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ARTICLE

HABITAT SELECTION BY MAMMALS IN AN ISOLATED FRAGMENT OF BRAZILIAN ATLANTIC FOREST

Douglas de Matos Dias[1], Meyline de Oliveira Souza Almeida[2], Talita Guimarães de Araújo-Piovezan[2], José Oliveira Dantas[2]

[1] Programa de Pós-Graduação em Ecologia, Conservação e Manejo da Vida Silvestre, Departamento de Biologia Geral, Universidade Federal de Minas Gerais. Avenida Antônio Carlos 6627, Belo Horizonte, MG, Brasil. CEP: 31270-901.

[2] Instituto Federal de Educação, Ciências e Tecnologia de Sergipe, Campus São Cristóvão. BR 101, Km 96, Quissamã CEP: 49100-000, São Cristóvão, SE, Brasil.

Corresponding Author: Douglas de Matos Dias, *diasdm.bio@gmail.com*

Abstract. Habitat loss, edge effects and the introduction of exotic species are interrelated impacts associated with the anthropogenic modification of landscapes, and represent the principal threats to biodiversity worldwide. These processes affect the composition of species assemblages and provoke varying responses in different species. We used camera traps to evaluate the frequency of occurrence and use of habitat by mammals in response to different abiotic (distance from the forest edge and watercourses) and biotic (frequency of domestic dogs) factors within an isolated fragment of Atlantic forest, in northeastern Brazil. We recorded the occurrence of 15 mammal species. *Dasyprocta iacki*, *Cuniculus paca* and *Sylvilagus brasiliensis* were the most frequent species, while the felines *Leopardus pardalis* and *Herpailurus yagouaroundi* were the least frequent mammals. *L. pardalis*, *Mazama gouazoubira*, *Procyon cancrivorus* and *Callithrix jacchus* occurred near the edge of the forest, but avoided sites with high frequency of domestic dogs. The proximity to water was an important predictor for *S. brasiliensis*, *Tamandua tetradactyla*, *Dasypus novemcinctus* and *Euphractus sexcinctus*, with armadillos tending to avoid edge environments. *Cuniculus paca* was recorded in sites farther away from water bodies and closer to the edge of the forest. *Herpailurus yagouaroundi* presented relationships with sites far from the edge and with high frequency of domestic dogs. *Didelphis albiventris* was associated with intermediate distances of the forest edge and mean frequencies of domestic dogs. In general, the mammals recorded at the study site were generalist species, able to adapt to different types of vegetation and impacts.

Keywords: camera traps, *Dasyprocta iacki*, habitat use, *Sylvilagus brasiliensis*

Resumo. A perda de habitat, os efeitos de borda e a introdução de espécies exóticas são impactos inter-relacionados associados à modificação antropogênica das paisagens e representam as principais ameaças à biodiversidade em todo o mundo. Esses processos afetam a composição das comunidades e provocam respostas variadas em diferentes espécies. Utilizamos armadilhas fotográficas para avaliar a frequência de ocorrência e uso de habitat por mamíferos em resposta a diferentes fatores abióticos (distância da borda da floresta e dos cursos de água) e bióticos (frequência de cachorros domésticos) dentro de um fragmento isolado de Mata Atlântica, no nordeste do Brasil. Registramos a ocorrência de 15 espécies de mamíferos. *Dasyprocta iacki*, *Cuniculus paca* e *Sylvilagus brasiliensis* foram as espécies mais frequentes, enquanto os felinos *Leopardus pardalis* e *Herpailurus yagouaroundi* foram os menos frequentes. *Leopardus pardalis*, *Mazama gouazoubira*, *Procyon cancrivorus* e *Callithrix jacchus* ocorreram próximo à borda da floresta, mas evitaram locais com alta freqüência de cães domésticos. A proximidade com a água foi um importante preditor para *S. brasiliensis*, *Tamandua tetradactyla*, *Dasypus novemcinctus* e *Euphractus sexcinctus*, com tatus tendendo a evitar ambientes de borda. *Cuniculus paca* foi registrado em locais mais distantes dos corpos de água e mais próximos da borda da floresta. *Herpailurus yagouaroundi* apresentou relações positivas com locais distantes da borda e com alta frequência de cães domésticos. *Didelphis albiventris* associou-se à valores intermediários de distância para a borda da floresta e de frequência de cães domésticos. Em geral, os mamíferos registrados no local do estudo eram espécies generalistas, capazes de se adaptar a diferentes tipos de vegetação e impactos.

Palavras-chave: armadilhas fotográficas, *Dasyprocta iacki*, uso do habitat, *Sylvilagus brasiliensis*

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INTRODUCTION

Changes in natural landscapes resulting from the replacement of native habitats by cropland and urban areas represent a major challenge for the conservation of biodiversity (Schipper et al. 2008, Ceballos et al. 2015). The expansion of agriculture drastically reduces forest cover and compromises not only the persistence of species but also ecosystem services (Laurance et al. 2014). Although some species have the ability to survive in heterogeneous environments (Schuette et al. 2013), the ongoing growth of human populations leads to increasingly fragmented landscapes, and a progressive reduction in the availability of resources needed by the native fauna (Woodroffe 2000).

In the Neotropical region, forest remnants are typically isolated within a matrix of farmland (Tabarelli et al. 2004), which limits the dispersal of many species (Chiarello 2000). Over time, the composition of a community will typically shift through the loss of the species more sensitive to disturbance and, in consequence, the increasing predominance of the more resilient species (Chiarello 2000, Tabarelli et al. 2012). Animals in isolated forests, however, are also more vulnerable to other impacts, such as hunting, the invasion of exotic species, logging (Bogoni et al. 2017) and edge effects.

The edge effect is an ecological process that results from the interaction of two adjacent ecosystems along an abrupt transition zone (Murcia 1995). In the case of forest fragments surrounded by an anthropogenic matrix, the margin of the forest is exposed to the more open conditions of the matrix, leading to changes in microclimate, vegetation structure, and associated shifts in species composition (Stevens & Husband 1998). The forest edge is also more accessible to domestic mammals, which may constitute both potential predators and/or competitors, and provoke changes in the use of habitat by resident mammals (Attum et al. 2009, Lacerda et al. 2009, Lessa et al. 2016). The availability of water within the modified landscape is an additional factor contributing to the distribution of species (Ferreguetti et al. 2017). This is because, in addition to water itself, riparian environments can provide greater availability of other resources, including food and shelter (Schuette et al. 2013, Astete et al. 2016).

Given the ecological relevance of mammals, it is important to understand how these animals respond to multiple anthropogenic impacts. This is especially the case for the Brazilian Atlantic Forest, which has been subjected to high levels of deforestation. Only 11-16% of the original cover remains in the Atlantic forest, most of which is distributed in relatively small and isolated fragments (Ribeiro et al. 2009). In this context, our objectives were to (1) identify the species richness and composition of medium- and large-sized mammal communities in a remnant of Atlantic Forest in northeastern Brazil, and (2) analyze the relationships of the occurrence and distribution of species with specific biotic and abiotic variables. These variables include the distance from the edge of the forest, the availability of water, and the presence of domestic dogs.

MATERIALS AND METHODS

Study site

This study was carried out in a ~400 ha fragment of Atlantic Forest owned by the Sergipe Federal Institute of Education, Science and Technology (IFS), in São Cristóvão, Sergipe, Brazil (Figure 1). The region's climate is hot and humid, with a rainy season from March to August (Santos et al. 2014), and mean annual rainfall is 1500 mm, according to the historical data provided by the Sergipe State Secretariat for the Environment and Water Resources.

The landscape is flat and the vegetation of the fragment is composed mainly of semi-deciduous tropical forest at various stages of post-disturbance succession, with some patches of oil palm, *Elaeis guineensis* Jacq. The IFS forest borders the Poxim reservoir to the west, and contains four

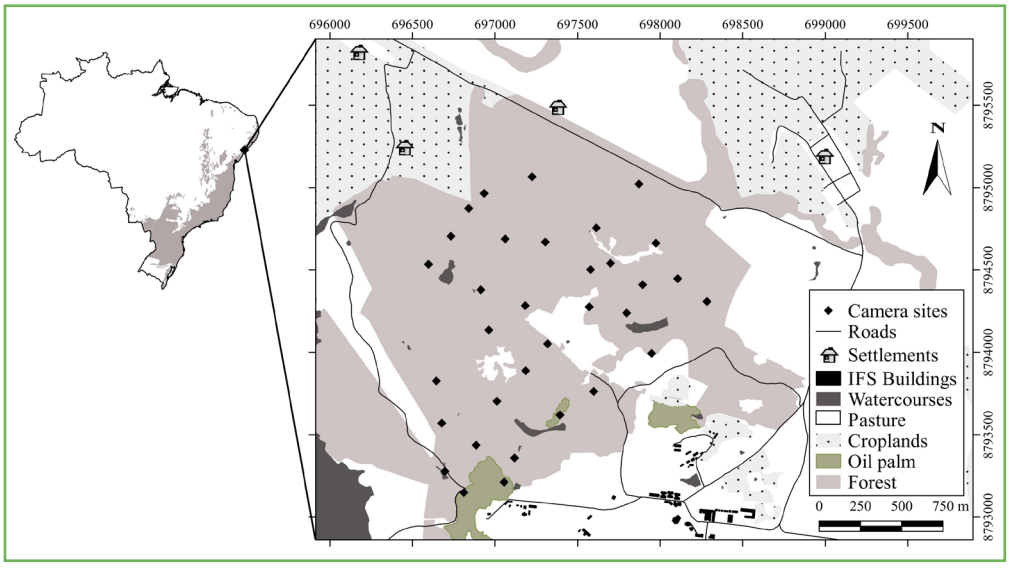

Figure 1. Location of the forest fragment of the Federal Institute of Sergipe (IFS), in São Cristóvão, Sergipe, Brazil, and the camera traps sites used in the present study. The insert (top left) shows the location of Sergipe state and the Atlantic Forest domain within Brazil..

large lagoons, and 24 smaller water bodies. Within a 5 km radius from the center of the IFS fragment, the landscape is composed mostly of pastures (59.4%), forest remnants make up 18.1% and croplands (sugar cane, corn, beans, manioc, fruits, etc.) cover 16.3% of the area, while buildings, settlements and water bodies make up the remainder of the landscape. Some smaller forest patches (<50 ha) are found in the surroundings of IFS forest, isolated by roads or the agricultural matrix. There are some narrow strips of riparian forests that were formed after the impoundment of the Poxim River. At a distance of approximately 6 km south of the IFS, there is a forest patch of 470 ha. The two larger fragments are separated by a highly anthropic matrix, including settlements, pastures, exposed soil and an important federal highway (BR 101). In addition, the IFS is located within the metropolitan area of Aracaju, the Sergipe state capital, where almost one million people live.

Data Collection

We selected 33 sites within the IFS forest for the systematic sampling of the mammalian fauna using camera traps (Bushnell® and Ltl Acorn 5210A), which were fixed at set points mainly inside the forest. Due to the limited number of camera traps available, we rotated the cameras among sites within the IFS. Specifically, we deployed cameras at two sites for 32 consecutive days on average; then, we moved the cameras to two other sites and repeated this process until all 33 sites had been sampled. On two occasions cameras were stolen which partially compromised our sampling effort. We placed the cameras at medium intersite distances of 665 m, installed at a height of 30 cm from the ground and scheduled to operate for 24 h. We monitored the mammalian fauna over a 21 month period, between July 2015 and August 2017, with a total sampling effort of 1076 trap-days. We did not use bait to attract the animals. We considered photographic images of a species obtained by a given trap to be independent records when separated by an interval of at least 1 h (e.g. Goulart et al. 2009). During the camera trap inspections, we collected opportunistic records (tracks, visualizations, odors, etc.) to complement the list of species.

Data Analysis

We calculated the frequency of occurrence (FO) of each mammal species by dividing the number of independent records obtained for the species by the total sampling effort (in days), multiplied by 100, and plotted the results as a bar chart. To evaluate the effects of environment variables on the FO of each species, we measured the distance (m) from each sampling point to the forest edge and the nearest body of water, using QGis 2.14 (QGIS Development Team, 2014). We also tested the influence of the presence of domestic dogs on the occurrence of wild mammals by calculating the FO of this canid at each sampling point. We used a canonical correspondence analysis (CCA) to evaluate the possible relationships among the FO scores of the native species and the three different variables (distance to the forest edge and the nearest body of water, and the FO of dogs) recorded at each sampling point. The statistical analyses were conducted using R-software along with the vegan library (R Core Team 2017) considering only the records obtained by the cameras trap.

RESULTS

We recorded the occurrence of 15 mammal species at the IFS forest (Table 1). Thirteen species were detected by camera traps (494 records); the other two species, *Conepatus semistriatus* and *Hydrochoerus hydrochaeris*, were recorded opportunistically during fieldwork at the site.

Table 1. Mammalian species recorded in a small fragment of Atlantic Forest of IFS, São Cristóvão, Sergipe, Brazil. Records: Ct = camera trap, Vi = visual record, Tr = tracks, Od = odor.

Species	Common name	Type of record
DIDELPHIMORPHIA		
Didelphis albiventris (Lund, 1840)	Opossum	Ct
PILOSA		
Tamandua tetradactyla (Linnaeus, 1758)	Collared anteater	Ct
CINGULATA		
Dasypus novemcinctus Linnaeus, 1758	Nine-banded armadillo	Ct
Euphractus sexcinctus (Linnaeus, 1758)	Six-banded armadillo	Ct
CETARTIODACTYLA		
Mazama gouazoubira (G. Fischer, 1814)	Brocket deer	Ct
PRIMATES		
Callithrix jacchus (Linnaeus, 1758)	Common marmoset	Ct, Vi
CARNIVORA		
Cerdocyon thous Linnaeus, 1766	Crab-eating fox	Ct, Tr, Vi
Leopardus pardalis (Linnaeus, 1758)	Ocelot	Ct
Herpailurus yagouaroundi (É. Geoffroy, 1803)	Jaguarundi	Ct, Vi
Procyon cancrivorus (G. Cuvier, 1798)	Crab-eating raccoon	Ct, Tr
Conepatus semistriatus (Boddaert, 1785)	Striped hog-nosed skunk	Od
RODENTIA		
Hydrochoerus hydrochaeris (Linnaeus, 1766)	Capybara	Tr
Cuniculus paca (Linnaeus, 1766)	Spotted paca	Ct, Tr
Dasyprocta iacki Feijó & Langguth, 2013	Agouti	Ct, Tr, Vi
LAGOMORPHA		
Sylvilagus brasiliensis (Linnaeus, 1758)	Tapeti	Ct

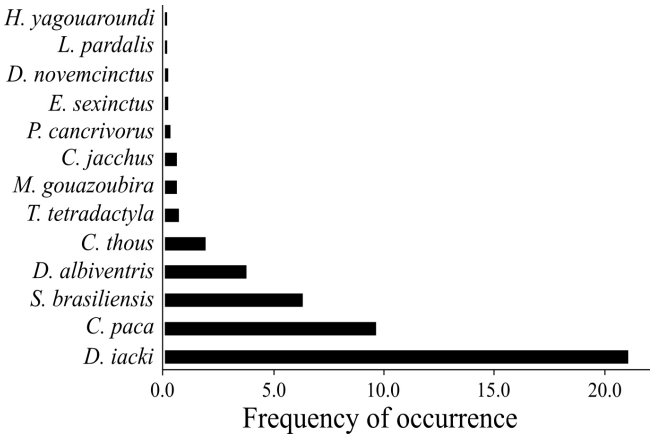

Figure 2. Frequency of occurrence of the different mammal species recorded in a small fragment of Atlantic Forest of IFS, São Cristóvão, Sergipe, Brazil.

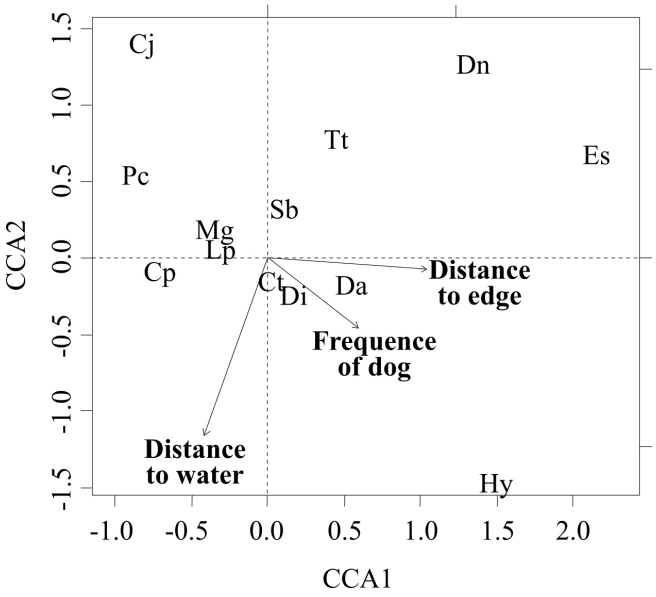

Figure 3. Relationships among mammal species and some environmental parameters (distance of edge, distance of water and frequency of occurrence of domestic dogs) in a small fragment of Atlantic Forest of IFS, São Cristóvão, Sergipe, Brazil. Legends: Da: *Didelphis albiventris*; Tt: *Tamandua tetradactyla*; Dn: *Dasypus novemcinctus*; Es: *Euphractus sexcinctus*; Mg: *Mazama gouazoubira*; Cj: *Callithrix jacchus*; Ct: *Cerdocyon thous*; Lp: *Leopardus pardalis*; Hy: *Herpailurus yagouaroundi*; Pc: *Procyon cancrivorus*; Cp: *Cuniculus paca*; Di: *Dasyprocta iacki*; Sb: *Sylvilagus brasiliensis*.

Together, the five most frequent species contributed 94.9% of all records (Figure 2), with *Dasyprocta iacki* being the most frequent species (FO = 21.6). In contrast, the two native felines, *Leopardus pardalis* and *Herpailurus yagouaroundi*, were the species recorded least frequently (FO = 0.09).

The CCA indicated that the species responded differently to the independent variables tested, with the first two axes explaining 90% of the results (axis 1 = 62%; axis 2 = 28%). The CCA indicated that species such as *Sylvilagus brasiliensis*, *L. pardalis*, *Mazama gouazoubira*, *Procyon cancrivorus* and *Callithrix jacchus* occurred near the edge of the forest, but avoided sites with a high frequency of domestic dogs (Figure 3). Proximity to water was an important predictor for *Tamandua tetradactyla*, *Dasypus novemcinctus* and *Euphractus sexcinctus*, with armadillos tending to avoid edge environments. In contrast, *Cuniculus paca* presented the opposite pattern, being recorded at sites furthest from water bodies and closest to the forest edge.

The results of the CCA indicated that *H. yagouaroundi* presented positive relations with sites far from the edge and with high frequency of domestic dogs. *Didelphis albiventris* was associated with intermediate distances of forest edge and medium frequencies of domestic dogs. The species least influenced by the examined variables were *D. iacki* and *Cerdocyon thous* (Figure 3).

DISCUSSION

The mammalian species richness observed in the IFS forest (S = 15) is consistent with that recorded in other fragments of Atlantic Forest in Sergipe, where between 10 and 14 medium- and large-sized mammals have been recorded (Chagas et al. 2010, Albuquerque et al. 2016, Dias et al. 2017, Rocha et al. 2017). In total, 321 species of mammals are listed for the Brazilian Atlantic Forest (Graipel et al. 2017), being that in protected areas, the expected richness in inventories can vary between 20 and 30 medium- and large-size mammal species (Oliveira et al. 2005, Feijó et al. 2016). The reduced mammalian species richness typically observed in small remnants of Atlantic forest is related to the degree of degradation of this biome (Chiarello 1999), although we had expected to register a greater richness, including *Leopardus tigrinus*, *Galictis cuja* and arboreal mammals like *Sapajus xanthosternos*, *Callicebus coimbrai* and *Bradypus torquatus*. These species occur in other Atlantic Forest patches within Sergipe (Chagas et al. 2010, Beltrão-Mendes et al. 2011, Albuquerque et al. 2014) but apparently are either extinct in IFS not detected using our methodology.

In the context of this habitat degradation, the size of the fragment and the characteristics of the surrounding matrix are the principal factors determining the species composition and richness of mammalian assemblages (Magioli et al. 2016, Bogoni 2016). Current estimates indicate that only 7.1% of the original Atlantic Forest cover now remains in Sergipe, distributed in small fragments embedded within the anthropogenic matrix (Nascimento et al. 2016). The IFS

forest is typical of this scenario, with the effects of the reduced size and isolation of the fragment being accentuated by a series of anthropogenic impacts, leading to an increase in the prevalence of more tolerant, generalist species, which are better adapted to environmental impact. This is probably why none of the species recorded here are listed as endangered, with only *H. yagouaroundi* being classified as vulnerable on the Brazilian list of endangered species (Almeida et al. 2018).

The three most abundant mammals at IFS were *D. iacki*, *C. paca* and *S. brasiliensis*. These species are habitat generalists and reproduce twice a year, which allows them to reach high population densities (Emmons 2016, Emmons & Reid 2016, AMCELA 2018). Given their tolerance of altered environments and their primarily frugivorous diet, these species may be at an advantage in the heterogeneous IFS forest, with abundant water sources and a considerable diversity of fruiting trees, including *Byrsonima* sp. L., *Psidium* sp., *Eugenia candolleana* DC., *Campomanesia xanthocarpa* O.Berg, *Annona cacans* Warm, *Bromelia pinguan* L., *Genipa americana* L., *Passiflora* sp., *Licania tomentosa* Benth, and *Talisia esculenta* (A. St.-Hil.) Radlk., as well as the exotic *Mangifera indica* L. and *Elaeis guineensis* Jacq.

Surprisingly some species were not sensitive to edge environments, specifically those of larger size in the community. Mammals such as *L. pardalis*, *P. cancrivorus* and *M. gouazoubira* have relatively large home-range areas, which may even be larger than our study fragment. In fact, because of the complexity and variability of the processes underlying land-use changes across landscapes, the responses to the effects of habitat fragmentation may vary among species (Pardini et al. 2018). Recent evidence suggests that even substantially fragmented landscapes can maintain relatively high levels of biodiversity, if the matrix exhibits heterogeneity of habitats (Ruffell et al. 2016). In south-eastern Brazil, for example, a recent study indicated that even small forest fragments can support medium- and large-sized mammals, due to the heterogeneity of the matrix composed of eucalyptus and other small forest fragments that facilitate animal movement (Massara et al. al., 2018). In this sense, the landscape context can be as important as local conditions for understanding species persistence in fragmented landscapes (Joly et al. 2014). The only primate found in the IFS, also tended to be more frequent in sites near the edge of the fragment. In fact, the ecological flexibility of *C. jacchus* allows it to colonize marginal habitats (Amora et al. 2013).

Leopardus pardalis, *P. cancrivorus*, *M. gouazoubira* and *C. jacchus* showed a negative relation with the frequency of dogs detected in IFS. Free-ranging domestic dogs cause many negative impacts on wildlife, such as predation and disease spread (Young et al. 2011), and affect the distribution of many native mammals (Lacerda et al. 2009, Massara et al. 2018). Hunting with dogs is extremely popular in rural or peri-urban areas of Brazil, and the hunting dogs are typically poorly-fed and subject to few controls, which means that they often range freely in areas of forest (Neto et al. 2012). In some regions of Brazil, dogs have become more abundant than native carnivores, even in protected areas (Paschoal et al. 2016) and this seems to be occurring in the IFS. For this reason, we suggest that measures be taken to manage and control dogs through vaccination and sterilization campaigns. Educational actions in the settlements surrounding the IFS are also important and should be considered as a way to restrict the access of domestic dogs to the forest fragment.

We found positive relationships between the occurrence of armadillos, *D. novemcinctus* and *E. sexcinctus*, and the distance to the forest edge. Although *E. sexcinctus* is commonly found in open areas and forest edges (Redford & Wetzel 1985), we assume that the habitat use observed in the IFS may be related to the greater availability of potential resources to the species within the forest and this should be under study. This hypothesis requires further investigation. In fact, in Atlantic Forest and Cerrado biomes, armadillos were also more frequent in densely forested areas and this was attributed to the greater availability of food and shelter against predators (Bonato et al. 2008, Goulart et al. 2009). Just like armadillos, *T. tetradactyla* and *S. brasiliensis* they were also more frequent in sites close to watercourses. The relationship between xenarthrans and the proximity of water is not well understood, although it has been discussed that it is due to their feeding habits, as foraging is facilitated by the moister soil in these places (Taber 1945, Hayssen 2011). Alternatively, it could be related to resting places. Armadillos and anteaters were predominantly nocturnal in our study area. Accordingly, these mammals are likely to use sites near the watercourses during the day to rest (because of the cooler microclimate). Although few data are available on the *S. brasiliensis* ecology, this lagomorph it seems to prefer riparian habitats and forest edges (Reis et al. 2011). In IFS, the relationship between *S. brasiliensis* and the proximity of water may be associated with the structural characteristics of these environments. The higher humidity and luminosity in these areas favors the growth of some typical plants of the understory such as herbs and grasses (Maraschin-Silva et al. 2009), which serve as food for this mammal.

Perhaps surprisingly, *C. paca* was more frequent close to the forest edge, contradicting other data available for the species (Pérez 1992, Oliveira & Bonvicino 2011). In better conserved sites, *C. paca* may prefer dense forest (Goulart et al. 2009, Jax et al. 2015), although in agro-forest systems in the Bolivian Amazon, Benavides et al. (2017) found that

C. paca tended to be more abundant in plantations (e.g. rice, corn, water melon, banana, squash, manioc, peanuts, papaya and various species of *Citrus*) than in secondary forests. This may be consistent with the distribution of the species in the IFS forest, given that the surrounding matrix is dominated by cornfields, and orchards of species such as *Anacardium occidentale* L., *Passiflora edulis* Sims, *Annona squamosa* L., *Mangifera indica* L., *Malpighia emarginata* DC. and *Annona muricata* L., which produce fruit almost year-round and may represent an important food resource for *C. paca*.

The use of sites further away from the forest edge by *H. yagouaroundi* suggests that the forest fragment is important for this feline. Jaguarundis needs a natural matrix for their survival (Almeida et al. 2013), and their persistence in small forest fragments can be facilitated by maintaining naturally low densities and the availability of important prey such as small rodents and birds (Almeida et al. 2013, Giordano 2016). The frequent presence of domestic dogs within the IFS is a concern from the point of view of the conservation of this species. The positive relationship between the frequency of dogs and the occurrence of *H. yagouaroundi* indicates a spatial overlap between these species. In large natural habitats such as Brasilia National Park (30 000 ha), the frequency of dogs tends to decrease from the border towards the interior of the fragment and this induces a habitat shift in native mammals (Lacerda et al. 2009). Considering the reduced size of the IFS (~ 400 ha), the dogs easily traverse the interior of the fragment. In this sense, native species are forced either to move through the anthropic matrix or overlap spatially with domestic dogs. We believe that the *H. yagouaroundi* avoids agonistic encounters with dogs by segregating temporarily. Future studies on niche partitioning should better elucidate these issues.

Our data indicate that *D. albiventris* does not totally avoid the forest edge. This is consistent with findings from another fragment of Atlantic Forest in southern Sergipe where the species was observed in the interior of the forest, at least 40 m from the edge (Stevens & Husband 1998). *Didelphis albiventris* is known to occupy a broad ecological niche, and is found in forests of many different sites and, even, in urban environments (Costa et al. 2015). This species has scansorial habits (Paglia et al. 2012), and will roost in tree trunks and roots, and even bird nests (Gardner 2007, Rossi & Bianconi 2011). As *D. albiventris* is able to obtain adequate resources within the forest, it is likely that the species will visit the pastures that surround the IFS forest infrequently.

The carnivore *C. thous* and the rodent *D. iacki* were little influenced by the analyzed variables. *Cerdocyon thous* is a generalist carnivore in terms of both habitat use and diet (Dias & Bocchiglieri 2016, Dias et al. 2019). In the IFS this opportunistic species seems to benefit from the availability of water and various food resources. As no ecological data are available on *D. iacki* (Roach & Naylor 2016), inferences on its ecology must be made from congeners, which are all generalists. Agoutis are found in a diversity of environments, including small fragments and secondary forests (Oliveira & Bonvicino 2011, Emmons & Reid 2016). Accordingly, we suggest that the species is well adapted to local IFS conditions.

In general, the mammal species recorded at our study site are generalists, adapted to a range of types of vegetation and habitat impact. This is not surprising given the characteristics of the forest and the surrounding matrix. Although they are disconnected, the presence of some small fragments and narrow strips of riparian forests around the IFS may be acting as corridors and stepping stones, allowing the movement of the animals in the landscape. This scenario corroborates the hypothesis that the suitability for the survival and persistence of mammals is related not only to size of the fragment, but also to the spatial arrangement of the matrix elements that allow biological flux (Martensen et al. 2008). Although our results do not allow us to make inferences about extinction trends, studies indicate that niche-breadth in terms of habitat requirements is associated with the response of each species to habitat loss, with only the more generalist tending to persist (Pardini et al. 2010). Extinction due to habitat loss is thus likely influenced by deterministic, niche-related processes (Püttker et al. 2014).

Studies suggest that habitat loss leads to an increasing important of deterministic processes affecting evolved niche preferences and leading, in consequence, to biotic homogenization (Püttker et al. 2014). In fact, when considering recent studies developed in four other Atlantic Forest patches in Sergipe (e.g. Chagas et al. 2010, Albuquerque 2016, Rocha et al. 2017, Dias et al. 2017), a high similarity in species composition among these remnants is observed. It is believed that the action of ecological filters can result in biotic homogenization leading to the dominance of a similar subset of species capable of resisting harsh conditions (Chase 2007), either because of their high competitive capacity or competitive release (Azevedo et al. 2012) and this may have broader implications for the functioning of the ecosystem (Püttker et al. 2014).

It is worth noting that, despite the reduced size of the IFS (about 400ha), the richness of the medium- and large-sized mammals of this fragment was higher than that recorded in larger remnants (e.g. Albuquerque 2016, Rocha et al. 2017) and in sites with a 10-fold greater area than IFS (Chagas et al. 2010). There is evidence that several forest-dependent species can use, and even persist in, certain

types of matrices (Joly et al. 2014). This evidence is particularly clear for matrices that provide important food resources for species, as observed in this study. Species richness cannot be explained simply by a species-area relationship, but the matrix and other landscape effects must also be considered. The landscape context can be as important as the local conditions to process dubbed "landscape supplementation", because organisms can supplement resource needs through use of patches of habitats available in the landscape (Dunning et al. 1992).

Effective preventive measures, nevertheless, will be necessary to ensure the conservation of this fragment of Atlantic Forest. These measures should include the reduction in selective logging, hunting, and the intrusion of domestic animals. Although we have not recorded the local occurrence of some species native to the Atlantic Forest elsewhere, like some felids, mustelids, sloths and primates, the IFS forest has considerable conservation potential, due in particular to the presence of many important seed dispersers and an abundance of water sources.

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