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ARTICLE

Medium and large sized mammals and the effect of habitat heterogeneity from a Caatinga shrubby forest at Serra de Santa Catarina, Paraíba, Brazil

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Abstract. In xeric environments, such as Caatinga Biome, habitat characteristics such as phytophysiognomy type and presence of water bodies can represent higher resource availability. In this context, the present study investigated the effect of phytophysiognomies and presence of water bodies in the abundance and community structure of medium and large mammal species (MLM) in the Serra de Santa Catarina, Paraíba, Brazil. To evaluate these variables we conduct an effort of 373 camera-trap days, between August 2012 and November 2014. We recorded 12 MLM species, distributed in six orders and 11 families. From those, *Kerodon rupestris* is the only one listed in the Brazilian List of Threatened Fauna. Regarding the habitat, the Mann-Whitney showed a significant higher frequency to the Shrubby habitat and the ANOSIM showed no shifts in the community structure between Arboreal and Shrubby. Concerning the presence of water bodies, both the Mann-Whitney and the ANOSIM showed significant higher frequency to the habitat with water presence. We observed that both phytophysiognomy and water bodies are important variables which affect mainly the abundance of mammalian species from semiarid environments. Nonetheless, whereas the forest remnants get smaller the existence of water bodies becomes a preponderant factor to the MLM species and its community structure.

Keywords. Camera-trapping; Mammalian inventory; Habitat effect; Xeric environment.

INTRODUCTION

The Caatinga biome is endemic of Brazil comprising 11% (844,453 km^2) of its territory, mostly in Northeast region (Prado, 2003). Dry climate predominates, with irregular and accentuated rainfalls and prolonged droughts (Jacomine, 1996; Ab'Saber, 2003). Caatinga is under considerable threat due to degradation and loss of habitat, with *ca.* 40% reduction of its original vegetation (Castelletti *et al.,* 2003; MapBiomas, 2020), a direct consequence of urban, agricultural and livestock expansions (Leal *et al.,* 2003; Albuquerque *et al.,* 2012). The biome's vegetation is typically xerophilic (Oliveira *et al.,* 2003), mostly composed of trees and deciduous bushes, succulent and thorny species, and a great number of herbs and grasses (Pennington *et al.,* 2006, 2009), differing among regions (Andrade-Lima, 1981). This reflects in the formation of diverse habitats and phytophysiognomies throughout the biome, influencing faunal components (Prado, 2003).

Mammal diversity, on the contrary, did not seem to keep up with the heterogeneity of biome's vegetation, for a long time considered less rich and with low levels of endemism. Its

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species were counted as a subgroup of those found in the Cerrado (Mares *et al.,* 1981, 1985; Fonseca *et al.,* 1996; Oliveira *et al.,* 2004), which is changing with the increase of new studies. Nowadays, there are 183 registered species, 11 endemics (Gutiérrez & Marinho-Filho, 2017; Carmignotto & Astúa, 2018). Among those species, the medium- and large-body mammals (MLM) comprise a heterogeneous polyphyletic group usually having small population size, requiring large home ranges, and cannot be collected in traditional traps designed for small mammals (*i.e.,* Sherman and Tomahawk) (Feijó & Brandão, 2022). Considering rock cavy *Kerodon rupestris* as a MLM, and a taxonomic catalog (Feijó & Langguth, 2013) from the Brazilian Northeast mammals, there are 29 species occurring in the northern limits of the Caatinga domain (left bank of São Francisco River). Some of these species are considered to be threatened with extinction in some degree, including the endemic *K. rupestris* and Brazilian three-banded armadillo *Tolypeutes tricinctus* (Miranda *et al.,* 2014; MMA, 2022).

The composition and abundance of mammal species are directly associated with habitat type and resource availability over space and time (Tews *et al.,* 2004; Stein *et al.,* 2014). Habitat type, heterogeneity, complexity, degrees of maturity, or disturbance in each area, play important roles in the maintenance and variation of mammal species along the landscape (August, 1983; Fonseca, 1989; Williams *et al.,* 2002; Haugaasen & Peres, 2005; Boron *et al.,* 2019). In xeric environments (arids or semi-arids), phytophysiognomy type can represent higher (arboreal habitat) or lesser (shrubby habitat) resource availability (Freitas *et al.,* 2005; Dias & Bocchiglieri, 2016). Meanwhile, the presence of water can be determinant for the occurrence of a variety of species, particularly water-dependent ones (mandatory drinkers) (Western, 1975; James *et al.,* 1999).

Among current studies, most increase knowledge about mammal diversity in the Caatinga, while few investigate how different habitat conditions affect the composition and structure of the mammalian fauna. When studying habitat condition, the existing are related to small mammals (*e.g.,* Rocha *et al.,* 2015; Delciellos, 2016), species with different ecological requirements compared to MLM. Meanwhile, habitat loss, hunting, trampling, forest fires, and other factors continue to negatively affect mammal species across the Caatinga (Leal *et al.,* 2005; Barboza *et al.,* 2016; Bonifácio *et al.,* 2016). Species such as white-lipped peccary *Tayassu pecari,* collared peccary *Dicotyles tajacu,* jaguar *Panthera onca,* giant anteater *Myrmecophaga tridactyla,* and paca *Cuniculus paca* are already extinct in a great part of the biome, and historical documentation points to the total extinction of *Priodontes maximus* and *Tapirus terrestris* within this territory (Carmignotto *et al.,* 2011; Feijó & Langguth, 2013; Alves *et al.,* 2016).

Therefore, we present here the MLM species inventory of Serra de Santa Catarina (SSC), a shrub forest remnant in the Caatinga, western of Paraíba state. In addition, in a preliminary condition, we analyzed the dynamics of habitat use by species according to local phytophysiognomies (arboreal *vs.* shrubby) and the presence and absence of water bodies in the study area.

MATERIAL AND METHODS

Study site

The complex of Serra de Santa Catarina (SSC) is situated in the extreme west of Paraíba State (07°00′46″S, 38°11′12″W; 360-650 m asl), northeastern Brazil, in the micro-region among the municipalities of Sousa and Cajazeiras (East-West), with an area of approximately 112.1 km² (Sousa & Oliveira, 2010) (Fig. 1). The local landscape is composed by deciduous seasonal forest, dry forest, forested and arboreal steppe savanna (shrubby), with most of vegetation as arboreal, followed by shrubby and patches of herbaceous vegetation. The illegal logging, fire and hunting are the main anthropic threat that occurs in higher frequency in the region (BATPC, pers. obs.). The main precipitation season occurs between March and July, reaching *ca.* 900 mm of annual precipitation, with a mean annual temperature of 24°C.

Data sampling

We carried out the sampling effort in four campaigns between August 2012 and November 2014, totaling 373 days of sampling, ranging from 65 to 114. We used camera-traps (Bushnell, model: 119436C) as the main sampling method, varying between campaigns (9, 4, 8, 2). Camera-traps were set to activate by motion, recording (photographs or videos) full time, with the aim of maximizing the recordings of individuals who remained at the sampling site, according to Giman *et al.* (2007). To assess the effect of different habitat types and conditions, we set up camera-traps in three habitat types (arboreal, shrubby, shrubby-arboreal; Fig. 2) and in two habitat conditions (presence and absence of water bodies; Fig. 2). We conducted active searches, in addition to complimentary records, through direct observations or indirect sampling through vestiges (*i.e.,* feces, tracks, carcass/skull, fur, scarifications, burrow, and vocalizations) (Wilson *et al.,* 1996). These additional records were considered only for the composition of the species list. We registered some domestic animals such *Bos taurus* (catle) and *Capra hircus* (goats). They were not considered in our analysis.

Data analysis

The recorded data were classified in spreadsheets containing date, time, sampling location, habitat type (arboreal, shrubby, and shrubby-arboreal), habitat condition (absence/presence of water bodies), type of record (camera-trap and complimentary approach), species identification at the best taxonomic level, and its respective abundance. Records more than 60 min apart were considered as independent samples. For taxonomic

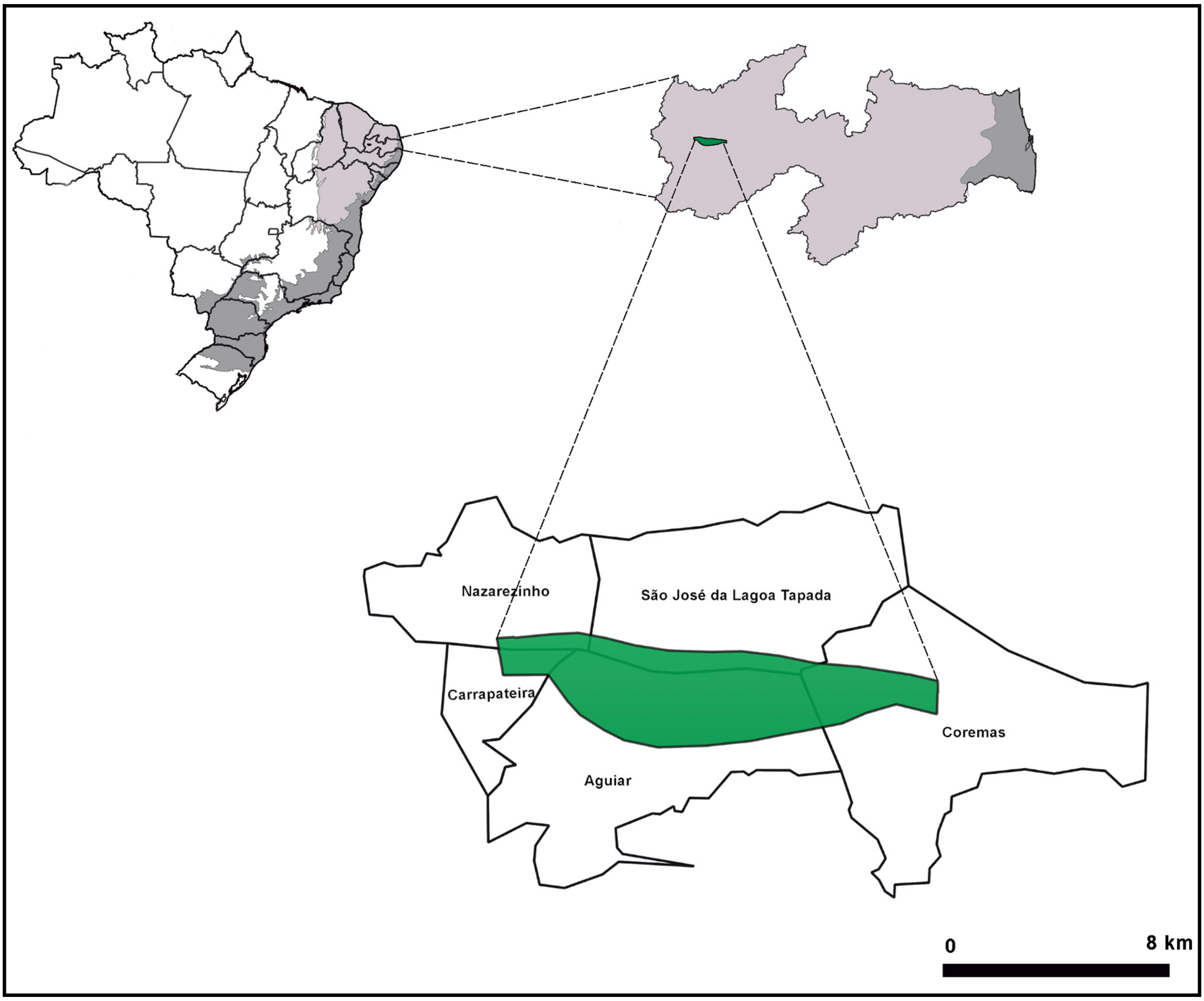

Figure 1. Study area, the Serra de Santa Catarina, extreme West of Paraíba state, northeastern Brazil. In light gray Caatinga biome and in dark gray Atlantic Forest Biome; in green, Serra de Santa Catarina limits.

classification and species identification, we follow Wilson & Reeder (2005), Nascimento & Feijó (2017), and Quintela *et al.* (2020), Bernegossi *et al.* (2023). For the identification of vestiges, tracks, among others, we use field guides (*e.g.,* Navarro & Muñoz, 2000; Borges & Tomás, 2008; Júnior & Luz, 2008; Reis *et al.,* 2009).

Descriptive and statistical analyses were performed only with data obtained by (systematic) camera-trapping. We considered the days with effective records in different camera-traps throughout the campaigns as independent samples. We calculated the sampling effort (number of camera-traps * sampling days), and recording success (number of independent samples/sampling effort * 100), while for the rarefaction curve we used the Jackknife 1 index, calculated using EstimateS 9.0 (Colwell, 2013) based on 1,000 runs. We did not conduct any seasonal analysis, as there was no regular rainfall during the samplings.

As we did not have regular ecological conditions, we performed ecological analyses as preliminary and exploratory approaches assessing the effects of habitat type (phytophysiognomies: Arboreal *vs.* Shrubby) and condition (Presence *vs.* Absence of water bodies). We consider data from different camera-traps in different field campaigns as independent samples. With regard to the analysis of the habitat type, we excluded data from the fourth campaign, as it mainly sampled the Shrubby-Arboreal phytophysiognomy, not included as a variable here. To test the above cited effects on recording success (median frequency), we use the non-parametric Mann-Whitney (according Shapiro-Wilk test). To test shifts in the structure of the MLM community, we used Analysis of Similarity (ANOSIM, one-way), represented by a Non-Metric Multidimensional Scaling (NMDS). In order to avoid the abundance bias of group-living species (mainly capuchin monkeys), we used the non-parametric indices Jackknife 1 (diversity) and Jaccard (similarity and NMDS). Analyses were run in BioEstat 5.3 (Ayres *et al.,* 2007) and PAST 3.2 (Hammer *et al.,* 2001) at a significance level of 5%.

The present work does not present any ethical conflict, since we do not manipulate any live animal. The Instituto Chico Mendes de Biodiversidade (ICMBio) authorized this study through research permit (SISBio 34872-2).

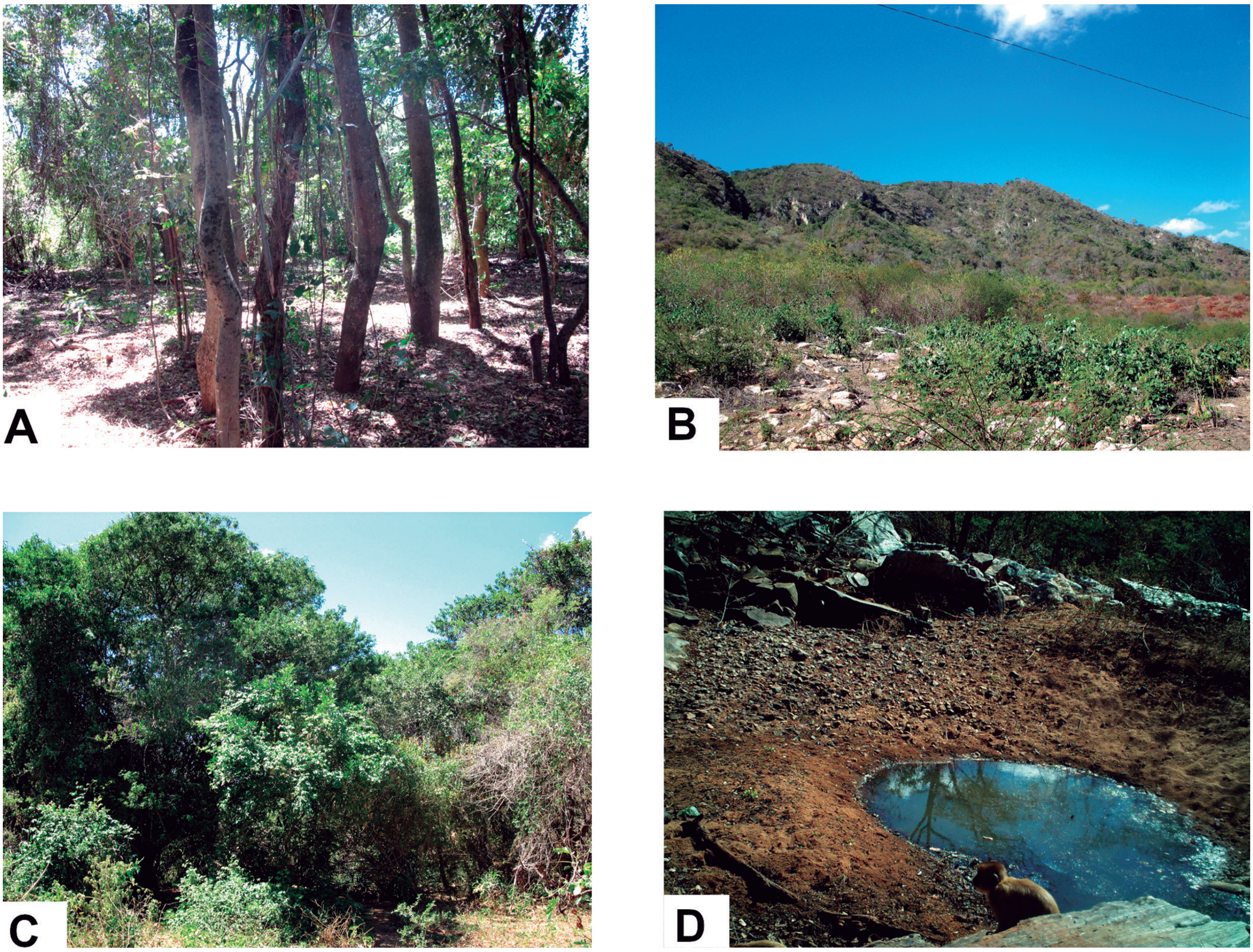

Figure 2. Different habitats analyzed in Serra de Santa Catarina, Paraíba, Brazil. A = Arboreal; B = Shrub; C = Arboreal-shrub; D = Water spot with a capuchin monkey in the foreground.

RESULTS

The field effort resulted in 373 camera-trap.day sampling effort with camera-trap, of which 118 had records that we considered independent sampling days, representing 31.6% of record success. This effort resulted in the record of 10 MLM species, in addition to two species through active searches *(Euphractus sexcinctus* and *Galictis cuja),* totaling 12 MLM for the Serra de Santa Catarina, distributed in six Orders and 11 Families (Table 1). The order Carnivora was the most represented – six species (50%), followed by Primates ($n = 2$; 16.8%), while the remnants (Cingulata, Pilosa, Rodentia, and Artiodactyla) were represented by only one species (8.3% each).

The observed richness (S = 10) represents 77.1% for the estimated richness (S = 12.97 ± 1.7) by Jackknife 1 (Fig. 3), with no significant difference. This result suggests the record of new MLM species (3 to 5) with continued samplings. Considering that we recorded 12 species with combined methods, there may be at least three additional species yet to be recorded in the SSC.

Regarding the preliminary assessment of habitat effects, the Mann-Whitney showed a significant difference both for the habitat type (arboreal *vs.* shrubby, $U = 432$, $p < 0.05$) with higher frequency to the shrubby phytophysiognomy (Fig. 4A), as for the water bodies (presence *vs.* absence, $U = 387$, $p < 0.05$) with higher frequency for the presence of water (Fig. 2b). The ANOSIM showed no shifts in community structure between

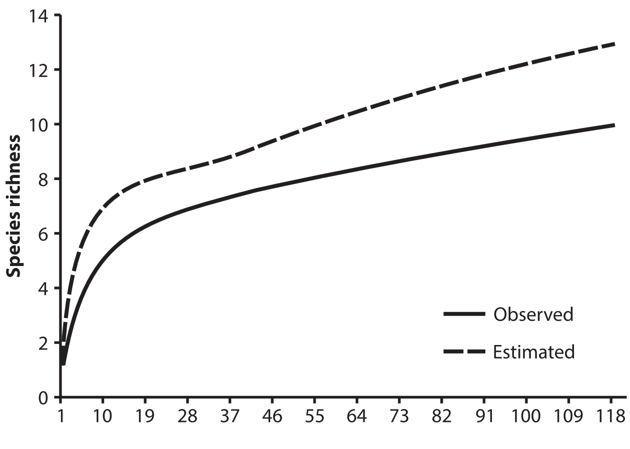

Figure 3. Rarefaction curve for camera-trap sampling to medium-large mammal species of the Serra de Santa Catarina, Paraíba, northeastern Brazil, sampled between August 2012 and November 2014. Observed richness (S = 10 ± 1.76) has no significant difference to estimated richness (S = 12.97 ± 1.7) through the non-parametric Jackknife 1. Sample unit were defined as days with effective records in different camera-traps.

Table 1. Taxonomic list of medium-large mammal species recorded to the Serra de Santa Catarina, West of Paraíba, Northeast Brazil, according to type of record, type of habit, and relative abundance, sampled between August 2012 and November 2014.

TAXON	VERNACULAR NAMES ENGLISH (PORTUGUESE)	TYPE OF RECORD	HABITAT	FREQUENCY OF RECORDS (%)
Cingulata				
Chlamyphoridae				
Euphractus sexcinctus (Linnaeus, 1758)	Yellow armadillo (Tatu-peba)	O	D	1 (0.5%)
Pilosa				
Myrmecophagidae				
Tamandua tetradactyla (Linnaeus, 1758)	Southern Tamandua (Tamanduá-mirim)	CT	SA	1 (0.5%)
Primates				
Callitrichidae				
Callithrix jacchus (Linnaeus, 1758)	Common marmoset (Sagui-de-tufos-brancos)	O, CT	D	7 (3.2%)
Cebidae Gray, 1831				
Sapajus libidinosus (Spix, 1823)	Bearded Capuchin (Macaco-prego)	CT	D	58 (26.7%)
Carnivora				
Felidae				
Leopardus pardalis (Linnaeus, 1758)	Ocelot (Jaguatirica)	CT, F	A, D	27 (12.4%)
Puma concolor (Linnaeus, 1771)	Puma (Suçuarana)	CT, F	S, D	17 (7.8%)
Canidae				
Cerdocyon thous (Linnaeus, 1766)	Crab-eating fox (Raposa, cachorro-do-mato)	O, CT	SA, D	4 (1.8%)
Mustelidae				
Galictis cuja (Molina, 1782)	Lesser grison (Furão pequeno)	F	S	1 (0.5%)
Mephitidae				
Conepatus amazonicus (Boddaert, 1785)	Hog-nosed Skunk (Jeritataca)	O, CT, F	S, SA, D	9 (4.1%)
Procyonidae				
Procyon cancrivorus (G. Cuvier, 1798)	Crab-eating raccoon (Guaxinim)	CT, F	S, A, D	66 (30.4%)
Artiodactyla				
Cervidae				
Subulo gouazoubira (G. Fischer, 1814)	Gray brocket deer (Veado-catingueiro)	CT, F	S, SA, D	23 (10.6%)
Rodentia				
Caviidae				
Kerodon rupestris (Wied-Neuwied, 1820)[1]	Rock cavy (Mocó)	O, CT	A	3 (1.4%)

CT = camera-trap, F = footprint, O = direct observation, type of habitat S = shrubby, A = arboreal, SA = shrubby-arboreal, D = dry forest. [1] = Species considered as Vulnerable (VU), according to the Brazilian Official List of Fauna Species Threatened of Extinction (MMA, 2022).

habitat types (R = 0.0745, $p > 0.05$) (Fig. 5A), although there were significant differences between sites with the presence-absence of water (R = 0.3126, $p < 0.05$) (Fig. 5B).

DISCUSSION

Medium-large mammalian species community

We documented a richness (S = 12) similar to that obtained in studies performed in the Caatinga (Table 2), corresponding to 43% of total MLM species (S = 28) known to the biome (Feijó & Langguth, 2013), and close to that listed for neighboring municipalities of the SSC (see Table 2 for details). We confirmed the presence of *Euphractus sexcinctus, Tamandua tetradactyla, Sapajus libidinosus,* and *Procyon cancrivorus,* previously only reported by local informants. However, we failed to record *Dasypus novemcinctus, Sylvilagus brasiliensis, Leopardus emiliae* (formerly part of *Leopardus tigrinus; sensu* Nascimento & Feijó, 2017), and *Herpailurus yagouaroundi.* The intense land-use change can be one of the main factors leading to the lack of some records. Dotta & Verdade (2007) observed the predominance of diet generalist species in an anthropic landscape (matrix of pasture, eucalyptus, sugarcane, and native forest), contrasting with the reduction or extinguishing of specialized species. Additionally, Alves *et al.* (2016) report that hunting also affects some species, even locally extinguishing or lowering the densities of some of them. That might have been preponderant to the absence of *D. novemcinctus* and *S. brasiliensis,* widely hunted and appreciated as bushmeat (Barboza *et al.,* 2016).

Although being specialized species, the virtual absence of *L. emiliae* and *H. yagouaroundi* may also be the result of the "ocelot effect". According to this effect, the predation of small-sized prey by *L. pardalis* inhibits the presence and persistence of smaller felid species (Oliveira *et al.,* 2010). While ocelots do not suffer any negative effects from larger felids as a result of competitive exclusion. This may have been extended to *C. thous* that presented a single record (n = 1), although being commonly abundant in the Caatinga (Delciellos, 2016). Despite small felids being common to the Caatinga, habitat reduction certainly decrease prey densities that in turn drive the lack of such predators. Larger areas, on the other, undoubtedly benefits a higher number of predator species through the availability of different sized prey (see Schaller & Crawshaw, 1980; Emmons, 1987).

Table 2. Medium and large mammal richness comparison between sampling areas in the Caatinga. Legends: TS = Total richness; Cin = Cingulata; Pil = Pilosa; Pri = Primates; Lag = Lagomorpha; Car = Carnivora; Art = Artiodactyla; Rod = Rodentia. We did not accounted domestic species.

Locality (State)	TS	Cin	Pil	Pri	Lag	Car	Art	Rod	Reference
Serra de Santa Catarina (Paraíba)	12	1	1	2	0	6	1	1	**Present Study**
Neighboring municipalities from Serra de Santa Catarina (Paraíba)*	15	2	1	2	1	8	1	0	Feijó & Langguth, 2013
Porto da Folha (Sergipe)	5	0	0	2	0	3	0	0	Freitas *et al.*, 2011
Serra da Guia (Sergipe)	10	2	0	1	1	4	1	1	Rocha *et al.*, 2015
Ouricuri (Pernambuco)	10	1	0	1	0	6	1	1	Delciellos, 2016
São João do Piauí (Piauí)	14	2	1	1	1	6	1	2	Delciellos, 2016
Serra das Almas Nature Reserve (Ceará/Piauí)	20	3	1	2	0	9	2	3	Dias *et al.*, 2017
Grota do Angico Natural Monument (Sergipe)	13	1	1	1	0	7	1	2	Freitas *et al.*, 2017
Serra de Santana (Bahia)	14	2	1	2	1	5	2	1	Pereira & Peixoto, 2017
Serra de Santana (Rio Grande do Norte)	8	1	1	1	0	4	1	0	Marinho *et al.*, 2018
Lajes (Rio Grande do Norte)	9	2	1	0	0	5	1	0	Marinho *et al.*, 2018
Cerro Coró (Rio Grande do Norte)	6	1	0	0	0	4	1	0	Marinho *et al.*, 2018
Martins (Rio Grande do Norte)	7	2	0	1	0	3	1	0	Marinho *et al.*, 2018
Serrinha dos Pintos (Rio Grande do Norte)	8	2	1	0	0	4	1	0	Marinho *et al.*, 2018
Felipe Guerra (Rio Grande do Norte)	8	1	1	1	0	5	0	0	Marinho *et al.*, 2018
Caiçara do Norte (Rio Grande do Norte)	3	1	0	0	0	2	0	0	Marinho *et al.*, 2018
Luis Gomes (Rio Grande do Norte)	8	2	0	1	0	4	1	0	Marinho *et al.*, 2018
Dunas Rosado (Rio Grande do Norte)	6	1	1	0	0	3	1	0	Marinho *et al.*, 2018
Coronel Ezequiel (Rio Grande do Norte)	8	2	0	0	0	5	1	0	Marinho *et al.*, 2018
Boqueirão da Onça (Bahia)	22	3	2	2	0	11	3	3	Campos *et al.*, 2019

* = Municipalities considered as neighboring from Serra de Santa Catarina in the present study: São José da Lagoa Tapada, Patos, Teixeira, Coremas, Olho d'Água, Teixeira and Piancó.

In spite of the similarities of species richness to previous studies in the Caatinga, the area amount availability play a fundamental role. For instance, we recorded 12 species, comparing to 7-29 species recorded in protected areas in the states of Bahia, Ceará, and Piauí (see Table 2), probably due to the largest size of these areas and habitat heterogeneity they maintain. Therefore, habitat suitability and dynamic of population and community may be main drivers to those differences. Specific characteristics of study areas, such as the history of colonization and degradation may also have played an important role. Thus, differences in composition with respect to habitat heterogeneity are expected, as discussed below.

Effect of habitat type and presence of water bodies: preliminary and exploratory approaches

Probably the size of the study site (currently 112.1 km^2) and its heterogeneity were decisive in the maintenance of the mammalian community. We considered habitat types (arboreal and shrubby) and conditions (water presence and absence) as a proxy for habitat heterogeneity and complexity, both (types and conditions) being paramount for the local abundance of MLM. The presence/absence of water bodies also showed significant differences, where sites with water bodies presented higher abundances. According to Gadelha-Neto *et al.* (2018), arboreal phytophysiognomy (Seasonal Deciduous Forest) occurs mostly in the high slopes and tops of the SSC, with Rubiaceae plants (associated with humid microhabitats) comprising the second-largest diversity of local tree species. Such characteristics guarantee the maintenance of a more complex habitat, while the shrubby habitat act as a buffer zone, instead of pasture or agriculture landscape. The higher abundance of MLM in this buffer shrubby habitat may be a response to its larger size, whereas the arboreal phytophysiognomies represent a core environment, an important habitat to specialized species.

The water bodies are responsible for other effects on the diversity of mammals in the SSC, such as the maintenance of arboreal habitat, and proving to be a preponderant factor in the detection of MLM species. As a result, sampling sites with the presence of water recorded a different mammalian community compared to the sampling sites without water (Figs. 4 and 5). Even in tropical rain forests, wetter areas present a strong relationship between habitat structure, composition, and abundance of mammalian species (Williams *et al.,* 2002). This result suggests that habitat structure (presence/absence of water) is even more crucial for the mammalian community in xeric habitats and/or with less resource availability, as in the SSC.

Habitat diversity also plays an important role in mammal richness, recording higher rates in more productive and humid habitats. This pattern was recorded in the Central Amazon (Tardio & Da Silveira, 2015), Caatinga and associated environments (Freitas *et al.,* 2005; Pereira & Geise, 2009; Bezerra *et al.,* 2014; Rocha *et al.,* 2015; Delciellos, 2016; Dias & Bocchiglieri, 2016), and the African savannah (Western, 1975). The presence of water in xeric environments is so valuable that even artificial sources can change the geographical distribution of certain species (Owen-Smith, 1996; James *et al.,* 1999), being particularly important to water-dependent species (compulsory drinkers: grazers and larger-sized species). Since they consume higher rates of resources with low

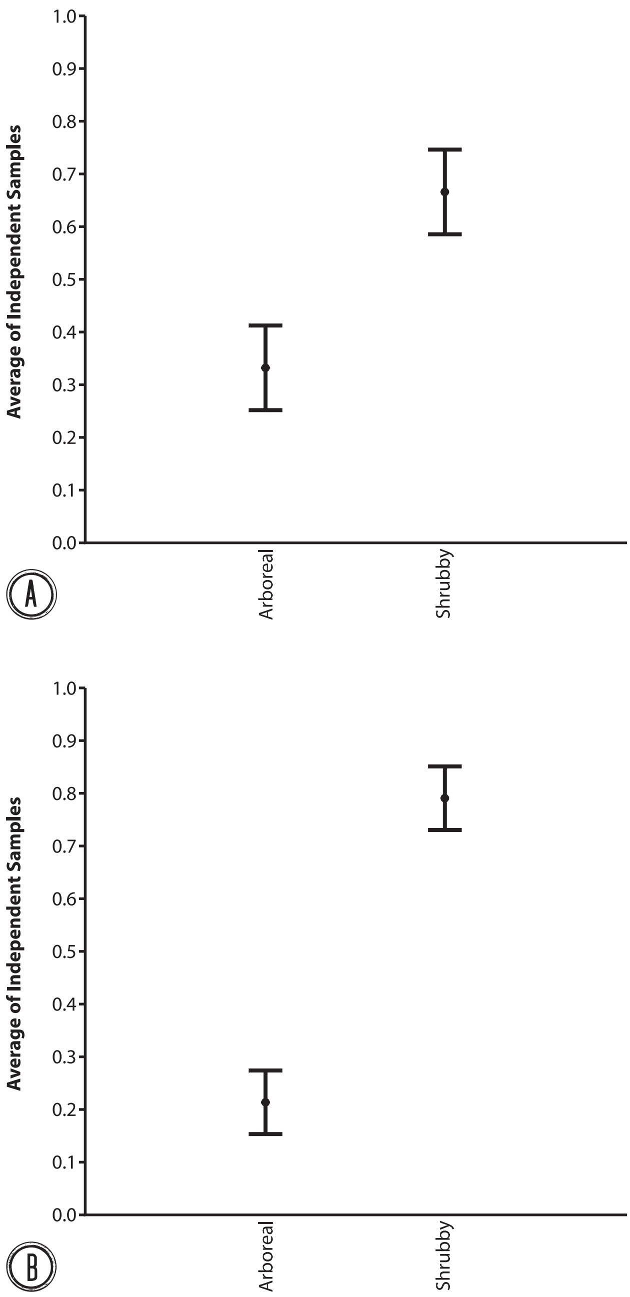

Figure 4. Average of abundance of medium-large mammal species according to different phytophysiognomies (a) and presence of water bodies (b), recorded in the Serra de Santa Catarina, Northeast Brazil, between August 2012 and November 2014. The Mann-Whitney analysis showed no difference between both phytophysiognomies (U = 29.5, $p > 0.05$) and presence of water bodies (U = 48.5, $p > 0.05$).

water levels, the presence of water sources is mandatory for their occurrence (Owen-Smith, 1996; Redfern *et al.*, 2003; Moreira-Ramírez *et al.*, 2016).

Mammals from Caatinga are physiologically less adapted to hydric stress (see Mares *et al.*, 1985) highlighting the requirement for regular water sources. However, the presence of water affects mammals less as the remaining forest increases. In Serra da Capivara National Park (Parque Nacional Serra da Capivara – PNSC; 130,000 ha) mammals were not affected by distance from water sources (Wolff, 2001). The same was not observed in the Serra das Almas Private Natural Heritage Reserve (Reserva Particular do Patrimônio Natural Serra das Almas – RPPN Serra das Almas; 5,800 ha) (Dias *et al.*, 2017). Notwithstanding, the later authors did not evaluate the water effect on mammalian abundance. The maintenance of higher quality habitats in the PNSC and RPPN Serra das Almas, due to their large size, guarantees a lower effect of drought events. It certainly decreases dependence on water bodies. Thus, the consequences of the presence of water seem to exert a strong influence on richness and abundance as forest remnants decrease in size, as observed in the present study. Additionally, these habitat characteristics may be even more important during prolonged droughts. Further investigations

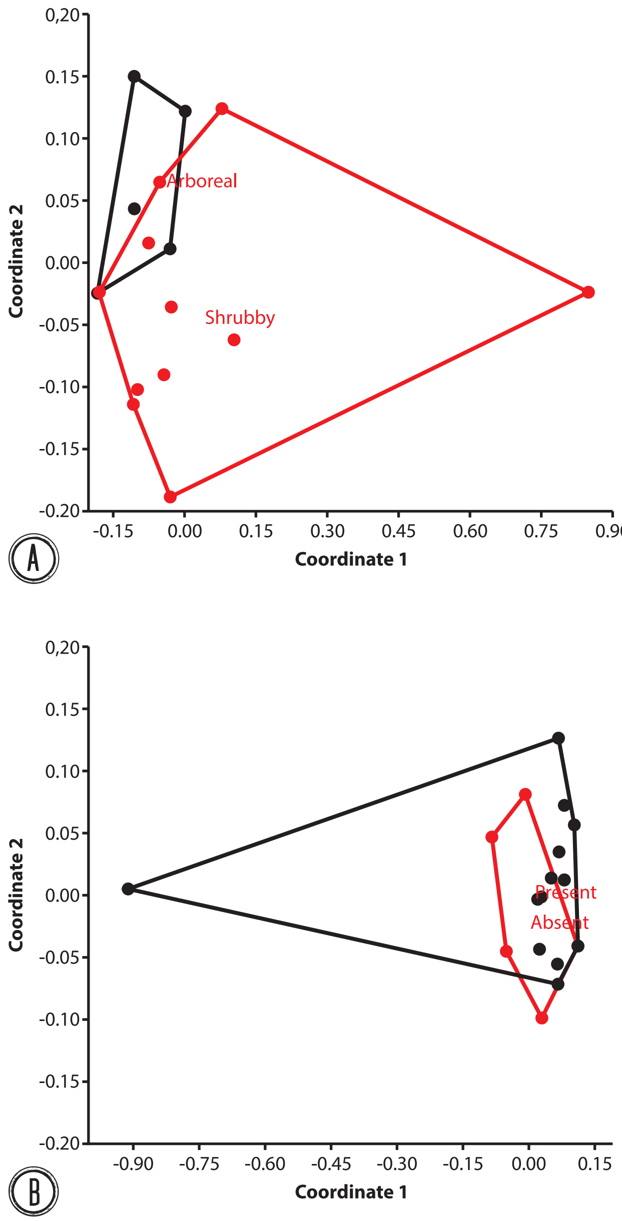

Figure 5. Non-metric Multidimensional Scaling of medium-large mammal community structure according to different phytophysiognomies (a) and presence of water bodies (b), recorded in the Serra de Santa Catarina, Northeast Brazil, between August 2012 and November 2014. The ANOSIM (one-way) analysis showed no difference between phytophysiognomies (R = 0.1124, $p > 0.05$) and a significant difference between the presence of water bodies (R = 0.3907, $p < 0.05$).

may address better attention to those characteristics (habitat type and condition) and their effect on mammalian community along the Caatinga biome.

Threats and conservation

Regarding the species richness, the SSC exhibit an intermediate conservation status. The SSC presents both MLM species that are common and tolerant to anthropic pressure *(e.g., Callithrix jacchus, Cerdocyon thous),* as well as rare and lower tolerant to anthropization *(e.g., Puma concolor)*. We highlight the presence of *Kerodon rupestris* (endemic to Caatinga – Gutiérrez & Marinho-Filho, 2017), considered to be threatened with extinction (see Table 2). The recent review of threatened species in Brazil ("National red list", MMA, 2022) does not consider regional or state contexts, removing sensitive species such as *Puma concolor.* However, these species deal with regional threats, facing a reduction in local populations, if not local extinctions. In this sense, State red lists would deal with such local or regional contexts for sensitive species, being an important outcome for local policy.

The species found in the SSC are commonly subjected to hunting. *Euphractus sexcinctus, K. rupestris,* and *S. gouazoubira* are possibly the most affected species by the hunting activity, usually as bushmeat. Traps, standing points and baiting points (NFC and BATPC, pers. obs.) confirm the hunting activity along the SSC. The subsistence may be the main purposes. However, even species with high reproductive rates as the *K. rupestris,* is facing local extinction due to its overexploitation (Alves *et al.,* 2016; Barboza *et al.,* 2016). Hunting also directly affects the *Puma concolor* due to conflicts with humans in order to avoid livestock loss (mainly goats). Indirectly, hunting decreases the number of prey, mainly medium-sized mammals (Carvalho-Jr. & Morato, 2013; Michalski *et al.,* 2006). The excessive withdrawal of specimens from the nature is one of the most important threats to the wildlife (Dirzo *et al.,* 2014). In the Neotropics, hunting is usually performed in an impactful and unsustainable manner (*e.g.,* Alvard *et al.,* 1997; Nogueira & Nogueira-Filho, 2011), even in Caatinga MLM (Barboza *et al.,* 2016). This makes the Caatinga historically the most impacted in Brazil due to hunting.

Followed by hunting, habitat reduction and fragmentation are the main drive to the biodiversity loss (Chiarello *et al.,* 2008; ICMBio, 2018). The conservation measurements to the local diversity of the SSC, therefore, should consider not only the protection of the forest remnant, but the nearby forest remnants. The establishment of forest corridors associated with riparian forest, besides being a largely used strategy, allows the supply of the perennial condition of small streams even if they get far from the SSC. This strategy allows mammals and other animal species to travel between forest remnants. It also guarantees a decrease in the effects of prolonged droughts on the water reservoirs supply located in the SSC surroundings. Sustaining local human populations and their diverse activities. The creation and maintenance of artificial water sources such as dam along the SSC can also be an important strategy to maintain the local mammal species or even other groups of animals. Artificial water spots are utilized as management measures of protected areas (PA) in Africa and Australia. This strategic spots guarantee water source during prolonged drought periods, besides being touristic points (see Owen-Smith, 1996; James *et al.,* 1999; Redfern *et al.,* 2003).

CONCLUSIONS

Our results highlight the importance of setting the camera-traps both near water bodies and through different habitat types. That guarantees the sampling of a higher number of species in a small time-effort, in preliminary, or in rapid mammalian survey/assessment. Besides, it is possible to evaluate the effect of habitat type and water presence in the distribution of mammalian fauna throughout the Caatinga habitats.

We observed that habitat type (phytophysiognomy) is an important variable affecting the distribution, composition, and abundance of mammals in xeric environment, corroborating previous studies. We highlights the need of maintenance of large forest remnants of the Caatinga, especially those with large arboreal habitats. The present study also highlights the significance of water sources or more humid habitats to the maintenance of MLM fauna throughout the Caatinga. Particularly when forest remnants are reduced. Which means, whereas the forest remnants get smaller the water presence becomes a preponderant factor in the presence and abundance of mammals in xeric environments. That emphasizes the importance of protection of Caatinga areas such as the Serra de Santa Catarina. They are responsible for the maintenance of mammal diversity in a biome with a lack of protected areas. The conservation of the SSC brings as a consequence the maintenance of the local hydric resources. An important resource for local populations and their economic activities, mainly in semiarid environments.

In time, it is important to consider that factors such as fragment size and hunting can also exert a strong influence over the maintenance of those species, therefore, they should be considered as a variable in further studies. Future researches may also consider the investigation of the effect of arboreal and shrubby environments in the context of core and buffer conditions, as pointed by the present results.

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