

**DIVERSITY OF NOCTURNAL BIRDS IN FOREST FRAGMENTS
IN THE PAMPA BIOME, SOUTHERN BRAZIL**

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ABSTRACT

Studies on nocturnal birds in the Neotropical region are still considered scarce in the literature, lacking bioecological approaches to this group in the wild. The present study aimed to obtain information on the abundance, richness, and composition of nocturnal birds found in forest fragments in the Central Region, state of Rio Grande do Sul, Brazil. Data collection was conducted between 2015 and 2016 through listening points, in three fragments in the region (defined as A, B, and C). Seven species of nocturnal birds were recorded and the most abundant were Ferruginous Pygmy-Owl (*Glaucidium brasilianum*) and Tropical Screech-Owl (*Megascops choliba*). Summer was the most representative season in abundance and species richness. In terms of composition, fragment (A) presented a distinction, with an exclusive species, the bacurau-chintã (*Hydropsalis parvula*). The feeding guilds are composed of carnivorous and insectivorous individuals, most of which are annual residents of the state. The assemblage of nocturnal birds recorded in the fragments of deciduous seasonal forest in the central region reports information about this group, which seems to be locally adapted to live in these altered forest environments, which in a way, still provide resources to meet their trophic needs.

Keywords: Abundance; Birds; Strigiformes; Caprimulgiformes; Nyctibiiformes; Central region; Rio Grande do Sul.

RESUMO

Diversidade de aves noturnas em fragmentos florestais no Bioma Pampa, sul do Brasil. Estudos na região neotropical direcionados a aves noturnas ainda são considerados escassos na literatura, carecendo de abordagens bioecológicas deste grupo em vida livre. O presente estudo teve por objetivo obter informações de abundância, riqueza e composição de aves noturnas encontradas em fragmentos florestais da Região Central, estado do Rio Grande do Sul, Brasil. A coleta de dados foi realizada entre 2015 e 2016 através de pontos de escuta, em três fragmentos na região (definidos como A, B e C). Sete espécies de aves noturnas foram registradas e as mais abundantes foram caburé (*Glaucidium brasilianum*) e corujinha-do-mato

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(*Megascops choliba*). O verão foi a estação mais representativa em abundância e riqueza de espécies. Na composição o fragmento (A) apresentou distinção, com uma espécie exclusiva, o bacurau-chintã (*Hydropsalis parvula*). As guildas alimentares são compostas basicamente por indivíduos carnívoros e insetívoros, sendo estes, em maioria, residentes anuais no estado. A assembleia de aves noturnas registrada nos fragmentos de floresta estacional decidual na região central reporta informações sobre este grupo, que aparentemente parece estar localmente adaptadas a viver nesses ambientes florestais alterados, que de certa forma, ainda disponibilizam recursos para suprir suas necessidades tróficas.

Palavras-chave: Abundância; Aves; Strigiformes; Caprimulgiformes; Nyctibiiformes; Região Central; Rio Grande do Sul.

INTRODUCTION

Representatives Strigiformes, Nyctibiiformes and Caprimulgiformes are nocturnal and crepuscular birds, found in higher frequency mainly in forest environments (Belton, 1994; Sick, 1997). These species naturally present low population density in nature, due to the need for specialized environments to attend to all their territorial and trophic requirements (Sick, 1997; Motta-Junior et al., 2017). Due to their great ecological importance, they are considered apex species in the food chain and bioindicators (Fontana et al., 2008). However, with constant anthropic pressure, urban expansion, and fragmentation of natural areas, their populations are suppressed and vulnerable to these impacts (Jullien and Thiollay, 1996; Bencke et al., 2006).

Studies in the neotropical region targeting nocturnal birds are still considered scarce in the literature, and applied methodologies and information about these species need adaptations to obtain population results since due to their discreet habits, they are considered animals difficult to observe in the wild when compared to diurnal birds (e.g., Sick, 1997; Bencke and Bencke, 1999; Motta-Junior, 2006; Legal et al., 2009; Matter et al., 2010). In the state of Rio Grande do Sul, a transition between the Atlantic Forest and Pampa Biomes occurs, which presents the occurrence of 27 species of this group (Belton, 1994; Bencke et al., 2010; Franz et al., 2018).

Considering that population information about this group is still scarce in southern Brazil (e.g., Belton, 1994; Motta-Júnior and Braga, 2012; Motta-Junior et al., 2017), studies that evaluate trophic patterns (Brentano et al., 2020), behavioral patterns (Sick, 1997; Motta-Júnior et al., 2017), abundance, composition (Sick, 1997; Motta-Junior, 2006; Legal et al., 2009; Motta-Júnior et al., 2017) and structure of vegetation on the environments that present nocturnal birds occurrence (Menq and Anjos, 2015) are extremely important to be documented (Motta-Júnior et al., 2017). In this sense, the current study aimed to obtain information on the abundance, richness, and composition of nocturnal birds found in forest fragments in southern Brazil.

MATERIAL AND METHODS

Study Area

The study was conducted in the region of the municipality of São Sepé, located in the central portion of the state of Rio Grande do Sul, Brazil. The region is inserted in the Pampa Biome and presents tree vegetation of the Deciduous Seasonal domain that suffers intense pressure from anthropic activities (IBGE, 2004). Climate is temperate, with an annual mean temperature of 19 °C and precipitation with an annual

mean of 1,750mm (Alvares et al., 2013). Three forest fragments were delimited to carry out the sampling efforts (Figure 1). The study fragments had an average distance of 20 km between them. Fragment (A), with 450ha (30°05'35.3"S, 53°36'22.9"W), in the vicinity of the São Sepé River slope (Corrêa et al., 2010; 2020). Fragment (B), with around 400ha (30°00'16.99"S, 53°42'38.63"W), near the headwaters of the Vacacaí River. Fragment (C), with around 500 ha (30°20'08.50"S, 53°35'42.88"W), on the hillside of Santa Bárbara Brook.

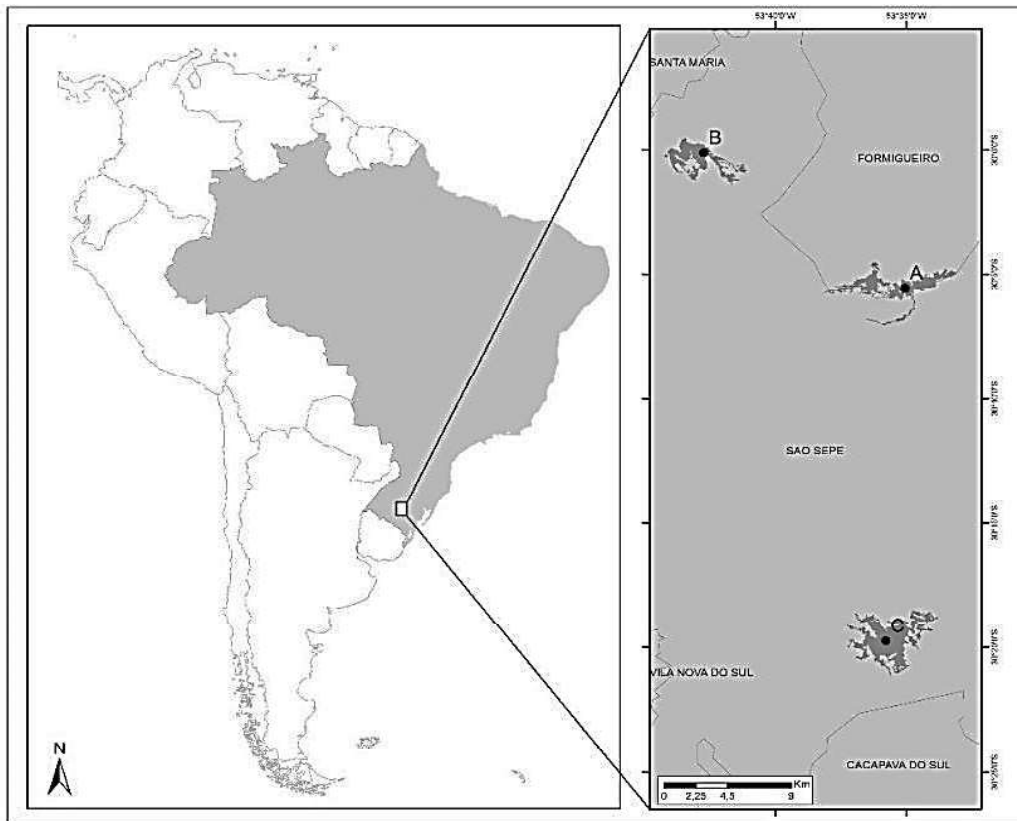


Figure 1. Location of study areas. Fragment (A): between the municipalities of São Sepé and Formigueiro; Fragment (B): between the municipalities of São Sepé and Santa Maria; Fragment (C): borders of the municipalities of São Sepé and Caçapava do Sul. Central Region, state of Rio Grande do Sul, Brazil.

Data Sampling

In each fragment, three listening points were delimited, distributed equally to cover the size of the studied area, due to the habits of the study group. For each area, the listening points were 500 meters apart on average, thus ensuring sample Independence. Each point was marked at an average of 50 m from the edge (Bibby et al., 2000). Each fragment and listening point was visited twice per season (autumn, winter, spring, and summer), between the years 2015 and 2016.

Field activities (at each listening point) started after dark and lasted until 11 pm when necessary, mainly on clear moon nights, using a clear moon and avoiding periods with winds and rain (Esclarski and Cintra, 2014). After arriving at the point, the researcher remained on hold for about five minutes before starting activities (Bibby et al., 2000), then using the playback technique. It started with the vocalization

of the smallest bird species and thus proceeding until the largest (Braga and Motta-Junior, 2009; Esclarski and Cintra, 2014). Audio reproduction was performed using the vocalization and calls of the species (reproduced using a digital recorder (mp3) and amplified speaker), totaling about two minutes played slowly. After this waiting period, a possible response was expected for about three minutes (Braga and Motta-Junior, 2009).

Subsequently, it went on to the next species and so on, according to the nocturnal birds' occurrence in the state of Rio Grande do Sul, mentioned in Bencke (2001) and Bencke et al. (2010). The nomenclature of the registered species was according to Piacentini et al. (2015), occurrence status according to Belton (1994) and Bencke (2001), and food guilds according to Sick (1997) and Azpiroz (2001).

Data Analysis

Abundance data were analyzed using the Point Abundance Index (IPA) (Bibby et al., 2000; Vielliard et al., 2010). To compare the abundance wealth of the species between the fragments, during the different seasons, analysis of variance (ANOVA) was performed, followed by tukey, accepting significance of $p < 0.05$. Statistical tests were performed using Past Software (Hammer et al., 2001). Rarefaction analysis was performed checking species richness between stations and their respective study areas, using the R project, package iNEXT, function iNEXT, with an endpoint of 35. Between stations and between points the endpoint was 100 (R Core Team, 2018). Finally, a non-metric multidimensional scaling (NMDS) analysis was performed to compare the composition between areas. Statistical tests were performed using Past Software (Hammer et al., 2001).

RESULTS AND DISCUSSION

Seven species were identified, and of these, four are Strigiformes (one Tytonidae and three Strigidae), one Nyctibiiformes (Nyctibiidae), and two Caprimulgiformes (Caprimulgidae); thus, totaling 25.9% of the nocturnal birds found in the state of Rio Grande do Sul. Fragment (A) presented a greater abundance of species, followed by fragment (C) and lastly, fragment (B), the less expressive. The species *Glaucidium brasilianum* and *Megascops choliba* (Strigiformes: Strigidae) stood out in relation to the abundance between the fragments. *Glaucidium brasilianum* obtained the highest IPA, 3.33 in fragment (A), followed by *M. choliba* with 3.11, also in the fragment (A). The registered food guilds are represented by individuals with carnivorous and insectivorous habits (Table 1).

Checking the differences between the seasons, summer was the most representative period in abundance among the areas ($p = 0.00017$). Checking for richness, summer was most representative among the areas, followed by spring. In the analysis among the fragments, what stood out the most was fragment (A) (Figure 2). It is noted that in the composition the fragments (B and C) are close in species similarity. However, fragment (A) has a tendency to be distinct, with the registration of an exclusive species, *Hydropsalis parvula* (Caprimulgiformes: Caprimulgidae) (Figure 3).

Table 1. List of nocturnal birds recorded in three forest fragments in the Central Region, state of Rio Grande do Sul, Brazil. Study fragments (A, B, and C) and their respective point abundance indexes, by species and sampled area. Occurrence status (S): (R) annual resident; (M) resident of spring and summer, migratory, who nests in the state; (#) status assumed, but not confirmed. Food guild (G): preferably carnivorous food (Car); feeding based on arthropod insects (Ins).

Taxa	A	B	C	S	G
STRIGIFORMES					
Tytonidae					
<i>Tyto furcata</i> (Temminck, 1827)	0.33	0.22	0.22	R	Car
Strigidae					
<i>Megascops choliba</i> (Vieillot, 1817)	3.11	2.55	2.55	R	Car
<i>Bubo virginianus</i> (Gmelin, 1788)	0.55	0.11	0.44	R#	Car
<i>Glaucidium brasilianum</i> (Gmelin, 1788)	3.33	2.66	2.66	R	Car
NYCTIBIIFORMES					
Nyctibiidae					
<i>Nyctibius griseus</i> (Gmelin, 1789)	0.66	0.11	0.22	M#	Ins
CAPRIMULGIFORMES					
Caprimulgidae					
<i>Lurocalis semitorquatus</i> (Gmelin, 1789)	0.33	0.22	0.33	M#	Ins
<i>Hydropsalis parvula</i> (Gould, 1837)	0.22	-	-	M	Ins

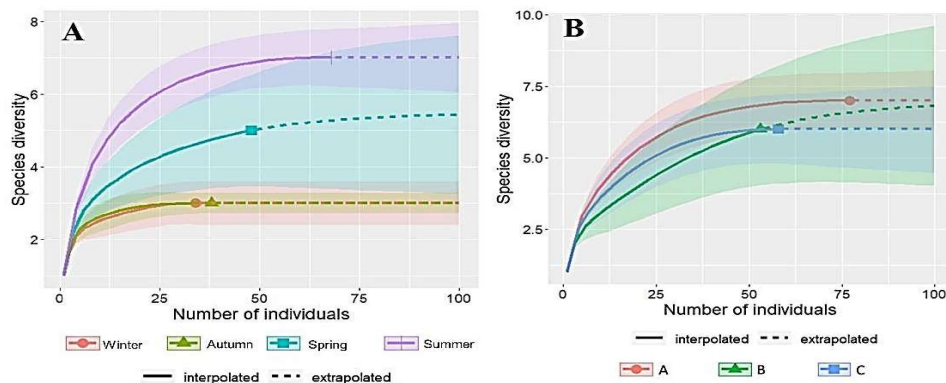


Figure 2. (A) Summer was the most representative season in species richness, followed by spring. (B) Species richness among fragments.

Considering that nocturnal birds are classified with needed population information still to be divulged in the neotropical region (Motta-Junior and Braga, 2012; Esclarski and Cintra, 2014), the bird assemblage sampled in these three forest fragments of the Deciduous Seasonal domain in the Pampa region is significant in its report of quantitative information for this group. Among the 27 nocturnal species registered in the state (Franz et al., 2018), about 20 occur in the Pampa (Belton, 1994).

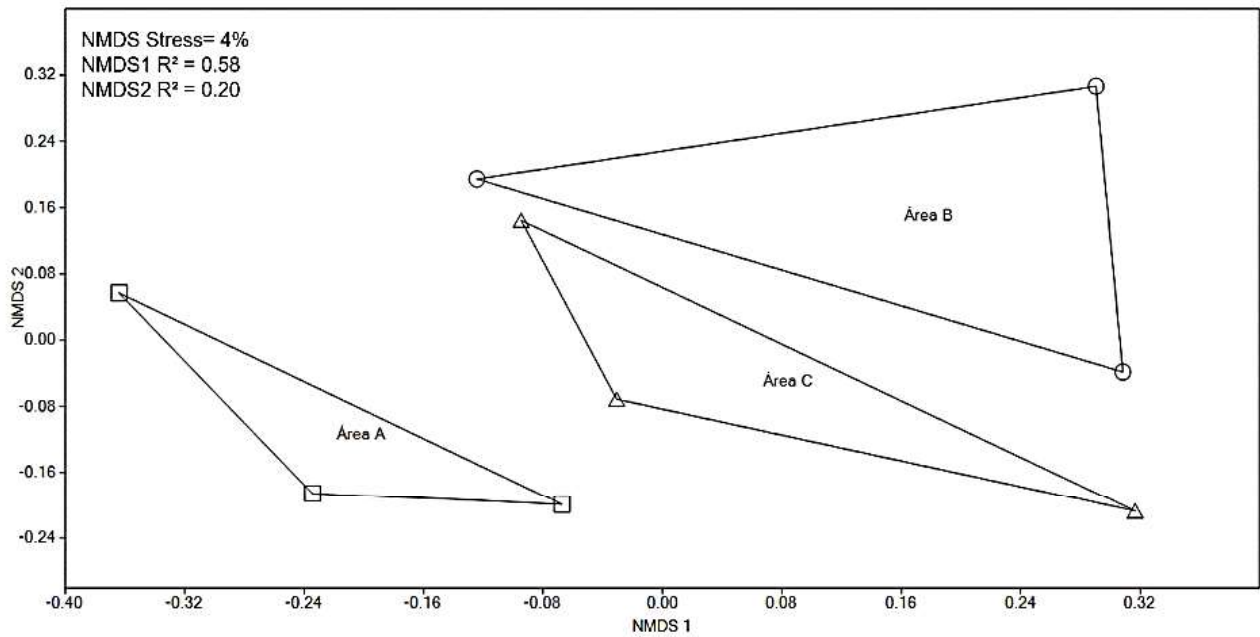


Figure 3. Ordering resulting from the analysis of Non-Metric Multidimensional Scheduling (NMDS) on the composition of nocturnal birds recorded in three forest fragments (A, B, and C) of the Seasonal Deciduous domain, in the municipality of São Sepé, Rio Grande do Sul, Brazil.

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In the present study, seven species were reported, four of which are considered annual residents and three with migratory habits (Bencke, 2001). *G. brasilianum* and *M. choliba* were the species that stood out when it came to abundance between the studied fragments, indicating that these species are probably more adapted to these altered environments in the region, being considered generalists in the selection of habitats for their trophic needs (Sick, 1997; Motta-Júnior et al., 2017).

The general abundance and richness of the registered species were more representative between the spring and summer seasons since the seasons with higher temperatures provide greater availability of food resources and coincide with the reproductive period of nocturnal birds in the neotropical region (Sick, 1997; Accordi and Barcellos, 2008; Motta-Júnior et al., 2017). In the composition between fragments (B and C), they showed a greater similarity of species. Fragment (A), on the other hand, presents a distinction, given the occurrence of an exclusive and specialist species (*H. parvula*), which is migratory and has a preference for still preserved forest environments that meet its trophic needs (Belton, 1994; Sick, 1997).

Fragment (A) presents its most conserved forest structure, sheltering the only known population of the endangered forest bird *Crypturellus noctivagus* (Tinamidae) in the state of Rio Grande do Sul (Correa et al., 2010; 2020), a species that needs still preserved environments to meet its trophic demands (Sick, 1997). In this area it has also been reported the presence of other vertebrates in need of conservation (e.g., *Alouatta g*

uariba clamitans (Atelidae), *Cuniculus paca* (Cuniculidae), *Mazama gouazoubira* (Cervidae), *Leopardus wiedii*, *Leopardus geoffroyi* and *Puma yagouaroundi* (Felidae) (Correa et al., 2013). Given the representative presence of nocturnal birds and species in need of conservation, thus considered environmental indicators, fragment (A) can be considered one of the environments in the region that represents the best attractive conditions for several species of wildlife.

Finally, the nocturnal bird assemblage found among the studied fragments represents the first study in the state of Rio Grande do Sul that reports information on the abundance of this group in the Central Region. Even if it is a group with low population rates, some of the registered species are considered top of the food chain, represented by individuals with forest, which in a way have been adapting to altered environments in the state and thus can be considered environmental bioindicators. In view of the effects of forest fragmentation on bird communities in the state, it is important to disseminate complementary studies involving this group in the southern region of Brazil.

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