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Mammals of a forest fragment in Cambuci municipality, state of Rio de Janeiro, Brazil

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Abstract: The Atlantic Forest is considered a hotspot due to its current state of vast degradation and high indexes of biodiversity. This biome has been degraded through the years by processes resulting from the Brazilian socioeconomic model of development. The seasonal semi-deciduous Atlantic Forest is a poorly studied phytophysiognomy specially degraded by human activities in the state of Rio de Janeiro. In the present study we report the results of a rapid mammalian inventory conducted in the municipality of Cambuci, in a fragment of seasonal semi-deciduous forest. We used live traps and pitfall traps to capture non-volant small mammals, and mist-nets of different lengths to collect bats. To sample medium and large-sized mammals we used camera traps. We recorded 27 mammal species in the region, of which 16 are volant mammals. We emphasize the distribution extension of *Trinomys setosus* in 150 km (that enabled its insertion in the species list of Rio de Janeiro) and the capture of *Lonchophylla peracchii*, a recently described species apparently restricted to Atlantic Forest. Both facts show the importance of the fragment for the region biodiversity.

Introduction

The Atlantic Forest has been degraded by activities such as the uncontrolled extractivism, livestock farming, extensive agriculture, and by processes related to industrialization and urbanization (Rocha *et al.* 2003; Bergallo *et al.* 2009). Such processes were responsible for the removal of large portions of native plant cover (Bergallo *et al.* 2000; Fundação S.O.S. Mata Atlântica and Fundação Renctas 2005). From the original extension of the Atlantic Forest, 11.7% remains, of which only 1.62% is located in protected areas (Ribeiro *et al.* 2009).

In the state of Rio de Janeiro, the Atlantic Forest situation is not different. Despite its higher percentage of native plant cover compared to other Brazilian states, which varies from 19.60% to 20.33% depending on the authors (according to Fundação S.O.S. Mata Atlântica and INPE 2009 or Fidalgo *et al.* 2009, respectively), the forest remnants are dispersed and fragmented (Fidalgo *et al.* 2009). These remnants occur in the six phytophysiognomy units present in the State (Costa *et al.* 2009): dense rainforest, mixed rainforest, seasonal semi-deciduous forest, pioneer formations, stepic savanna, and savanna. The two largest phytophysiognomies in the state are the seasonal semi-deciduous forest (2,056,746 ha) and the dense rainforest (1,803,224 ha) (Fidalgo *et al.* 2009; Costa *et al.* 2009). However, despite its large extension in the state, 90% of the seasonal semi-deciduous forest cover has vanished, and only 0.2% of its area is protected in reserves (Costa *et al.* 2009). Furthermore, 48.9% of the forest remnants have at maximum 100 ha (Fidalgo *et al.* 2009).

Regarding studies on the group of mammals in the state of Rio de Janeiro, we observe an expressive number of inventories (e.g. Guitton *et al.* 1986; Teixeira and Peracchi 1996; Dias *et al.* 2002; Esbérard and Bergallo 2005; Olifiers *et al.* 2007; Modesto *et al.* 2008a, b; Pessoa *et al.* 2009; Vieira *et al.* 2009). However, the biota of the seasonal semi-deciduous forest remains poorly known (Bergallo *et al.* 2009; Almeida-Gomes *et al.* 2010).

Hence, the objective of our study was to list the mammal species that occur in a seasonal semi-deciduous forest fragment located in the municipality of Cambuci, in the agricultural region of the rivers Pomba, Muriaé, and Itabapoana, state of Rio de Janeiro (Saraça *et al.* 2009). This fragment was chosen for this rapid inventory of mammals because it is the largest forest remnant in the seasonal semi-deciduous forest in the state, with ca. 1,000 ha (Fidalgo *et al.* 2009), and due to the lack of information on this taxonomic group in the region (Bergallo *et al.* 2009).

Materials and Methods

Study site

We carried out the present study in Esmeralda Farm (21°29'03" S, 41°52'21.8" W) located in the municipality of Cambuci, state of Rio de Janeiro, north to the Paraíba do Sul river (Figure 1). The vegetation, typical of seasonal semi-deciduous forest, covers approximately 15% of the area of the municipality and is composed of forest fragments in secondary state of regeneration (Rocha *et al.* 2003). Most of these fragments are located at hilltops, areas recognized by the law as under permanent protection (Law 4771/65 - article 2). The altitude varies from 200 to 650 m above sea level. Around fragments, we observe the massive presence of unproductive pastures, occupying ca. 84% of the area of

the municipality (TCE-RJ 2004). In stretches with higher declivity the soil is already exposed and undergoes erosion. The temperature varies from 15°C to 35°C throughout the year and the average annual rainfall is 1,276 mm. The total area of the fragment sampled is 1,000 ha (Attias *et al.* 2009).

Data collection

The rapid inventory was carried out from 22nd to 28th of August 2006. In this period the moon phase was New (Moon Connection 2011) and there was no rain (SIMERJ 2011). Meteorological data were obtained from the nearby municipalities of Itaocara and Santo Antônio de Pádua, because no meteorological station is available at Cambuci.

We used 126 live traps: 96 Sherman® (30.48 x 9.52 x 7.62 cm) and 30 Tomahawk® (40.00 x 12.00 x 12.00 cm). Among these traps, 90 were placed on the ground (Sherman® and Tomahawk®) and 36 on trees (Sherman®). Traps were placed in three different transects, with a distance of 400 m away from each other. Each transect had 30 traps on the ground, separated from each other by a distance of 40 m. On the fourth sampling day, all traps on the ground were moved 20 m, in order to sample a greater variety of microhabitats in forest formation. In each transect, we placed 12 traps on trees, at a distance of 100 m from each other. The trap system remained opened during six consecutive nights. The total sampling effort was 756 traps/night. We used three types of baits on traps: banana, bread anointed with sunflower oil, and a mixture of banana, peanut butter, cornmeal, and sardine oil. Baits were alternated among traps, in order to attract a greater variety of species.

We also used pitfalls in three systems opened during six consecutive nights. The systems were composed of 10 buckets of 30 liters, 5 m away from each other, connected by a plastic drift fence with 50 cm in height. The total effort of this method was 180 traps/night. The distance of this system from the trap system was 1,000 m.

Bats were captured in mist nets of different lengths (7 x 2.5 m, 9 x 2.5 m, and 12 x 2.5 m) to adjust to the different microhabitats sampled (*e.g.*, small areas with a dense understory hardly support mist nets of 12 x 2.5 m). Mist nets were opened after sunset and closed after six or twelve hours. The number of nets varied from eight to 13 each night, summing up 14,463.75 m^2h (Straube and Bianconi 2002). Nets were set up in open trails and near water bodies, trees with fruits, and refuges.

We identified the mammals captured to the lower taxonomic level possible, checked their sex, and measured and weighted them. Next, we marked the animals with sequential holes in their ears and released them at the site they were captured. When necessary, individuals of each species were collected as vouchers (License IBAMA#89-05/RJ) and deposited either in the collection of the Museu Nacional do Rio de Janeiro or in the collection of the Laboratory of Bat Diversity of the Universidade Federal Rural do Rio de Janeiro (UFRRJ). We identified the species captured through morphological characteristics (Vizotto

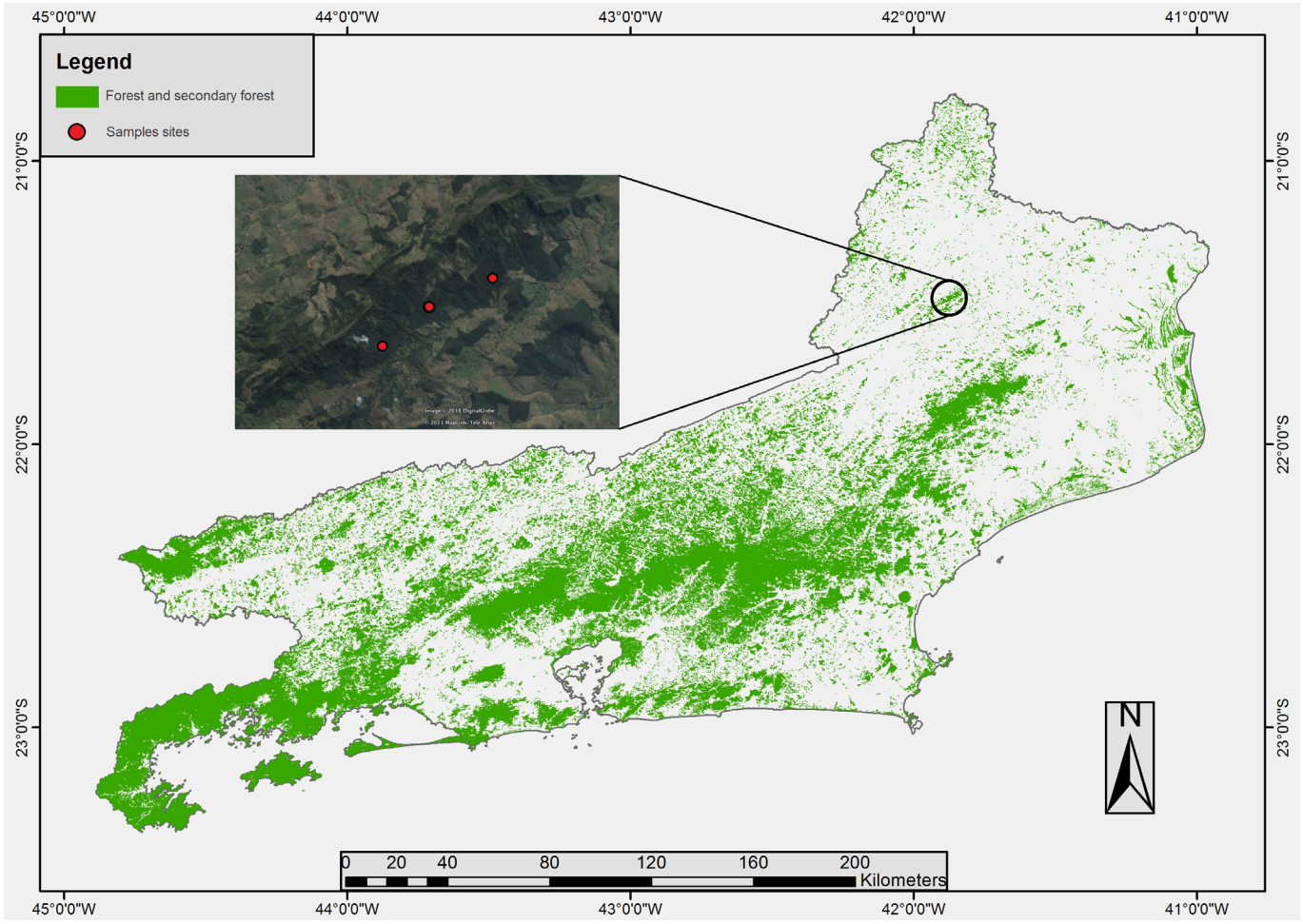

Figure 1. Map showing the location of the forest fragment analyzed in the municipality of Cambuci, state of Rio de Janeiro.

and Taddei 1973; Emmons and Feer 1990; Eisenberg and Redford 1999; Reis *et al.* 2006; Weksler *et al.* 2006) and in the case of some rodents, we collected specimens samples to identification.

To sample medium and large-sized mammals we used four camera traps, model CamTrack©, and baits such as sardine and banana. The CamTrack© uses automatic cameras of 35 mm and a passive sensor. Cameras were adjusted to shot night and day, with a minimal interval of 20 seconds. We used color photographic films with ASA 200 and 36 poses. Cameras were 1,000 m away from each other and were attached to trunks at a height up to 50 cm above ground, close to water bodies or in areas with animal tracks. Cameras were kept in the area for 20 days, remaining at the same place during the whole study.

Results and Discussion

We recorded 27 mammal species in the area: five of the Order Didelphimorphia, one of the Order Cingulata, 16 of the Order Chiroptera, two of the Order Carnivora, and three of the Order Rodentia (Table 1).

We captured seven species of non-volant mammals (Table 1) in Sherman® and Tomahawk® traps. No individual was captured in pitfalls. The most frequent species in traps were the marsupial *D. aurita*, with 38 captures (53.5%), followed by the rodent *T. setosus* with 12 captures (16.9%). The least captured species were the marsupial *M. incanus* and the rodent *A. cursor*, both with three captures (4.2%). For identification purposes, we collected five specimens of non-volant mammals: two *Akodon cursor* (MN71939 and MN 71940), one *M. scalops* (MN71941), and two *T. setosus* (MN70161 and MN70162).

We captured 173 volant mammals identified in 15 species. The most frequently captured species were *C. perspicillata* with 114 captures (65.9%), *S. lilium* with 18 captures (10.4%), *A. caudifer* with 11 captures (6,4%), and *M. nigricans* with eight captures (4.6%). The other 11 species were represented by three or less captures (Table 1). In addition to the 15 bat species captured, we recorded the species *T. cirrhosus*, which was observed in a residence close to the largest fragment of the region (Figure 2).

Five species were recorded with the camera traps: *D. aurita*, *P. frenatus*, *P. cancrivorus*, *C. paca*, and *N. nasua*. The last three species were recorded exclusively by this method (Table 1). The total of species captured represents ca. 5.9% of the terrestrial mammals that are known to occur in the Atlantic Forest (Paglia *et al*. 2012). The species richness found for non-volant mammals in Esmeralda Farm is low when compared with the region of Serra da Concórdia, which is in the same phytophysiognomy and was sampled using a similar methodology (20 species recorded; Modesto *et al.* 2008b). However, in the agricultural region of the rivers Pomba, Muriaé, and Itabapoana, the high rate of plant cover removal has led the region to a progressive desiccation process and to an increase in soil erosion (Bergallo *et al.* 2009). The largest forest remnant in the region has ca. 1,000 ha, but the great majority is no larger than 50 ha and are dispersed in the region, impeding the connection between fragments and, consequently, increasing population isolation (Pires *et al.* 2002; Fidalgo *et al.* 2009).

According to Moura *et al*. (2008), the number of rodent and marsupial species does not differ between phytophysiognomies (dense rainforest and seasonal semi-deciduous forest), but the abundance of rodents tends to be higher in dense rainforest, while marsupials are dominant in the seasonal semi-deciduous forest. Our results corroborate these hypotheses, as we had a higher abundance of marsupials (N=46) than rodents (N=15), and the number of species was similar (five marsupials vs. three rodents).

The bat fauna of this region of the state of Rio de Janeiro is poorly known (Bergallo *et al.* 2009). In an inventory carried out in the same phytophysiognomic formation with a similar sampling effort, Modesto *et al*. (2008a) found 16 bat species, eight of which common to both areas (*A. caudifer, A. fimbriatus, A. geoffroyi, A. lituratus, C. perspicillata, D. rotundus, M. minuta, S. lilium*). Modesto *et al*. (2008b) also provided a bat list for Desengano State Park (Parque Estadual do Desengano) in an adjacent region, the Região Serrana de Economia Agropecuária (Saraça *et al.* 2009). With a sampling effort similar to that used here, Modesto *et al*. (2008b) captured a similar number of species (15), with nine species in common with Cambuci. The seven species exclusive of Cambuci were *L. peracchii*, *L. aurita*, *M. minuta*, *P. discolor*, *P. hastatus*, *T. cirrhosus*, and *V. pusilla*. The record of some species exclusively in one of the regions may be related to methodological issues (*e.g.*, seasonal differences in sampling periods, low sampling effort), but may also be a result of different ecological opportunities in each area (*e.g.*, roost and food availability). In Desengano State Park, *S. lilium* was the dominant species, followed by *A. fimbriatus* (Modesto *et al*. 2008b), while in Cambuci *C. perspicillata* was the most abundant species.

Despite the low sampling effort and the high degradation level in the region, we captured species not very frequent in inventories carried out in the state of Rio de Janeiro, such as *L. aurita*, *M. minuta,* and *T. cirrhosus* (Esbérard and Bergallo 2005; Esbérard 2009; Bolzan *et al.* 2010). These species belong to the subfamily Phyllostominae, which may be considered indicator of the quality of the habitat, as it is present in higher abundance in well preserved areas (Fenton *et al.* 1992). In addition to these species, we captured *L. peracchii*, a specie recently described and apparently restricted to Atlantic Forest (Dias *et al*. 2013), which shows the importance of the fragment for the local biodiversity maintenance.

Grelle *et al*. (2010), in a study about the selection of reserves based on the vegetation in the state of Rio de Janeiro, showed that the forest fragment in the municipality of Cambuci is a high priority area for conservation. This is because in the area there are no reserves and the studied fragment is one of the last representative remnants in the region (Bergallo *et al.* 2009). Our sampling carried out in Cambuci provided an inventory of a poorly sampled phytophysiognomy of the Atlantic Forest, with a high rate of degradation by human activities and of high conservation priority. Additionally, it allowed, an extension of the distribution of the species *Trinomys setosus* in 150 km and enabled its insertion in the species list of Rio de Janeiro, as reported by Attias *et al*. (2009).

Table 1. Species list of mammals from Cambuci, state of Rio de Janeiro, southeastern Brazil.
Legend: Ca = capture; Ct = camera-trap; MN = mist net; Si = sighting.

SPECIES	TYPE OF RECORD
Order Didelphimorphia	
Family Didelphidae	
Didelphis aurita (Wied-Neuwied, 1826)	Ca/Ct
Marmosops incanus (Lund, 1840)	Ca
Metachirus nudicaudatus (É. Geoffroy, 1803)	Ca
Monodelphis scalops (Thomas, 1888)	Ca
Philander frenatus (Olfers, 1818)	Ca/Ct
Order Cingulata	
Family Dasypodidae	
Dasypus novemcinctus Linnaeus, 1758	Si
Order Chiroptera	
Family Phyllostomidae	
Anoura caudifer (É. Geoffroy, 1818)	Mn
Anoura geoffroyi Gray, 1838	Mn
Artibeus fimbriatus Gray, 1838	Mn
Artibeus lituratus (Olfers, 1818)	Mn
Carollia perspicillata (Linnaeus, 1758)	Mn
Desmodus rotundus (É. Geoffroy, 1810)	Mn
Lonchophylla peracchii Dias, Esberárd and Moratelli, 2013	Mn
Lonchorhina aurita Tomes, 1863	Mn
Micronycteris minuta (Gervais, 1856)	Mn
Phyllostomus discolor (Wagner, 1843)	Mn
Phyllostomus hastatus (Pallas, 1776)	Mn
Platyrrhinus lineatus (É. Geoffroy, 1810)	Mn
Sturnira lilium (É. Geoffroy, 1810)	Mn
Trachops cirrhosus (Spix, 1823)	Si
Vampyressa pusilla (Wagner, 1843)	Mn
Family Vespertilionidae	
Myotis nigricans (Schinz, 1821)	Mn
Order Carnivora	
Family Procyonidae	
Nasua nasua (Linnaeus, 1766)	Ct
Procyon cancrivorus (G. [Baron] Cuvier, 1798)	Ct
Order Rodentia	
Family Cricetidae	
Akodon cursor (Winge, 1887)	Ca
Family Cuniculidae	
Cuniculus paca (Linnaeus, 1758)	Ct
Family Echimyidae	
Trinomys setosus (Desmarest, 1816)	Ca

Figure 2. Photo showing the presence of the bat *Trachops cirrhosus* in the municipality of Cambuci, state of Rio de Janeiro. Photo: Julia Lins Luz

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