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Biology-Zoology

Mammalian biodiversity in a protected area of the Brazilian Atlantic Forest: an *in situ* survey

Biodiversidade de mamíferos em área protegida da Mata Atlântica: um levantamento *in situ*

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ABSTRACT

Mammal richness, occurrence, diversity and uniformity were assessed in the northwest region of the Serra dos Toledos Biological Reserve, in the municipality of Itajubá, Minas Gerais State, Brazil. Richness was estimated via direct and indirect methods, and calculated using first- and second-order Jackknife. Shannon-Wiener and Simpson's diversity indices, as well as Pielou's evenness index, revealed a diverse environment, with values of 2.539, 0.8806 and 0.799, respectively. Interpretation of data on such diversity aspects indicated ecological heterogeneity in the mammals within the evaluated area. This survey identified 24 mammal species: 21 wild and three domestic; it allowed to draw an initial picture of the mammal diversity in this forest reserve, given the lack of published data on this fauna group in the region. To perform a survey of mammals in such environments, a larger sample effort and in larger area is more effective than in a representative area. Moreover, surveys on the geographic distribution of mammals in tropical forests are crucial when assessing conservation priorities in South America. The presence of humans and domestic mammal species recorded throughout the study reveals the fragility of this protected area; thus, monitoring and surveillance should be improved to prevent free movement of these individuals within this forest reserve.

Keywords: Richness; Wild mammals; Endangered species

RESUMO

A riqueza, ocorrência, diversidade e uniformidade de mamíferos foram avaliadas na região noroeste da Reserva Biológica Serra dos Toledos no município de Itajubá, Estado de Minas Gerais, Brasil. A riqueza foi estimada por métodos diretos e indiretos e calculada usando Jackknife de primeira e segunda

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ordem. Os índices de diversidade de Shannon-Wiener e Simpson, bem como o índice de uniformidade de Pielou revelaram um ambiente diverso, com valores de 2,539, 0,8806 e 0,799, respectivamente. A interpretação dos dados sobre tais aspectos da diversidade indicou heterogeneidade ecológica nos mamíferos da área avaliada. Este levantamento identificou 24 espécies de mamíferos: 21 selvagens e três domésticos; permitiu traçar um quadro inicial da diversidade de mamíferos desta reserva florestal, dada a falta de dados publicados sobre este grupo faunístico na região. Para realizar um levantamento de mamíferos em tais ambientes, um esforço amostral maior e em área maior mostra-se mais eficaz do que em uma área representativa. Além disso, levantamentos sobre a distribuição geográfica de mamíferos em florestas tropicais são cruciais para avaliar as prioridades de conservação na América do Sul. A presença de humanos e espécies de mamíferos domésticos registrados ao longo do estudo revela a fragilidade dessa área protegida; portanto, o monitoramento e a vigilância devem ser melhorados para evitar a livre movimentação desses indivíduos dentro dessa reserva florestal.

Palavras-chave: Riqueza; Mamíferos silvestres; Espécies em extinção

1 INTRODUCTION

Protected Areas (PAs) in Brazil, terrestrial and/or marine, are recognized as Nature Conservation Units. They were instituted by the Public Power and are managed by legal instruments, which are exclusively dedicated to the protection and maintenance of the biological diversity, natural resources and scenic beauty, associated with their ecosystem services, which may also include cultural resources (Brasil 2000; IUCN 2008; Riondet-Costa 2012; Buitrago 2019). Creation of these areas is an important strategy for territorial control, since it establishes use and occupation limits (Milano 2002; Buitrago 2019).

Nevertheless, creation of PAs has incorporated other motivations, according to cultural, economic and political specificities (Diegues 2008; Buitrago 2019). Scientific development, in parallel with the increasing impacts which result from the extraction of natural resources and industrial activities, and the consequent decline in global biodiversity, prompted the emergence of a new perspective for the PAs: biodiversity conservation in a more sustainable basis. In this setting, the rational use of natural resources and species management are encouraged (Guerra & Coelho 2009; Santamaría et al. 2018).

Article 7 of Law No. 9,985/2000, which established the National System of Conservation Units (NSCU) in Brazil, foresees two PAs groups: Integral Protection, of which primary objective is the conservation and preservation of nature, and only the indirect use of its resources is allowed (Brasil 2000; Milano 2002; Garbelini 2011); and Sustainable Use, of which primary aim is to harmonize nature conservation with the sustainable use of part of the existing natural resources (Brasil 2000). Biological Reserves are included in the Integral Protection group; their two main goals are to preserve the environment in its entirety, and to recover the environment that was once changed (Brasil 2000).

According to the NSCU (Brasil 2000), PAs are major instruments employed by the public policies to preserve biological diversity and to ensure conservation of representative samples of ecosystems, including mammal populations (ICMBio 2016; Torrecilha et al. 2017; ICMBio 2018a). Therefore, the existence of a protected area maintains the integrity of portions of the habitat, protecting against the severe population decline of certain species (Torrecilha et al. 2017; ICMBio 2018a). If, on the one hand, widely distributed species that struggle with hunting pressure or habitat loss can fall into a threatened category, even when protected in PAs, on the other hand, many species which have a restricted distribution are considered not threatened for occurring in a protected area (Bressan et al. 2009; ICMBio 2018a).

Biological diversity places Brazil as the second country with the greatest number of mammal species worldwide (ICMBio 2018a); of the 6,399 extant species (Burgin et al. 2018), about 732 species occur in the Brazilian territory (ICMBio 2016, 2018a, 2018b; Graipel et al. 2017). Comparing, for example, four of the latest published lists of Brazilian mammals, one can notice an advance in knowledge regarding the oscillation in the number of species (ICMBio 2016; Graipel et al. 2017; ICMBio 2018a, b). Among them, 110 were officially considered as threatened (15%) (ICMBio 2016, 2018b).

The Atlantic Forest biome is one of the richest ecosystems worldwide in terms of diversity and endemism of plant and animal species; it has approximately 321 species

of mammals, 89 of which are endemic (Paglia et al. 2012; Silva 2017). Knowledge on Brazilian mammal richness and diversity is rising due to factors as new techniques employed to determine species, the growing number of taxonomists/systematics, the use of different species and subspecies concepts, new capturing techniques, and preparation of inventories in areas considered unexplored in zoological terms (Graipel et al. 2017). In the ranking of endangered species, the Atlantic Forest occupies an "uncomfortable" first place; of the 1,173 endangered fauna species in Brazil, 593, that is, just over 50%, are from the Atlantic Forest, and, of these, 452 are endemic to this biome (ICMBio 2018a).

The great biodiversity of the Atlantic Forest, considering the different scales of understanding of this term, is one of the reasons for its recognition as a hotspot, alongside another 33 regions in the planet (Bononi 2010; Silva 2017). In addition to the biodiversity, the region is under high threat of destruction, thus being a priority for the conservation of biological diversity worldwide (Galindo-Leal & Câmara 2005; Silva 2017). Even so, due to the increasing loss and fragmentation of habitats and other anthropic activities, more and more species are threatened with extinction, many of which remain unknown (Alle Son & Dick 2012; Graipel et al. 2017; ICMBio 2018a, b).

Mammals are considered a good group to indicate ecosystem integrity for playing several ecological roles, in addition to certain species having requirements regarding the quality of the environment (Luiz, 2008; Jorge et al. 2013; Paise et al. 2020). The use of the mammal group may be an essential tool to monitor the tendencies of an entire ecosystem, thus being considered as bioindicators (Morrison et al. 2007; Jorge et al. 2013; Graipel et al. 2017). According to Morrison et al. (2007) and Graipel et al. (2017), studies measuring the presence and richness of mammalian species can indicate how the environment responds to anthropic pressures.

The loss and low population of mammals in the Atlantic Forest can cause changes in the ecological interactions they maintain (Brocardo 2011; Jorge et al. 2013), with consequences for the forest composition and future of the biome (Brocardo 2011).

Understanding which factors are responsible for maintaining mammalian species and which threats they suffer is fundamental to direct efforts towards the conservation of mammals and of the entire forest (Jorge et al. 2013; Graipel et al. 2017). Almeida (2016) indicates that mammals play a vital role in the maintenance and regeneration of tropical forests, with functions in structuring biological communities, predation, seed dispersal, pollination, plant growth control through herbivory and frugivory, and actively helping in the processes that influence the dynamics and maintenance of these ecosystems.

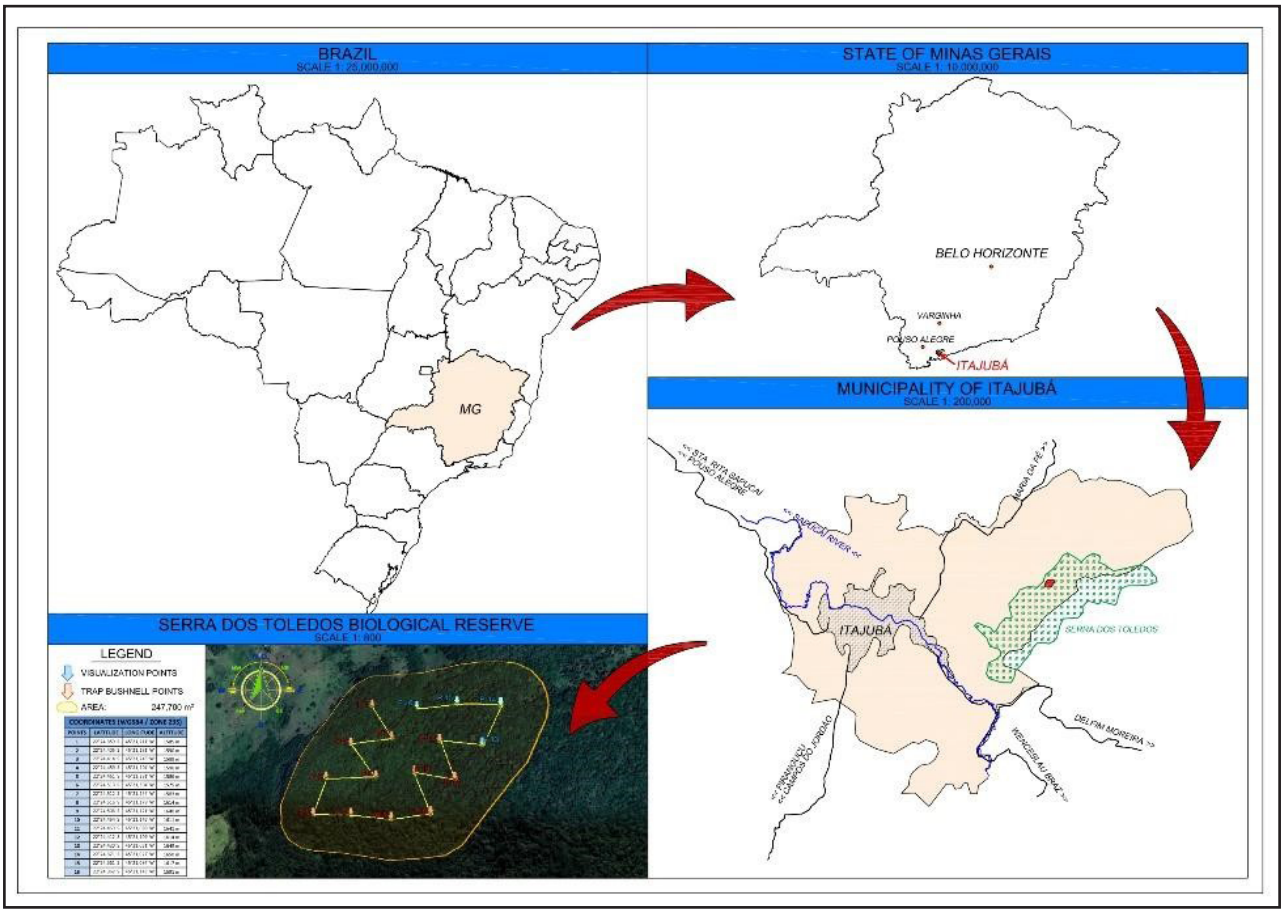
In view of the importance of mammals and their habitat for biodiversity conservation of this specific biome as well as of all areas where the wild animals of South American occur (Coelho et al. 2018), this research aims to survey mammalian species in the Serra dos Toledos Biological Reserve (in the municipality of Itajubá, Minas Gerais State), within the Brazilian Atlantic Forest, and obtain data on richness, occurrence, diversity, and uniformity.

2 METHODS

2.1 Description of the Study Area

The study was carried out in the Serra dos Toledos Biological Reserve. This important fragment of the Atlantic Forest was created by Municipal Law nº 2,088/1996 (Itajubá 2009) and sits entirely within the territory of the municipality of Itajubá (Fig. 1). It has a total area of 1,128.60 hectares and is covered by original vegetation represented by Dense and Mixed Ombrophilous Forests. Besides being rich in water resources, the reserve also has a great diversity of endemic fauna and flora species (Itajubá 2002). Moreover, it is located next to another important protected area, the Serra da Mantiqueira Environmental Protection Area, which is the most significant portion of preserved Atlantic Forest in the southern region of Minas Gerais State and houses a great diversity of endemic fauna and flora species (Itajubá 2002).

Figure 1 – Geographic location of the Serra dos Toledos Biological Reserve, in the municipality of Itajubá, Minas Gerais State, Brazil, and georeferenced sampling points where the camera traps and the active search visualization points were set



Source: Authors' private collection (December 2021)

2.2 Data collection

Data was collected in a 24.77-ha area in the northwest region of the reserve, which represents 2.31% of its total area. The methods used to select the areas were based on previously observed selective criteria: sites of vestiges, dens and footprints visualization, and around bodies of water which are useful and indispensable for animal desedentation (Becker and Dal Ponte 1999; Pardini et al. 2003; Reis et al. 2014). Sixteen georeferenced sampling points were selected with a 010-00970-00 Garmim eTrex 10 GPS (Fig. 1).

The initial twelve points (01 to 12) are where the camera traps were positioned.

The last four points (13, 14, 15, and 16) refer to where certain species were sighted during active search: *Lontra longicaudis*, point 13; Sciurus aestuans, point 14; *Didelphis aurita*, point 15; and *Callithrix aurita* and *Dasyprocta leporina*, point 16 (Fig. 1). Data collection occurred from April 29, 2018, to December 27, 2019. The area was visited during day-time inspections and, sometimes, until dusk, fortnightly.

The following methods were used in combination to estimate mammal richness: indirect method of active search for vestiges on the banks of streams and trails (Becker & Dal Ponte 1999; Pardini et al. 2003; Moro-Rios et al. 2008; Reis et al. 2009, 2014; Siviero & Setz 2011); and direct methods of visualization in line transects using eight camera traps (four Tigrinus Digital® and four Bushnell ThrophyCam®) equipped with motion and infrared sensors (Silveira et al. 2003; Tomás & Miranda 2003; Tobler et al. 2015; Welbourne et al. 2016).

The photographic records were made daily from April 29 to December 27, 2018, using Tigrinus Digital® cameras, and from December 28, 2018, to June 4, 2019, using Bushnell ThrophyCam® cameras, totaling 371 sampling days with the cameras being placed at 12 distinct points within the reserve. The devices were preferably installed along trails or close to watercourses at a distance of approximately 100 m apart, fixed on tree trunks at 30 to 40 cm above the ground; no baits were used. The geographic coordinates of each point were taken with a Garmim eTrex 10 GPS (Santos & Mendes-Oliveira 2012).

Confirmation of direct and indirect records and species identification and classification were performed in laboratory using field guides and specialized literature (Becker & Dal Ponte 1999; Moro-Rios et al. 2008; Reis et al. 2009, 2014; Siviero & Setz 2011). Additionally, consultations helped solve any uncertainty regarding safe identification of species.

Data collection related to species richness enabled analysis via occurrence, diversity and uniformity. The City Hall of Itajubá, Minas Gerais State, Brazil, granted permission (Nº 004/2018/SEMEA) for the development of the present scientific research (Supplementary Material).

2.3 Data analysis

Analyses were carried out after having performed the field data collection to determine species richness, occurrence, diversity and uniformity. All images of the same species obtained in 24 h from all cameras corresponded to one record.

Richness was estimated by first jackknife, which is a non-parametric species rich estimator (Zahl 1977; Burnham & Overton 1978, 1979; Palmer 1991; Hellmann & Fowler 1999).

The surveyed animals were related to their conservation status or degree of threat in three official lists of wild fauna species: at global level, as in the IUCN Red List of Threatened Species (IUCN 2016); at national level, according to the Brazil Red Book of Threatened Species of Fauna (ICMBio 2018b); and at regional level, as in Minas Gerais State Red List of Endangered Species, in COPAM Normative Resolution no. 147/2010 (Minas Gerais 2010).

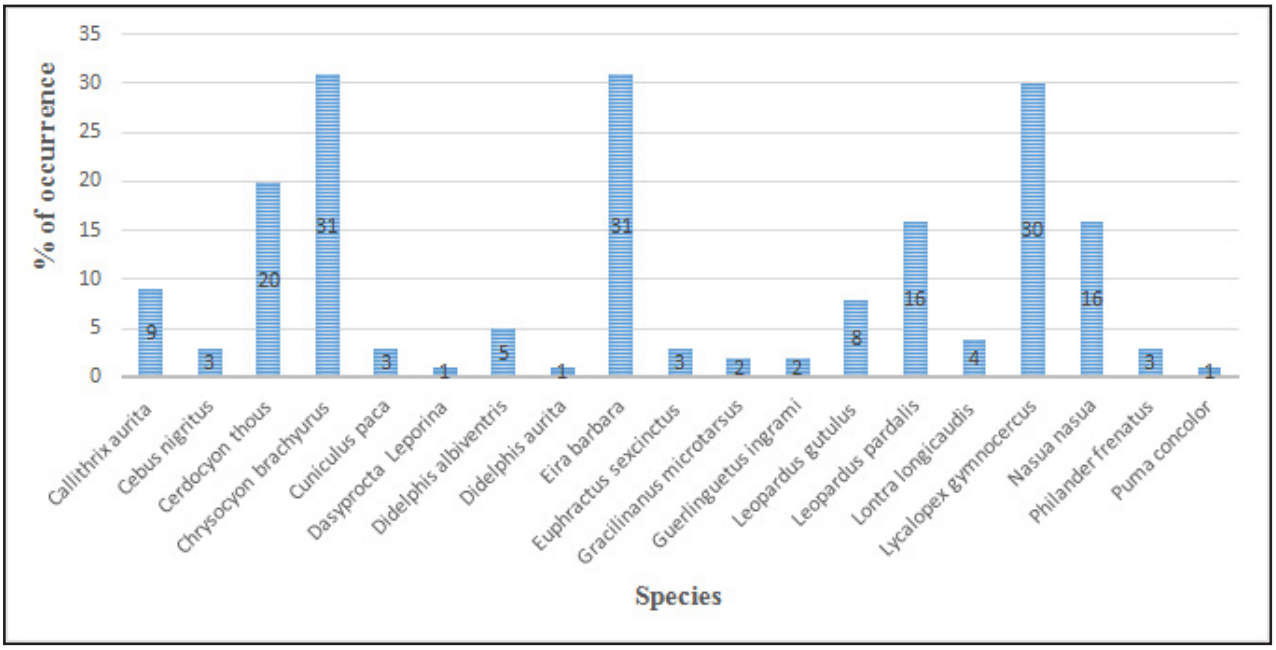
The species were classified into trophic guilds as in Marinho-Filho et al. (2002) and Dalponte (2009) by using the predominant feeding habit. The taxa were defined according to the species nomenclature followed by Paglia et al. (2012). Exotic species are those occurring outside their natural range, that is, outside their area of occurrence, as in Falk-Petersen et al. (2006).

The species diversity obtained for each point by camera trapping was analyzed via the Shannon-Wiener diversity index (H'), as described by Magurran (1988). The Simpson's index (1/D), a measure of heterogeneity, was calculated in order to complement the diversity analysis, as proposed by Alatalo and Alatalo (1977) and Routeldje (1979). The Pielou's evenness index (J') was applied to measure uniformity of the species. The evenness index ranges in value from 0 to 1.0, where 1 represents the maximum diversity. The PAST program (version 3.0) was used to statistically analyze the data regarding the above mentioned indices.

Species occurrence (presence/absence) was considered throughout the surveyper, and the number of records for each species represented the frequency of

occurrence. Species occurrence was also expressed by the total amount of photographic records for each species in relation to the total amount of photographic records for all species, expressed as percentage and graphically presented (Fig. 2).

Figure 2 – Frequency of occurrence for the species surveyed via camera trapping in the Serra dos Toledos Biological Reserve, municipality of Itajubá, Minas Gerais State, Brazil



Source: Authors' private collection (December de 2021)

3. RESULTS

3.1 Species Richness

This study recorded 24 mammals; 21 of them were wild, ranging from small- to large-sized species, and three were domestic. The surveyed animals belong to 13 families and eight orders. With the total richness surveyed, classification into trophic guilds was performed as described by Marinho-Filho et al. (2002) and Dalponte (2009). The species were included into four trophic guilds, with a predominance of the carnivore category (Table 1).

Table 1 – Mammal richness in the Serra dos Toledos Biological Reserve, municipality of Itajubá, Minas Gerais State, Brazil

(Continue)

TAXON	COMMON NAME	RT	CT	TG
ARTIODACTYLA				
*Bos taurus taurus**	Cattle	As	-	GR
CARNIVORA				
Canidae				ON
Cerdocyon thous (Linnaeus, 1766)	Crab-eating fox	Ct	-	CA
Lycalopex gymnocercus (G. Fischer, 1814)	Pampas fox	Ct	-	CA
Chrysocyon brachyurus (Illiger, 1815)	Maned wolf	As/Ct	NT (IUCN), VU (BR, MG)	CA
Canis familiaris (Linnaeus, 1758)*	Domestic dog	As/Ct	-	ON
Felidae				
Puma concolor (Linnaeus, 1771)	Puma	Ct	VU (BR, MG)	CA
Leopardus pardalis (Linnaeus, 1758)	Ocelot	Ct	VU (MG)	CA
Leopardus guttulus (Hensel, 1872)	Southern Tiger Cat	Ct	VU (IUCN, BR, MG)	CA
Procyonidae				
Nasua nasua (Linnaeus, 1766)	South American coati	Ct	-	CA/ON
Mustelidae				
Lontra longicaudis (Olfers, 1818)	Neotropical otter	As	NT (IUCN), VU (MG)	CA
Eira barbara (Linnaeus, 1758)	Tayra	Ct	-	CA
CINGULATA				
Dasypodidae				
Euphractus sexcinctus (Linnaeus, 1758)	Yellow armadillo	Ct	-	ON
CHIROPTERA				
Unidentified	Bat (U/I)	Ct	-	-

Table 1 – Mammal richness in the Serra dos Toledos Biological Reserve, municipality of Itajubá, Minas Gerais State, Brazil

(Conclusion)

TAXON	COMMON NAME	RT	CT	TG
DIDELPHIMORPHIA				
Didelphidae				
Didelphis aurita (Wied-Neuwied, 1826)	Brazilian common opossum	As	-	IN/ON
Didelphis albiventris (Lund, 1840)	White-eared opossum	Ct	-	IN/ON
Philander frenatus (Olfers, 1818)	Southeastern four-eyed opossum	Ct	-	IN/ON
Gracilinanus microtarsus (Wagner, 1842)	Brazilian gracile opossum	Ct	-	IN/ON
PERISSODACTYLA				
Equidae				
*Equus ferus caballus**	Horse	As	-	GR
PRIMATA				
Cebidae				
Cebus nigritus (Goldfuss, 1809)	Black-horned capuchin	Ct	NT (IUCN), VU (BR), EN (MG)	ON/FR
Callitrichidae				
Callithrix aurita (É. Geoffroy, 1812)	Buffy-tufted-ear marmoset	As	VU (IUCN), EN (BR, MG)	IN/FG/ON
RODENTIA				
Dasyproctidae				
Dasyprocta leporina (Linnaeus, 1758)	Red-rumped agouti	As	-	FG/IN
Cuniculidae			-	
Cuniculus paca (Wagler, 1830)	Agouti	Ct	-	FG
Sciuridae				
Sciurus aestuans (Linnaeus, 1766)	Guianan squirrel	As/Ct		FG
-	Rodent (U/I)	Ct	-	-

Source: Authors' private collection (December de 2021). Record type (RT) - Ct: Camera trap; As: Active search (visualization). Category of Threat (Ct) - EN: Endangered; VU: Vulnerable; NT: Near threatened; *exotic species; Trophic Guild (TG) - FG: Frugivore; GR: Granivore; ON: Omnivore; CA: Carnivore; IN: Insectivore. MG = Minas Gerais; BR = Brazil; IUCN (International Union for Conservation of Nature). U/I: unidentified

Regarding the category of threat of the registered taxa, seven are included in the Minas Gerais State Red List of Endangered Species (Minas Gerais 2010): C*hrysocyon brachyurus* (Illiger 1815), *Puma concolor* (Linnaeus 1771), *Leopardus pardalis* (Linnaeus 1758), *Leopardus gutulus* (Hensel 1872), *L. longicaudis* (Olfers 1818), *Cebus nigritus* (Goldfuss 1809) and *C. aurita* (É. Geoffroy 1812). *C. brachyurus* (Illiger 1815), *L. gutulus* (Hensel 1872), *C. nigritus* (Goldfuss 1809) and *C. aurita* (É. Geoffroy 1812) are classified as endangered species both in the Brazil Red Book of Threatened Species of Fauna (ICMBio 2018b) and in the IUCN Red List of Threatened Species (IUCN 2016). P. concolor (Linnaeus 1771) is listed in the Brazil Red Book of Threatened Species of Fauna (ICMBio 2018b), and *L. longicaudis* (Olfers 1818) in the IUCN Red List of Threatened Species (IUCN 2016).

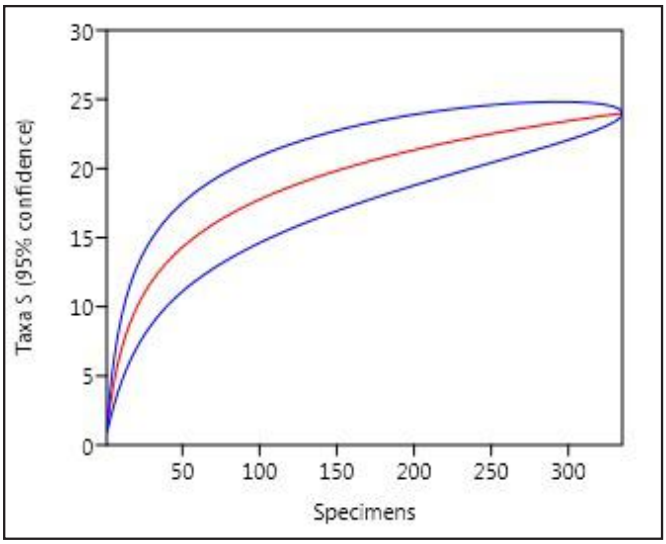
3.2 Species Occurrence

Camera trapping allowed to verify the occurrence of several wild species in the 371 sampling days. Based on the constancy of occurrence, the most frequently-occurring species were *Eira barbara* (31%) and *C. brachyurus* (31%) (Fig. 2); the latter is classified as a near-threatened species by the IUCN Red List of Threatened Species (IUCN 2016) and as a vulnerable species by the Brazil Red Book of Threatened Species of Fauna (ICMBio 2018b) and by the Minas Gerais State Red List of Endangered Species (Minas Gerais 2010). With a frequency of occurrence of 1% each, *D. aurita, D. leporina* and *P. concolor* were the least frequently observed species (Fig. 2). P. concolor is listed as vulnerable both in the Brazil Red Book of Threatened Species of Fauna (ICMBio 2018b) and in the Minas Gerais State Red List of Endangered Species (Minas Gerais 2010).

The richness estimated by the jackknife method is graphically shown (Fig. 3). The collection effort (rarefaction), considering each survey sighting, was standardized at 371 Trap/day, with a 95% CI. This technique has been used by ecologists to perform quantitative comparisons between sets of species (Sanders 1968; Colwell & Coddington 1994; Gotelli & Colwell 2001). The species accumulation curves of the present study were adjusted with the first-order jackknife estimator; 34 species were estimated, being

registered in area 24. The second-order jackknife estimated a richness of 41 species (Fig. 3). Such data evidence that the Serra dos Toledos Biological Reserve is a rich area that must be preserved, and thus requires the implementation of conservation strategies.

Figure 3 – Collector curve (rarefaction) considering each survey sighting as a sampling unit using first- and second-order jackknife for the sampled area, Serra dos Toledos Biological Reserve, municipality of Itajubá, Minas Gerais State, Brazil



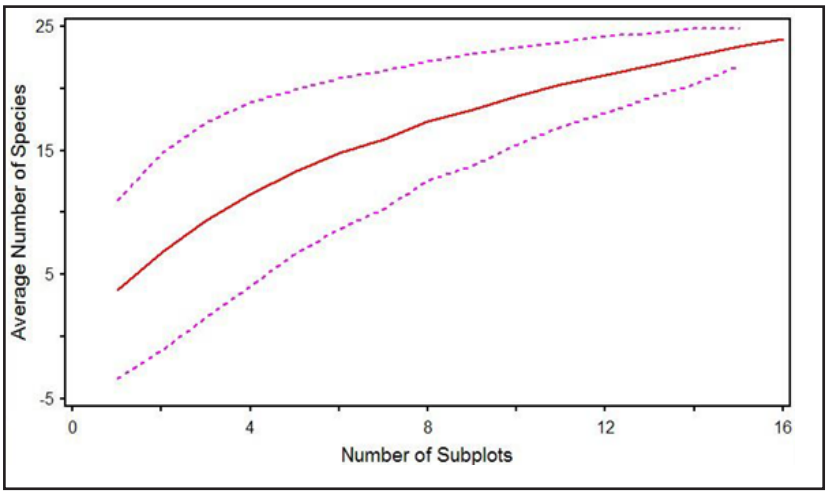
Source: Authors' private collection (December de 2021)

There was no stabilization of the species accumulation curve (red line) in the current assessment, but more species can be found in the study area. According to this estimate, ten (first-order jackknife) or 17 (second-order jackknife) species remain to be found in the surveyed area (Fig. 4). Therefore, the sampling site requires more survey time, or more areas should be sampled within the reserve in order to collect all the species it contains.

ackknife estimates the potential species richness; so, it estimates the amount of species that could still exist in the area but were not sampled (Santos 2003; Magurran 2011). Therefore, the jackknife technique was developed to be applied in studies comprising different taxonomic groups, and it considers the occurrence of rare species

(species occurring at low frequencies). This estimator should not be strictly interpreted or considered when used to assess wild species, since fauna displacement may occur and there may be more species than those estimated ones (Walther and Martin 2001; Herzog et al. 2002).

Figure 4 – Collection effort curves considering the sampling unit (survey point) in the Serra dos Toledos Biological Reserve, municipality of Itajubá, Minas Gerais State, Brazil



Fonte: Authors' private collection (December 2021)

3.3 Diversity and Uniformity

Data collected through camera trapping indicated a Shannon-Wiener diversity index (*H'*) of 2.539; this is a relevant value, since the diversity index is typically between 1.5 and 3.5 (Magurran 1988). The Simpson's index (1/D) was also employed in the present research to improve results' reliability; analyses found a value of 0.8806, which indicates species diversity and the absence of a dominant species. Moreover, a Pielou's evenness index (*J'*) of 0.799 was found, thus demonstrating that abundance between species is similar; it refers to relatively homogeneous environments, since its value is constrained between 0 and 1.0. The diversity, heterogeneity and evenness indices showed no significant differences, although the Simpson's index presented a considerable value, evidencing no tendency towards the dominance of one species.

4 DISCUSSION

4.1 Species Richness

This study revealed that, despite the small sampling area of the surveyed forest fragment (24.77 ha), a relatively high species richness was found in comparison with studies conducted in other PAs fragments in the Atlantic Forest Preuss et al. (2016). Thus, the assessed area requires further investigation, and more efforts should be made targeting its conservation. Although most of the surveyed species do not appear in categories of threats on the official lists, it does not mean that they are not impacted by anthropogenic activities responsible for habitat degradation and fragmentation Rossaneis (2014). These species possibly present greater plasticity and tolerance to such effects, besides having a wide geographical distribution, as cited by Preuss et al. (2016). Thus, species prioritization is a key component of conservation strategies (Brocardo (2011). However, it is not easy to identify threatened species of many taxa that require information on distribution (Bressan, Kierulff, Sugieda, 2009).

Earlier investigations have assessed species richness throughout Brazil. In Rio de Janeiro State, Araujo et al. (2008) registered 12 species within two Biological Reserves with a total area of 7.990 ha. In the west of Santa Catarina State, Preuss et al. (2016) found a richness of 23 species in a 220-ha area. In the southwest of Paraná State, Wolfart et al. (2013) recorded 20 taxa in a remnant of 220 ha of Atlantic Forest; in the north of the same state, Rossaneis (2014) observed 14 taxa in four small forest remnants (fragments) with a total area of 27.4 ha. The distinct sizes of the surveyed areas, different sampling efforts and the combination of methodologies employed in these investigations may account for the differences in the number of registered taxa.

Was surveyed in this study (24) species in comparison to the work of Bovo et al. (2018), which reported six small and 16 medium or large species, totaling 22, in three forest fragments of 10, 14, and 26 ha within the Atlantic Forest biome; thus, the assessment was performed in a 50-ha area, which is two times larger than the

fragment sampled in the current research. In view of that, the importance of the Serra dos Toledos Biological Reserve as an essential area of preservation is demonstrated.

This investigation found a predominance of the carnivore category. According to Machado et al. (2008), carnivores are important for natural ecosystems and for conservation of biodiversity in general; as large areas are required to maintain viable populations, all efforts towards protecting areas large enough for these species also preserve the other animals within the community. Carnivores play an important role in keeping ecosystems balanced, since they occupy the top of the food chain and require large areas so that sufficient prey is available. Thus, habitat destruction, fragmentation and alteration constitute the greatest threats to the survival of the wild species within this ecological guild (Machado et al. (2008); Jorge et al. 2013).

All members of the Family Felidae registered in this survey are under the threat category at global, national and regional levels. Crooks et al. (2011) and Monroy-Vilchis et al. (2019) state that mammals are among the most threatened groups: 27% of the species are in danger of becoming extinct. Fragmentation aggravates edge effects, affects movement of individuals and reduces connectivity between parts of a landscape (Machado et al. (2008). Besides such threats, particular features of wild felids as low population density, large home ranges and slow population growth make the probability of extinction even greater. It must be highlighted that surveys are the basis for designing specific and effective strategies based on the peculiarities of the assessed areas with the aim to ensure long-term conservation of ecosystems and species (Monroy-Vilchis et al. 2019).

4.2 Species Occurrence

C. brachyurus is the largest canid of South America (Dietz 1985; Silva 1994), and its threat category varies depending on the country (Paula et al. 2013). It used to occur in open habitats in the entire continent, but there has been a significant reduction in its distribution, especially in the southernmost parts of its former geographic range (Torres et al. 2013). Reports on the distribution of this species may reveal the causes

which contribute to its decline as well as indicate its current global distribution (Coelho et al. 2018). The fact that *C. brachyurus* is found in official fauna lists at global, national and regional levels reinforces the relevance of the studied area. Coelho et al. 2018 pointed to the southeast and center of Brazil as some of the most favorable areas for the presence of this carnivore, along with the northeast of Argentina and the south of Paraguay. It is crucial to detect the distribution of *C. brachyurus* in South America in order to guide conservation measures to improve its status.

Santos (2003) claims that when the curve stabilizes (i.e., reaches a point where the increase in the collection effort does not imply an increase in the number of species), it means that approximately all the richness in the area has been sampled.

The average frequency of occurrence of *L. pardalis* in relation to that of P. concolor found in this assessment is in line with the results of Massara et al. (2018); these authors observed enhanced nocturnal activity of *L. pardalis* where the probability of *P. concolor* occupancy was high, and also where there was more pasture or close to human settlements. Thus, temporal segregation seems to be a strategy adopted by *L. pardalis* in fragments of the Atlantic Forest so that coexistence with P. concolor and humans may occur (and/or vice versa). However, the current scenario of degradation seen in the Atlantic Forest does not ensure that segregation of *L. pardalis* will allow it to persist within the protected area.

4.3 Diversity and Uniformity

The lower the anthropic interference, the greater the *H'*, that is, the diversity index is related to the level of environmental disturbance. In the north of Paraná State, Brazil, Rossaneis (2014) registered diversity indices ranging from 1.97 to 2.02 in Atlantic Forest remnants with areas varying from 5.4 to 15 ha, respectively. Such comparisons indicate that Shannon-Wiener indices above 2.0 in the Atlantic Forest are only recorded in heterogeneous areas in good conservation status (Patterson et al. 2003; Dias et al. 2008; Pires & Fabián 2013).

The analyses performed in this assessment evidenced the importance of conserving this protected area and the need for effective management, given the number of species (richness) found in a spot which represents only 2.3% of the total area of the reserve. Considerable diversity, occurrence of threatened species and uniformity between species were also demonstrated by the findings. This great biodiversity struggles with the anthropic pressures of degradation and fragmentation, so this forest reserve needs protection.

Another relevant fact refers to the adequate use of the information collected by the entities in charge of managing this Conservation Unit, thus encouraging knowledge appropriation practices; in this way, the local community and the society in general can combine nature conservation with sustainable planning. The Serra dos Toledos Biological Reserve is one of the PAs in Minas Gerais State with a predominance of the Atlantic Forest. It ranks among the world's top biodiversity hotspots, and its restoration represents a huge challenge. Knowledge on the ecology of mammalian species is of great importance to restore this biome, since they play a role in the biological dynamics of Neotropical forests. The understanding of such dynamics as well as the knowledge on the populations inhabiting forest fragments are also essential to design effective conservation management plans.

Further research considering the individual identification of the sampled specimens is suggested. The gathered information would enable the development of a population-based approach in the surveyed area as well as in the region, thus contributing to population studies on forest mammals. Such inventories are highly valuable for biodiversity conservation, especially when conducted in the long-term to allow comparisons over time.

5 CONCLUSIONS

This study registered 24 mammals ranging from small- to large-sized species belonging to 13 families and eight orders. It contributed to improve knowledge

regarding the mammals inhabiting this region as well as their importance within this ecosystem, all of which are essential to support and guide conservation management plans in this Conservation Unit.

Significant results were found regarding species diversity, which was obtained by camera trapping. Data indicated a significant Shannon-Wiener diversity index (H') of 2.539; it is worth mentioning that the diversity index is typically between 1.5 and 3.5. As for species occurrence, attention must be drawn to the presence of *C. brachyurus*, which is classified as a near-threatened species by the IUCN Red List of Threatened Species and as a vulnerable species by the Brazil Red Book of Threatened Species of Fauna and by the Minas Gerais State Red List of Endangered Species.

Another relevant fact refers to the need for conservation efforts and effective management of this PA, since a relatively high species richness was found in a reduced sampling unit (2.3% of the total area) along with a significant diversity, the occurrence of threatened species and the uniformity between these species.

The Serra dos Toledos Biological Reserve forest is one of the world's top biodiversity hotspots, and its restoration poses a great challenge; it requires knowledge on the ecology of the mammal species that occur within this area since they play vital roles in the biological dynamics of Neotropical forests. Such dynamics needs to be well-understood.

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REFERENCES

Alatalo, R., & Alatalo, R. (1977). Components of diversity: multivariate analysis with interaction. *Ecology* 58:900-906. https://doi.org/10.2307/1936226

Alle Son, D.,& Dick, E. (2012). Gestão participativa em Unidades de Conservação: uma experiência na Mata Atlântica. In Dick E, Danieli MA, Zanini AM (Org.) *A Educação Ambiental como Chave para a Conservação da Natureza*, 1st ed. APREVAMI, Rio Grande do Sul, SC, pp. 58-59.

Almeida, D. S. (2016). *Recuperação ambiental da Mata Atlântica*. 3rd ed. Editus, Ilhéus.

Araujo, R. M. de, Souza, M. B. de, & Ruiz-Miranda, C. R. (2008). Densidade e tamanho populacional de mamíferos cinegéticos em duas Unidades de Conservação do Estado do Rio de Janeiro, Brasil. Iheringia, *Sér. Zool.*, Porto Alegre, 98(3):391-396. http://dx.doi.org/10.1590/S0073-47212008000300014

Becker, M., & Dalpont, J. C. (1999). *Rastros de mamíferos silvestres brasileiros: um guia de campo.* Editora Universidade de Brasília, Brasília

Brasil (2000). *Lei Federal nº 9.985* de 18 de julho de 2000. Regulamenta o art. 225, § 1º, incisos I, II, III e VII, da Constituição Federal e Institui o Sistema Nacional de Unidades de Conservação. Diário Oficial [da] República Federativa do Brasil. Brasília.

Bononi, V. L. R. (2010). *Secretaria do Meio Ambiente***.** Biodiversidade / Secretaria de Estado do Meio Ambiente, Instituto de Botânica. SMA, São Paulo.

Bovo, A. A.de A., Magioli, M., Percequillo, A. R., Kruszynski, C., Alberici, V. , Mello, M. A. R., Correa, L. S., Gebin, J. C. Z., Ribeiro, Y. G. G., Costa, F. B., Ramos, V. N., Benatti, H. R., Lopes, B., Martins, M. Z. A., Diniz-Reis, T. R., Camargo, P. B. de, Labruna, M. B., & Ferraz, K. M. P. M. de B. (2018). Human-modified landscape acts as refuge for mammals in Atlantic Forest. *Biota Neotropica*. 18(2):e20170395. http://dx.doi.org/10.1590/1676-0611-bn-2017-0395

Bressan, P. M., Kierulff M. C. M., & Sugieda, A. M. (2009). *Fauna ameaçada de extinção no estado de São Paulo: Vertebrados.* Fundação Parque Zoológico de São Paulo: Secretaria do Meio Ambiente, São Paulo.

Brocardo, C. R. (2011). *Defaunação em uma área contínua de mata atlântica e consequências para o sub-bosque florestal.* Dissertation, Universidade Estadual Paulista.

Buitrago, P. A. V. (2019). *Estrategies internacionales de conservación implementadas en el sistema nacional de áreas protegidas en Colombia.* RIAA 10(1):119-130. https://doi.org/10.22490/21456453.2225

Burgin, C. J., Colella, J. P., Kahn, P. L., & Upham, N. S. (2018) How many species of mammals are there? J *Mammal,* 99(1):1-14. https://doi.org/10.1093/jmammal/gyx147

Burnham, K. P., & Overton, W. S. (1978). Estimation of the size of a closed population when capture probabilities vary among animals. *Biometrika* 65:927-936. https://doi.org/10.1093/biomet/65.3.625

Burnham, K. P., Overton, W. S. (1979). Robust estimation of population size when capture probabilities vary among animals. *Ecology.* 60:927-936. https://doi.org/10.2307/1936861

Coelho, L., Romero D., Queirolo, D., & Guerrero, J. C. (2018). Understanding factors affecting the distribution of the maned wolf (Chrysocyon brachyurus) in South America: Spatial dynamics and environmental drivers. *Mamm Biol.* 92:54-61. https://doi.org/10.1016/j.mambio.2018.04.006

Colwell, R. K., & Coddington, J. A. (1994). *Estimating terrestrial biodiversity through extrapolation.* Phil Trans R Soc Lond B 345:101-118. https://doi.org/10.1098/rstb.1994.0091

Crooks, K., Burdett, C., Theobald, D., Rondinini, C., & Boitani, L. (2011). Padrões globais de fragmentação e conectividade do habitat de carnívoros mamíferos. *Phil Trans R Soc Lond B Biol. Sci.* 366(1578): 2642-2651. https://doi.org/10.1098/rstb.2011.0120

Dalponte, J. C. (2009). Lycalopex vetulus (Carnivora: Canidae). *Mamm Species.* 847:1-7. https://doi.org/10.1644/847.1

Dias, D., Esbérard, C.E.L., & Peracchi (2008). A Riqueza, diversidade de espécies e variações altitudinal de morcegos na Reserva Biológica do Tiguá, estado do Rio de Janeiro, Brasil (Mammalia, Chiroptera). In Reis NR, Peracchi Al, Santos GASD (eds.) *Ecologia de morcegos.* Technical Books, Londrina, pp 125-142.

Diegues, A. C. S. (2008). *O mito da natureza intocada,* 6th edn. HUCITEC - NUPAUB/USP, São Paulo

Dietz, J. M. (1985). Chrysocyon brachyurus. *Mamm Species.* 234:1- 4. https://doi.org/10.2307/3503796.

Falk-Petersen, J., Bohn T., & Sandlund, O.T. (2006). On the numerous concepts in invasion biology. *Biol Invasions.* 8(6):1409-1424. https://doi.org/10.1007/s10530-005-0710-6

Garbelini, S. M. (2011). *Manual prático de unidades de conservação:* Ministério Público do Estado de Goiás, Goiânia.

Galindo-Leal, C., & Câmara, I. G. (2005). Status do hotspot Mata Atlântica: uma síntese. In Galindo-Leal C., Câmara I. G. (eds.) Mata Atlântica: biodiversidade, ameaças e perspectivas. *Fundação SOS Mata Atlântica, Conservação Internacional,* Belo Horizonte, pp. 3-12.

Gotelli, N. J., & Colwell, R. K. (2001). Quantifying biodiversity: procedures and pitfalls in the measurement and comparison of species richness. *Ecol Lett.* 4:379-391. https://doi.org/10.1046/j.1461-0248.2001.00230.x

Graipel, M. E., Cherem, J. J., Monteiro-Filho, E. L. A., & Carmignotto, A. P. (2017). Mamíferos da Mata Atlântica. In Monteiro-Filho E. L. A., Conte C. E. (Org.) *Revisões em zoologia: Mata Atlântica,* 1st ed. UFPR, Curitiba, pp. 391-455

Guerra, A. J. T., & Coelho, M. C. N. (2009). *Unidades de conservação: Abordagens e Características Geográficas*. Bertrand Brasil, Rio de Janeiro.

Hellmann, J. J., & Fowler, G. W. (1999). Bias, precision and accuracy of four measures of species richness. *Ecol Appl.* 9:824-834. https://doi.org/10.1890/1051-0761

Herzog, S. K., Kessler, M., & Cahill, T. M. (2002). Estimating species richness of tropical bird communities from rapid assessment data. *The Auk.* 119(3):749-769. https://doi.org/10.1642/0004-8038

Itajubá (2002). *Secretaria Municipal da Educação. Atlas escolar, histórico e geográfico do Município de Itajubá*. Itajubá.

Itajubá (2009). *Decreto nº 4.136*, de 11 de dezembro de 2009. Institui Área de Amortecimento para a reserva Biológica Serra dos Toledos dá outras providencias.

ICMBio (2016). Instituto Chico Mendes de Conservação da Biodiversidade*. Livro Vermelho da Fauna Brasileira Ameaçada de Extinção.* https://www.icmbio.gov.br/portal/images/stories/comunicacao/publicacoes/publicacoes-diversas/livro_vermelho_2018_vol1.pdf. Accessed 1 September 2020.

ICMBio (2018a). *Livro Vermelho da Fauna Brasileira Ameaçada de Extinção*, Vol I, 1st ed. ICMBio/MMA, Brasília.

ICMBio (2018b*). Livro Vermelho da Fauna Brasileira Ameaçada de Extinção,* Vol II Mamíferos, 1st ed. ICMBio/MMA, Brasília.

IUCN (2008). *International Union for Conservation of Nature.* About Protected Areas Programme. https://www.iucn.org/theme/protected-areas/about. Accessed 3 November 2019.

IUCN (2016). The IUCN *Red List of Threatened Species.* http://www.iucnredlist.org. Accessed 6 September 2020.

Jorge, M. L. S. P., Galetti, M., Ribeiro, M. C., Ferraz, K. M. P. M. B. (2013). Mammal defaunation as surrogate of trophic cascades in a biodiversity hotspot. *Biol Conserv*. 163:49-57. https://doi.org/10.1016/j.biocon.2013.04.018

Luiz, M. R. (2008). *Ecologia e conservação de mamíferos de médio e grande porte na Reserva Biológica Estadual do Aguaí.* Monograph, Universidade do Extremo Sul Catarinense.

Machado, A. B., Drummont, G. M., Paguia A. P. (2008). *Livro vermelho da fauna brasileira ameaçada de extinção.* Ministério do Meio Ambiente, Brasília.

Magurran, A. E. (1988). *Ecological diversity and its measurement.* Princeton University Press, Oxford.

Magurran, A. E. (2011). *Medindo a diversidade biológica.* Tradução: Ed. da UFPR, Curitiba.

Marinho-Filho, J., Rodrigues, F. H. G., Juarez, K. M. (2002). The cerrado mammals: Diversity, ecology, and natural history. In Oliveira PS, Marquis RJ The Cerrados of Brazil: ecology and natural history of a Neotropical savanna. *Columbia University Press,* New York, pp 266-284.

Massara, R. L., Paschoal, A. M. O., Bailey, L. L., Doherty, P. F. (2018). Effect of humans and pumas on the temporal activity of ocelots in protected areas of Atlantic Forest. *Mamm Biol.* 92-86-93. 10.1016/j.mambio.2018.04.009

Milano, M. S. (2002). Por que existem as unidades de conservação? In: Milano MS (org.) *Unidades de Conservação: Atualidades e tendências*. Curitiba, Fundação O Boticário de Proteção à Natureza, pp193-208.

Minas Gerais (2010). Conselho de Política Ambiental - *COPAM (2010).* Deliberação Normativa COPAM nº 147, de 30 de abril de 2010. Aprova a Lista de Espécies Ameaçadas de Extinção da Fauna do Estado de Minas Gerais. Diário do Executivo do Estado de Minas Gerais, Belo Horizonte. http://www.siam.mg.gov.br/sla/download.pdf?idNorma=13192#:~:text=Aprova%20a%20Lista%20de%20Esp%C3%A9cies,do%20Estado%20de%20Minas%20Gerais.&text=D%20E%20L%20I%20B%20E%20R%20A%3A,%C3%9Anico%20da%20presente%20Delibera%C3%A7%C3%A3o%20Normativa. Accessed 6 September 2019

Monroy-Vilchis, O., Zarco-González, Z., Zarco-González, M. M (2019). Potential distribution and areas for conservation of four wild felid species in Mexico: Conservation planning. *Mammal Biol* 98:128-136. https://doi.org/10.1016/j.mambio.2019.09.003

Moro-Rios, R. F., Silva-Pereira, J. E., Silva, P. W., Moura-Britto, M. De, Patrocínio, D. N. M. (2008). *Manual de Rastros da Fauna Paranaense.* Instituto Ambiental do Paraná, Curitiba.

Morrison, J. C., Sechrest, W., Dinerstein, E., Wilcove, D. S., Lamoreux, J. F. (2007). Persistence of large mammal faunas as indicators of global human impacts. *J Mammal.* 88:1363-1380. https://doi.org/10.1644/06-MAMM-A-124R2.1

Paglia, A. P., Fonseca, G. A. B., Rylands, A. B. et al (2012). Lista Anotada dos Mamíferos do Brasil/ Annotated Checklist of Brazilian Mammals, 2.ed. *Occasional Papers in Conservation Biology,* 6:1-76. Available from.https://www.conservation.org/docs/default-source/brasil/annotated_checklist_of_brazilian_mammals_2nd_edition.pdf. Accessed 6 September 2019

Paise, G., Vieira, E. M., Prado, P. I. (2020). Small mammals respond to extreme habitat fragmentation in the Brazilian Atlantic Forest according to the landscape continuum model. *Mamm Res.* 65:309-322. https://doi.org/10.1007/s13364-020-00478-y

Palmer, M. W. (1991). Estimating species richness: the second order jackknife reconsidered. *Ecology.* 72: 1512-1513.

Pardini, R., Ditt, E. H., Cullen, Jr. L., Bassi, C., Rudran, R. (2003). Levantamento rápido de mamíferos terrestres de médio e grande porte. In Cullen Junior. L, Rudran. R, Padua-Valladares C (Orgs.) *Métodos de estudos em biologia da conservação e manejo da vida silvestre.* UFPR, Curitiba, Fundação O Boticário de Proteção à Natureza, pp 169-179.

Patterson, B. D., Willig, M. R., Stevens (2003). RD Trophic strategies, niche partitioning, and patterns of ecological organization. In Kunz TH, Fenton MB (eds.) *Bat Ecology,* University Chicago Press Chicago, pp 536-579.

Paula, R. C., Guimarães, F. H., Queirolo, D., Pinto, R., Lemos, F. G., Rodrigues, L. (2013). Avaliação do estado de conservação do Lobo-guará Chrysocyon brachyurus (Illiger, 1815) no Brasil *Biodivers Bras* 3(1):146-159.

Pires, D. P. S., Fabián, M. E. (2013). Diversidade, riqueza e estratificação vertical de espécies de morcegos em um remanescente de Mata Atlântica no Sul do Brasil. *Biotemas*. 26(4):121-131. https://doi.org/10.5007/2175-7925.2013v26n4p121

Preuss, J. F., Pfeifer, G. B., Toral, J. F., Bressan, S. J. (2016). Levantamento rápido de mamíferos terrestres em um remanescente de Mata Atlântica do Sul do Brasil. *Unoesc & Ciência.* 7(1):89-96. https://portalperiodicos.unoesc.edu.br/acbs/article/view/10044/pdf.

Reis, N. R., Peracchi, A. L., Fregonesi, M. N., Rossaneis B. K. (2009). *Guia Ilustrado mamíferos do Paraná* - Brasil. USEB, Pelotas.

Reis, N. R., Peracchi, A. L., Fregonezi, M. N., Rossaneis B. K. (2014). *Técnicas de Estudos Aplicados as Mamíferos Silvestres Brasileiros.* Tecnical Books, Rio de Janeiro.

Riondet-Costa, D. T. (2012). *Análise comparativa dos instrumentos de gestão em Unidades de Conservação visando a gestão participativa no Cone Sul.* Thesis, Universidade do Estado do Rio de Janeiro.

Rossaneis, B. K. (2014). Mamíferos de médio e grande porte em pequenos remanescentes florestais da Mata Atlântica com influências antropogênicas no norte do Paraná. *Semina* 35(1):15-24. http://dx.doi.org/10.5433/1679-0367.2014v35n1p15

Routeldje, R. D. (1979). Diversity indices: which ones are admissible? *J Theor Biol*. 76:503-515. https://doi.org/10.1016/0022-5193(79)90015-8

Sanders, H. L. (1968). *Marine benthic diversity: A comparative study.* Am Nat 102:243-282.

Santamaría, M., Areiza, A., Matallana, C., Solano, C. Y., Galán, S. (2018) .Estrategias complementarias de conservación en Colombia. Instituto Humboldt, *Resnatur y Fundación Natura.* Bogotá, Colombia .

Santos A. J. (2003). Estimativas de riqueza em espécies. In: Rudran R., Cullen L., Valladares-Padua C. (eds) *Métodos de estudo em biologia da conservação e manejo da vida terrestre.* Editora da Universidade Federal do Paraná, Curitiba, pp 19-41.

Santos, F. S., Mendes-Oliveira A. C. (2012). Diversidade de mamíferos de médio e grande porte da região do rio Urucu, Amazonas, Brasil. *Biota Neotrop.*12(3):282-291. https://doi.org/10.1590/S1676-06032012000300027

Silva, J. A. S. (1994). Lobo-guará. In: Fonseca G. A. B., Rylands A. B., Costa C. R. M., Machado R. B., Leite Y. L. R. (eds.) *Livro vermelho dos mamíferos brasileiros ameaçados de extinção.* Fundação Biodiversitas, Belo Horizonte, pp 281-288.

Silva, S. M. (2017). Mata Atlântica: uma Apresentação. In *Revisões em zoologia: Mata Atlântica.* 1st edn. UFPR, Curitiba.

Silveira, L., Jácomo, A. T., Diniz-Filho, J. F. A. (2003). Camera trap, line transect census and track surveys: a comparative evaluation. *Biol Conserv* 114(3):351-355. https://doi.org/10.1016/S0006-3207(03)00063-6

Siviero, M. C. B., Setz ,E. Z. F. (2011). Pegadas de mamíferos em parcelas de areia em fragmentos de vegetação da bacia do ribeirão Anhumas, Campinas, *Revista Instituto Florestal.* 23(1):39-55. https://agris.fao.org/agris-search/search.do?recordID=DJ2012069161. Accessed 6 September 2019

Tobler, M. W., Zúñiga-Hartley, A., Carrillo-Percastegui, S. E., Powell G. V. N. (2015). Spatiotemporal hierarchical modelling of species richness and occupancy using camera trap data. *J Appl Ecol* 52:413-421. https://doi.org/10.1111/1365-2664.12399

Tomás, W. M., Miranda, G. H. B. (2003). Uso de armadilhas fotográficas em levantamentos populacionais. In: Cullen-Jr L, Rudran R, Valladares-Pádua C. *Métodos de estudos em Biologia da Conservação e Manejo da Vida Silvestre*. Editora da Universidade Federal do Paraná, Paraná.

Torrecilha, S., Gonçalves, R. M., Laps, R. R., Tomás, W. M., Maranhão, H. L., Roque, F. O. (2017). Registros de espécies de mamíferos e aves ameaçadas em Mato Grosso do Sul com ênfase no Sistema Estadual de Unidades de Conservação. *Iheringia,* Ser Zool 107(suppl.). https://doi.org/10.1590/1678-4766e2017156

Torres ,R., Jayat, J. P., Pacheco, S. (2013). Modelagem de impactos potenciais das mudanças climáticas no envelope bioclimático e na conservação do lobo-guará (Chrysocyon brachyurus). *Mamm Biol.* 78:41-49. http://dx.doi.org/10.1016/j.mambio.2012.04.008

Walther B. A., Martin, J. L. (2001). Species richness estimation of bird communities: how to control for sampling effort? *Ibis* 143:413-419. https://doi.org/10.1111 / j.1474-919X.2001.tb04942.x

Welbourne, D. J., Claridge, A. W., Paul D. J., Lamber, (2016). A How do passive infrared triggered camera traps operate and why does it matter? Breaking down common misconceptions. *Remote Sens Ecol Conserv*. 2:77-83. https://doi.org/10.1002/rse2.20

Wolfart, M. R., Fré, M., Lucas, E. M., Miranda, G. B. (2013). Mamíferos terrestres em um remanescente de Mata Atlântica, Paraná, Brasil. *Biotemas.* 26(4):111-119. https://doi.org/10.5007/2175-7925.2013v26n4p111

Zahl, S. (1977). Jackknifing an index of diversity. *Ecology.* 58:907-913. https://doi.org/10.2307/1936227

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