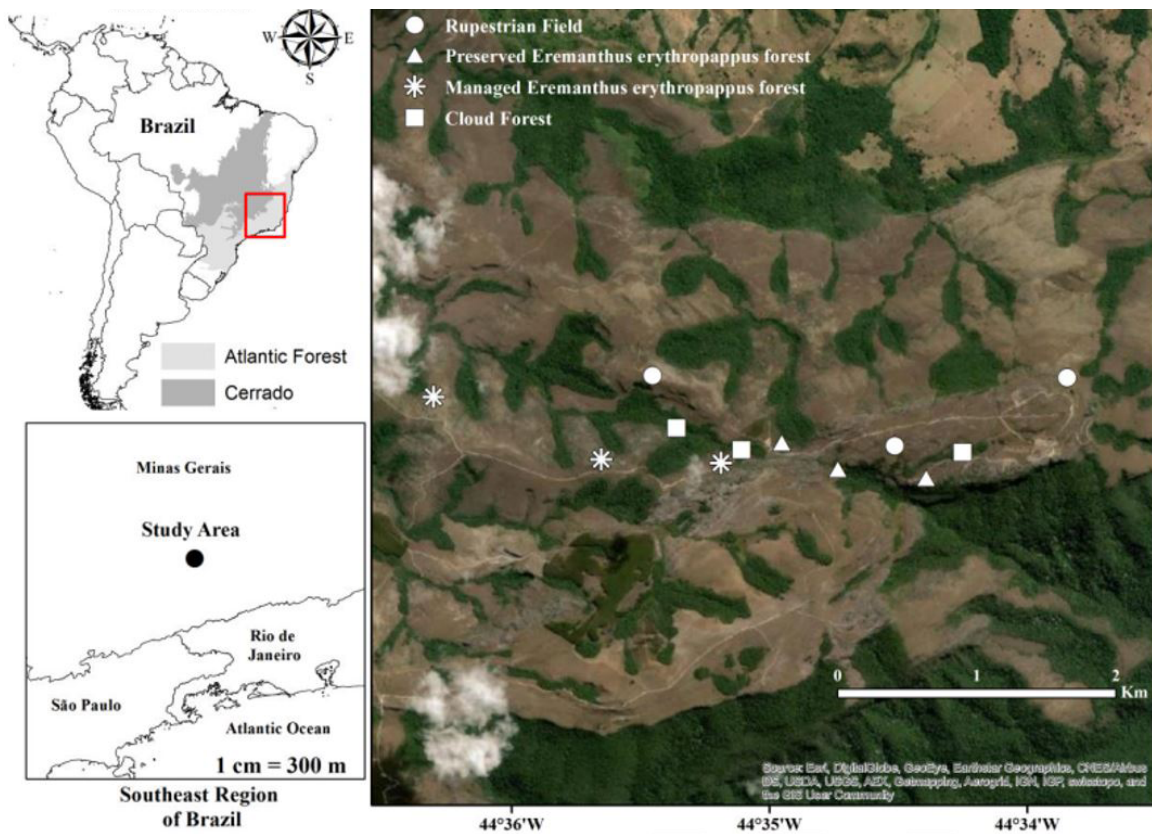


Figure 1. Sampling areas of the bird community in a montane ecosystem in the Atlantic Forest-Cerrado ecotone, southeastern Brazil.

RESULTS

Altogether we recorded 1,234 encounters in the studied montane ecosystem, which comprised 100 species of birds belonging to 88 genera and 34 families (Supplementary material). The bird families most represented in number of species were: Thraupidae (18 species), Tyrannidae (16), Trochilidae (9) and Rhynchocyclidae (5). The following exclusive species from the Cerrado domain were recorded: *Zenaida auriculata* (Des Murs, 1847), *Synallaxis spixi* Sclater, 1856, *Melanopareia torquata* (Wied, 1831) and *Coryphaspiza melanotis* (Temminck, 1822); and exclusive species of the Atlantic Forest: *Pyriglena leucoptera* (Vieillot, 1818), *Conopophaga lineata* (Wied, 1831), *Chiroxiphia caudata* (Shaw and Nodder, 1793), *Mionectes rufiventris* Cabanis, 1846, *Hemitriccus nidipendulus* (Wied, 1831), *Thamnophilus ruficapillus* Vieillot, 1816, *Knipolegus nigerrimus* (Vieillot, 1818) and *Tachyphonus coronatus* (Vieillot, 1822) (Silva 1995, Silva and Santos 2005, Lopes et al. 2017). Altogether 3% of the registered species (three species) are threatened with extinction (IUCN 2020, MMA 2014): *Culicivora caudacuta* (Vieillot, 1818), *Anthus nattereri* Sclater, 1878, and *Coryphaspiza melanotis* (Temminck, 1822).

Cloud forests were the environment with the highest species richness (58 species), followed by the preserved *Eremanthus erythropappus* forests with 49 species, the rupestrian fields with 45 species, and lastly by the managed *Eremanthus erythropappus* forests (35 species) with the least richness. Regarding the most registered species in the sampled vegetation types (Table 1), *Zonotrichia capensis* (Statius Muller, 1776) was the most represented species and one of the most registered species in three of the four sampled habitats (preserved and managed *Eremanthus erythropappus* forests, and rupestrian fields). The dominant species in the four sampled habitats mostly corresponded to insectivorous birds.

Our analyzes showed that each of the four studied habitats houses a distinct bird community (Anosim <0.0001; R = 0.96) (Figure 2), which could be seen by the first axis of the NMDS, where the points sampled in each habitat are grouped along the vegetation gradient from the field to the forest.

The areas sampled in the preserved and managed *Eremanthus erythropappus* forests were located between the cloud forests and the rupestrian fields.

The numbers of species shared between the preserved *Eremanthus erythropappus* forests and the rupestrian fields and cloud forests were similar, which in turn shared only two species. Together, the species recorded in the preserved *Eremanthus erythropappus* forests and the species shared with the other habitats represented 50% of the sampled species pool. The rest of the species were registered exclusively in managed *Eremanthus erythropappus* forests, or in cloud forests, or in rupestrian fields, or shared among these habitats (Figure 3).

Our data showed that the managed *Eremanthus erythropappus* forests did not have any shared species with the cloud forest, and that they had the largest number of species shared with the rupestrian field (Figure 4). In addition, the number of species shared between the rupestrian fields and the natural (N = 5) and managed (N = 6) *Eremanthus erythropappus* forests was greater than the number of species shared between the rupestrian fields and the cloud forests. (N=1).

Species sharing between the sampled vegetation types is associated with variations in the representativeness of species abundance across habitats, as demonstrated by the preponderance of the balanced variation in species abundance in the formation of Bray-Curtis dissimilarity observed among the sampled vegetation types (Figure 5).

Although changes in the representativeness of bird species occur along the vegetation gradient in the sampled montane ecosystem, the most abundant species in preserved *Eremanthus erythropappus* forests were also important in other habitats, corresponding to 30% of the number of views in cloud forests and in rupestrian fields, while the dominant species in these habitats (cloud forests and rupestrian fields) are less representative in preserved *Eremanthus erythropappus* forests. The most representative species (in this case the most abundant) shared between the preserved *Eremanthus erythropappus* forests and the cloud forests tend to correspond to the most representative species in the montane fields (Figure 6).

Table 1. Five bird species with the highest number of records in each of the four sampled habitats, with the number of views in parentheses, in a montane ecosystem in the Atlantic Forest-Cerrado ecotone, southeastern Brazil. Legend of food guild abbreviations: insectivore (Ins), nectarivore (Nec), granivore (Gra), frugivore (Fru), according to Sick (1997).

Field	Guild	Cloud Forest	Guild
<i>Knipolegus nigerrimus</i> (33)	Ins	<i>Tangara cyanoventris</i> (26)	Fru
<i>Colibri serrirostris</i> (31)	Nec	<i>Thamnophilus caeruleus</i> (21)	Ins
<i>Zonotrichia capensis</i> (28)	Gra	<i>Myiothlypis leucoblephara</i> (20)	Ins
<i>Culicivora caudacuta</i> (26)	Ins	<i>Platyrinchus mystaceus</i> (19)	Ins
<i>Sicalis citrina</i> (25)	Gra	<i>Patagioenas picazuro</i> (18)	Fru
Preserved <i>E. erythropappus</i> forests		Managed <i>E. erythropappus</i> forests	
<i>Zonotrichia capensis</i> (32)	Gra	<i>Zonotrichia capensis</i> (43)	Gra
<i>Elaenia obscura</i> (22)	Ins	<i>Ammodramus humeralis</i> (19)	Gra
<i>Tangara cyanoventris</i> (18)	Fru	<i>Patagioena spicazuro</i> (16)	Fru
<i>Knipolegus nigerrimus</i> (17)	Ins	<i>Colibri serrirostris</i> (13)	Nec
<i>Chlorostilbon lucidus</i> (17)	Nec	<i>Hirundinea ferruginea</i> (13)	Ins

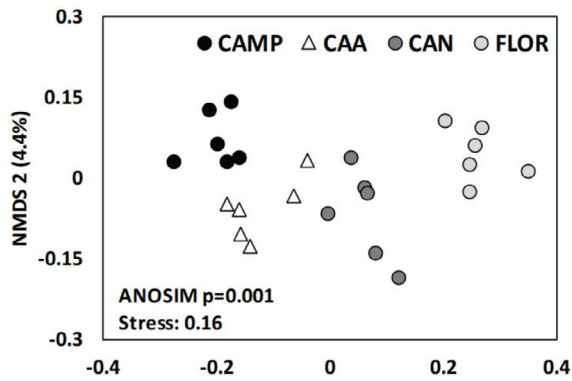


Figure 2. Non-Metric Multidimensional Scaling (NMDS) using Bray-Curtis as a distance measure for vegetations sampled in a montane ecosystem in the Atlantic Forest-Cerrado ecotone, southeastern Brazil. Note: CAN: preserved *Eremanthus erythropappus* forests; CAA: managed *Eremanthus erythropappus* forests; FLOR: cloud forests; CAMP: rupestrian fields.

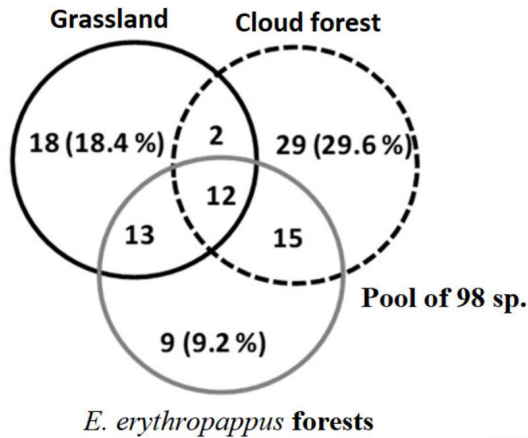


Figure 3. Venn diagram for the occurrence of bird species in preserved *Eremanthus erythropappus* forests, cloud forests and rupestrian fields in a montane ecosystem in the Atlantic Forest-Cerrado ecotone, southeastern Brazil.

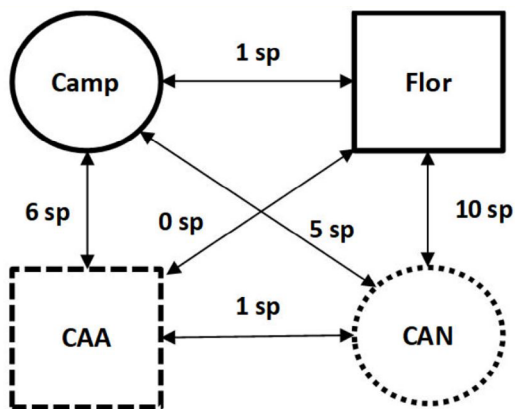


Figure 4. Species sharing between bird communities of different habitats, considering the species occurring in only two of the four habitats sampled in a montane ecosystem in the Atlantic Forest-Cerrado ecotone, southeastern Brazil. Note: CAN: preserved *Eremanthus erythropappus* forests; CAA: managed *Eremanthus erythropappus* forests; FLOR: cloud forests; CAMP: rupestrian fields.

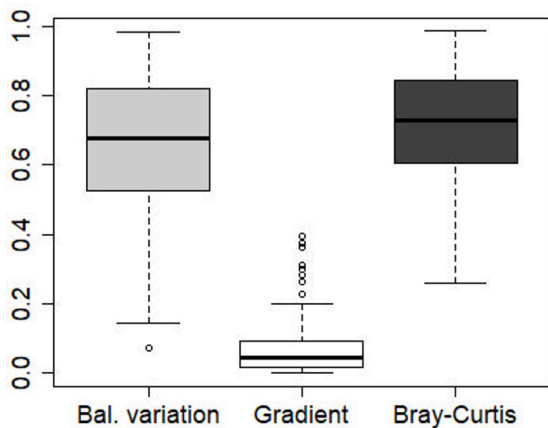


Figure 5. Partitioning of Bray-Curtis dissimilarity in the balanced variation and gradient variation components for comparisons of the bird community between the sampled vegetation types in a montane ecosystem in the Atlantic Forest-Cerrado ecotone, southeastern Brazil.

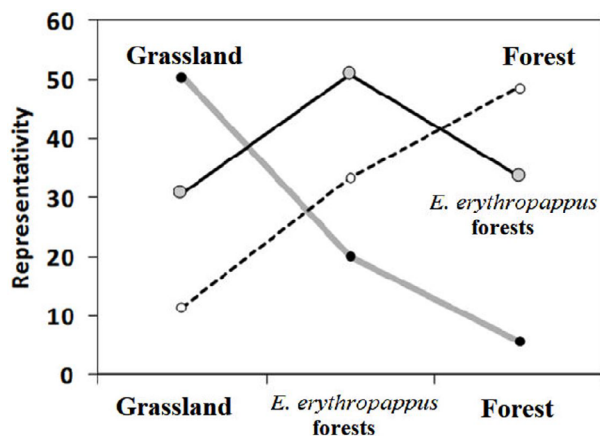


Figure 6. Representativeness of the most abundant bird species in the sampled vegetation types in a montane ecosystem in the Atlantic Forest-Cerrado ecotone, southeastern Brazil.

DISCUSSION

The present study aimed to evaluate whether monodominant *Eremanthus* forests have a unique bird community in relation to the adjacent vegetation in a vegetation mosaic located in a montane ecosystem, and also to compare the avifauna of preserved and managed monodominant *E. erythropappus* forests. Our data showed that these monodominant forests have a distinct bird community in relation to adjacent vegetation due to the replacement of species abundances, and that the bird community varied between managed and preserved *E. erythropappus* forests, suggesting that forest management may alter the fauna that frequent these forests.

Many of the bird families most represented in our work were well represented in other studies conducted in areas close to our study area (D'Angelo Neto et al., 1998; Ribon, 2000; Vasconcelos et al., 2002; Lopes, 2006; Braga et al., 2010; Moura et al., 2015), and also in studies developed in more distant regions in high altitude areas in Brazil (Rodrigues et al., 2005; Santos and Silva, 2007; Vieira et al., 2013). The most representative families in the studied montane ecosystem (Thraupidae, Tyrannidae and Trochilidae) correspond to the bird families of the largest number of species in the Brazilian territory (Piacentini et al., 2015), and also in South America (Erize et al., 2006; Ridgely and Tudor, 2009; Van Perlo, 2015).

The number of bird species recorded in the evaluated montane ecosystem (100 species) was similar to the values found in other studies carried out in nearby landscapes and with similar elevations (Vasconcelos, 2003; Vasconcelos and D'Angelo-Neto, 2007; Rodrigues et al., 2016). However, these studies did not evaluate the bird community of monodominant *Eremanthus* forests, although they occur in the regions studied in these studies. There are monodominant forests in the Neotropical region with a predominance of different species, such as *Tabebuia aureus* in the biogeographic region of the Pantanal (Capuzzo et al., 2012), *Acrocomia aculeata*, *Mauritia flexuosa*, and *Syagrus oleracea* in the biogeographic Cerrado region (Ribeiro and Walter 2008), *Tabebuia cassinoides* on the Brazilian

coast (Sebbenn et al., 2001), and *Polylepis* in the Andes (Lloyd and Marsden, 2008; Gareca et al., 2010). However, to our knowledge there are few studies which investigated whether these monodominant forests in the Neotropical region are home to a distinct bird community in relation to the bird community of adjacent communities, in this case studies carried out in monodominant *Polylepis* forests in the Andes (Lloyd and Marsden, 2008; Gareca et al., 2010). Thus, the present work contributes to the knowledge of bird communities from monodominant neotropical forests, suggesting that the conservation of such forests may be important for biodiversity, and that they should be taken into consideration in conservation plans.

Cloud forests showed the greatest richness of bird species, probably due to their greater structural complexity and diversity of plant species, as observed by Mota et al. (2012) in Atlantic Rain Forest areas compared to managed areas. The second largest bird richness was found in the preserved monodominant *E. erythropappus* forests (49 species), followed by the rupestrian fields (45 species), while the managed monodominant *E. erythropappus* forests had the lowest richness (35 species). This suggests that forest management in monodominant *Eremanthus* forests alters the bird community by reducing species richness. Negative effects of forest management on avifauna have also been recorded in managed restinga areas in the northeast of Brazil (Mota et al., 2012), where there was less use of habitat by species possibly due to reduced presence of shelter and food resources. The richness and uniqueness of the bird community found in monodominant *E. erythropappus* forests indicates that the impacts of forest management on the fauna of these forests cannot be neglected.

Although our results indicate that the bird community in monodominant *E. erythropappus* forests is distinct from the communities in the other studied vegetations, this distinction is the result of the combination of bird species from cloud forests and rupestrian fields, with variations in species abundance. Thus, our results suggest that monodominant *E. erythropappus* forests may correspond to small scale ecotones, harboring ecotonal communities. Transition areas, border regions and system edges where ecological communities (plants and animals) share the elements of the adjacent biomes are considered ecotones (Kark and Van Rensburg, 2006).

In addition, our data showed that monodominant *E. erythropappus* forests have few unique species. Furthermore, the exclusive and shared species associated with this vegetation together correspond to half of the total number of species sampled in our study area. On the other hand, the remaining half of the species was exclusively registered in areas of rupestrian fields and cloud forests, or shared by these two vegetation types. A similar result was found in a study carried out in monodominant *Polylepis* forests in the Peruvian Andes, where species exclusive to this vegetation and shared with the adjacent vegetations corresponded to half of the local species pool (Lloyd and Maridem, 2008). We emphasize that the avifauna composition found in the *Eremanthus erythropappus* forests in our study area probably differs from the avifauna

of other monodominant *Eremanthus* forests distributed over the wide range of occurrence of these forests (Lorenzi 2016; Flora do Brasil 2020), which occur both in the Atlantic Forest (Borges *et al.*, 2019; Flora do Brasil, 2020) and in the Cerrado (Flora do Brasil, 2020).

The bird community in the montane fields presented the second smallest number of species, which is probably due to the fact that this phytophysiognomy does not present vertical tree strata, with a predominance of herbaceous-shrub and grass plants (Vasconcelos, 2011), and scarce amounts of trees. However, even though it presented an avifauna with lesser richness when compared to the preserved cloud forests and the *Eremanthus erythropappus* forests, this vegetation presented the greatest number of threatened bird species (three species), thus corroborating studies which affirm that birds with closely related ecology fields are among the most endangered species (Machado *et al.*, 1998; Lopes *et al.*, 2009; Bird Life Internacional, 2020). In addition to these three species, another three species threatened with extinction were seen in areas of preserved *Eremanthus erythropappus* forests during the team's movements during data collection in the studied montane ecosystem (Chapada das Perdizes), but were not considered for our analysis because they were observed outside the sampling points, with these species being: *Urubitinga coronata* (Vieillot, 1817), *Amazona vinacea* (Kuhl, 1820) and *Alecturus tricolor* (Vieillot, 1816) (MMA, 2014; IUCN, 2020).

Montane ecosystems in ecotonal regions such as Chapada das Perdizes deserve prominence in conservation plans since the protection of these areas ensures the conservation of typical species from neighboring biomes, and also of species exclusive to ecotonal areas (Souza *et al.*, 2020). Ecotonal regions between biodiversity hotspots, which is the case of our study area (an ecotone Atlantic Forest-Cerrado), are even more important for conservation. The Atlantic Forest and the Cerrado have been recognized as global biodiversity hotspots (Myers *et al.*, 2000) since they have a high number of species (Sick, 1997; Castro *et al.*, 1998; Myers *et al.*, 2000; Mittermeier *et al.*, 2005), great alpha and beta diversity (Ratter *et al.* 2003; Bridgewater *et al.* 2004) and high level of endemism (Silva, 1995; Costa *et al.*, 2000; Klink and Machado, 2005). Despite this, Chapada das Perdizes has suffered an increasing loss of areas of native vegetation since the last decade due to changes in land use (Moura *et al.*, 2021).

Although *Eremanthus* forests are legally exploited (in this case monodominant *Eremanthus erythropappus* and *Eremanthus incanus* forests in the state of Minas Gerais, Brazil), studies on the fauna which use this vegetation type are still incipient. Thus, our study creates subsidies for the forest management of these forests. In addition, our results showed that forest management changes the bird community in these forests, decreasing species richness. We suggest that further studies involving communities of different animal taxa should be conducted in these monodominant forests in order to create more solid bases for forest management and conservation policies in these forests, and to enable comparisons with the results presented herein.

CONCLUSION

We conclude that the bird communities of the sampled phytophysiognomies in the studied montane ecosystem are different from each other due to structural and management differences in the studied vegetation types. We highlight that the monodominant *Eremanthus erythropappus* forests have a unique (their own) and dissimilar bird community, and are characterized as an ecotonal community for sharing species with the adjacent vegetation (i.e. cloud forests and rupestrian fields), pointing out the importance of conserving these monodominant forests for maintaining biodiversity in the studied vegetation mosaic.

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AUTHORSHIP CONTRIBUTION

Project Idea: ASM, FSM

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Processing: ASM, CRS, FSM, WJSJ, BSC, RFM, MALF

Analysis: ASM, FSM, WJSJ, BSC, RFM

Writing: ASM, FSM, WJSJ, BSC, RFM, MALF

Review: ASM, FSM, WJSJ, BSC, RFM, MALF

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SUPPLEMENTARY MATERIAL

Supplementary material 1. Bird species list of montane phytophysiognomies with abundances (managed candeias = MAC, Field = FIE, preserved candeias = PRC e florestas nebulares= FOR), from Perdizes Plateau, Brazil.

Família/Espécie	MAC	FIE	PRC	FOR
Tinamidae				
<i>Rhynchotus rufescens</i> (Temminck, 1815)	0	4	0	0
Cracidae				
<i>Penelope obscura</i> Temminck, 1815	0	0	2	1
Accipitridae				
<i>Geranoaetus melanoleucus</i> (Vieillot, 1819)	0	1	0	0
<i>Buteo brachyurus</i> Vieillot, 1816	0	0	1	0
Columbidae				
<i>Patagioenas picazuro</i> (Temminck, 1813)	16	11	11	18
<i>Zenaida auriculata</i> (Des Murs, 1847)	5	7	11	0
<i>Leptotila verreauxi</i> Bonaparte, 1855	0	0	2	0
Cuculidae				
<i>Piaya cayana</i> (Linnaeus, 1766)	1	0	0	0
Trochilidae				
<i>Phaethornis pretrei</i> (Lesson & Delattre, 1839)	1	1	7	4
<i>Phaethornis eurynome</i> (Lesson, 1832)	0	0	0	4
<i>Eupetomena macroura</i> (Gmelin, 1788)	0	1	1	0
<i>Colibri serrirostris</i> (Vieillot, 1816)	13	31	11	1
<i>Chlorostilbon lucidus</i> (Shaw, 1812)	7	5	17	7
<i>Thalurania glaucopis</i> (Gmelin, 1788)	1	0	0	0
<i>Leucochloris albicollis</i> (Vieillot, 1818)	0	0	0	3
<i>Amazilia fimbriata</i> (Gmelin, 1788)	0	0	0	1
<i>Amazilia lactea</i> (Lesson, 1832)	0	0	3	1
<i>Helioaster squamosus</i> (Temminck, 1823)	0	1	0	0
Bucconidae				
<i>Nystalus chacuru</i> (Vieillot, 1816)	0	0	1	0
Ramphastidae				
<i>Ramphastos toco</i> Stadius Muller, 1776	2	5	0	3
<i>Ramphastos dicolorus</i> Linnaeus, 1766	0	0	0	1
Picidae				
<i>Veniliornis passerinus</i> (Linnaeus, 1766)	1	0	2	1
<i>Colaptes campestris</i> (Vieillot, 1818)	6	15	2	0
Falconidae				
<i>Milvago chimachima</i> (Vieillot, 1816)	0	0	0	3

Família/Espécie	MAC	FIE	PRC	FOR
Psittacidae				
<i>Psittacara leucophthalmus</i> (Stadius Muller, 1776)	0	4	0	0
<i>Eupsittula aurea</i> (Gmelin, 1788)	0	6	2	0
Tyrannidae				
<i>Hirundinea ferruginea</i> (Gmelin, 1788)	12	8	2	0
<i>Camptostoma obsoletum</i> (Temminck, 1824)	0	0	0	1
<i>Elaenia flavogaster</i> (Thunberg, 1822)	0	1	0	1
<i>Elaenia chiriquensis</i> Lawrence, 1865	0	1	1	0
<i>Elaenia obscura</i> (d'Orbigny & Lafresnaye, 1837)	6	2	22	11
<i>Culicivora caudacuta</i> (Vieillot, 1818)	6	26	0	0
<i>Serpophaga subcristata</i> (Vieillot, 1817)	3	1	5	4
<i>Myiarchus ferox</i> (Gmelin, 1789)	7	1	9	0
<i>Colonia colonus</i> (Vieillot, 1818)	1	0	1	2
<i>Lathrotricus eulerei</i> (Cabanis, 1868)	0	0	0	9
<i>Knipolegus cyanirostris</i> (Vieillot, 1818)	0	0	0	2
<i>Knipolegus lophotes</i> Boie, 1828	10	8	8	0
<i>Knipolegus nigerrimus</i> (Vieillot, 1818)	10	33	17	7
<i>Xolmis cinereus</i> (Vieillot, 1816)	0	1	0	0
<i>Xolmis velatus</i> (Lichtenstein, 1823)	2	10	0	0
<i>Muscipira vetula</i> (Lichtenstein, 1823)	8	0	16	10
Thamnophilidae				
<i>Dysithamnus mentalis</i> (Temminck, 1823)	0	0	0	2
<i>Thamnophilus ruficapillus</i> Vieillot, 1816	0	0	2	0
<i>Thamnophilus caerulescens</i> Vieillot, 1816	4	0	13	21
<i>Pyriglena leucoptera</i> (Vieillot, 1818)	0	0	6	10
Melanopareidae				
<i>Melanopareia torquata</i> (Wied, 1831)	0	13	1	0
Conopophagidae				
<i>Conopophaga lineata</i> (Wied, 1831)	0	0	0	7
Rhinocryptidae				
<i>Scytalopus petrophilus</i> Whitney, Vasconcelos, Silveira & Pacheco, 2010	0	0	0	7
Dendrocolaptidae				
<i>Sittasomus griseicapillus</i> (Vieillot, 1818)	0	0	2	3

Família/Espécie	MAC	FIE	PRC	FOR
Xenopidae				
<i>Xenops rutilans</i> Temminck, 1821	0	0	0	1
Furnariidae				
<i>Heliobletus contaminates</i> Pelzeln, 1859	0	0	0	11
<i>Syndactyla rufosuperciliata</i> (Lafresnaye, 1832)	0	0	0	2
<i>Anumbius annumbi</i> (Vieillot, 1817)	0	3	0	0
<i>Synallaxis spixi</i> Sclater, 1856	7	2	5	2
Pipridae				
<i>Chiroxiphia caudata</i> (Shaw & Nodder, 1793)	0	0	0	5
Tityridae				
<i>Schiffornis virescens</i> (Lafresnaye, 1838)	0	0	0	1
Cotingidae				
<i>Phibalura flavirostris</i> Vieillot, 1816	0	0	2	2
Platyrinchidae	0	0	0	0
<i>Platyrinchus mystaceus</i> Vieillot, 1818	0	0	0	19
Rhynchocyclidae				
<i>Mionectes rufiventris</i> Cabanis, 1846	0	0	0	3
<i>Phylloscartes ventralis</i> (Temminck, 1824)	0	1	5	1
<i>Tolmomyias sulphurescens</i> (Spix, 1825)	0	0	0	2
<i>Hemitriccus diops</i> (Temminck, 1822)	0	0	0	4
<i>Hemitriccus nidipendulus</i> (Wied, 1831)	0	0	0	1
Hirundinidae				
<i>Pygochelidon cyanoleuca</i> (Vieillot, 1817)	0	0	4	0
Troglodytidae				
<i>Troglodytes musculus</i> Naumann, 1823	1	1	5	0
<i>Cistothorus platensis</i> (Latham, 1790)	1	13	0	0
Turdidae				
<i>Turdus leucomelas</i> Vieillot, 1818	0	0	0	4
<i>Turdus rufiventris</i> Vieillot, 1818	0	0	0	2
<i>Turdus albicollis</i> Vieillot, 1818	0	0	0	8
Motacillidae				
<i>Anthus nattereri</i> Sclater, 1878	0	6	0	0
<i>Anthus hellmayri</i> Hartert, 1909	0	15	0	0

Família/Espécie	MAC	FIE	PRC	FOR
Parulidae				
<i>Setophaga pitiayumi</i> (Vieillot, 1817)	0	1	0	0
<i>Basileuterus culicivorus</i> (Deppe, 1830)	0	0	2	0
<i>Myiothlypis leucoblephara</i> (Vieillot, 1817)	0	0	1	20
Icteridae				
<i>Gnorimopsar chopi</i> (Vieillot, 1819)	0	11	0	0
<i>Molothrus bonariensis</i> (Gmelin, 1789)	0	1	0	0
Passerellidae				
<i>Zonotrichia capensis</i> (Statius Muller, 1776)	43	28	32	11
<i>Ammodramus humeralis</i> (Bosc, 1792)	19	22	0	0
Thraupidae				
<i>Pipraeidea melanonota</i> (Vieillot, 1819)	0	0	2	3
<i>Stephanophorus diadematus</i> (Temminck, 1823)	0	0	0	2
<i>Schistochlamys ruficapillus</i> (Vieillot, 1817)	3	2	8	0
<i>Tangara cyanoventris</i> (Vieillot, 1819)	0	0	18	26
<i>Tangara desmaresti</i> (Vieillot, 1819)	0	0	5	7
<i>Tangara sayaca</i> (Linnaeus, 1766)	0	0	0	12
<i>Tangara cayana</i> (Linnaeus, 1766)	0	0	2	4
<i>Sicalis citrina</i> Pelzeln, 1870	8	25	0	0
<i>Volatinia jacarina</i> (Linnaeus, 1766)	0	0	2	0
<i>Tachyphonus coronatus</i> (Vieillot, 1822)	0	0	0	8
<i>Trichothraupis melanops</i> (Vieillot, 1818)	0	0	0	6
<i>Tersina viridis</i> (Illiger, 1811)	0	6	2	0
<i>Dacnis cayana</i> (Linnaeus, 1766)	0	2	7	2
<i>Coereba flaveola</i> (Linnaeus, 1758)	0	0	0	3
<i>Sporophila caerulescens</i> (Vieillot, 1823)	12	5	5	3
<i>Emberizoides herbicola</i> (Vieillot, 1817)	9	11	0	0
<i>Coryphaspiza melanotis</i> (Temminck, 1822)	0	2	0	0
<i>Saltator similis</i> d'Orbigny & Lafresnaye, 1837	3	0	6	13
Fringillidae				
<i>Spinus magellanicus</i> (Vieillot, 1805)	5	3	8	0
<i>Euphonia chlorotica</i> (Linnaeus, 1766)	2	0	2	0
Cardinalidae				
<i>Piranga flava</i> (Vieillot, 1822)	0	0	8	0