

## **Non-volant mammals of Picinguaba, Ubatuba, state of São Paulo, southeastern Brazil**

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**ABSTRACT:** Knowledge on the non-volant mammal fauna of the Brazilian Atlantic Forest is still incipient. We provide a list of the non-volant mammal species of Picinguaba, which belongs to Parque Estadual da Serra do Mar, a large (315,390 hectares) protected area in the Atlantic Forest of southeastern Brazil. We conducted a field expedition to Picinguaba to survey small mammals. In addition, we undertook a survey of museum specimens from Picinguaba. With a field effort of 1680 trap-nights, we captured 44 individuals belonging to eight rodent species and nine individuals from five marsupial species. We also recorded 14 additional species from museum collections, adding up to 27 species of non-volant mammals at Picinguaba, belonging to the orders Didelphimorphia, Carnivora, and Rodentia. We highlight one undescribed rodent species and three taxa listed in the Brazilian endangered species list. The study site is located at a relevant protected area in the Atlantic Forest, contributing to the conservation of mammal species diversity.

**Key words:** Atlantic Forest, Carnivora, Didelphimorphia, mammal survey, Parque Estadual da Serra do Mar, Rodentia.

**RESUMO:** Mamíferos não-voadores de Picinguaba, Ubatuba, estado de São Paulo, sudeste do Brasil. O conhecimento da fauna de mamíferos da Mata Atlântica é ainda incipiente. O presente estudo apresenta uma lista de mamíferos não-voadores de Picinguaba, que é parte do Parque Estadual da Serra do Mar, uma grande (315.390 hectares) unidade de conservação localizada na Mata Atlântica do sudeste do Brasil. Uma expedição para capturar pequenos mamíferos foi realizada em Picinguaba. Além disso, foram também analisados espécimes depositados em coleções de museus provenientes de Picinguaba. Com um esforço de captura de

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1.680 armadilhas-noite, 44 indivíduos de oito espécies de roedores e nove indivíduos de cinco espécies de marsupiais foram capturados. O levantamento nas coleções registrou 14 espécies adicionais, totalizando 27 espécies de mamíferos não-voadores na região de Picinguaba, pertencentes às ordens Didelphimorphia, Carnivora e Rodentia. Dentre estas destaca-se uma espécie não descrita de roedor e três táxons citados na lista de espécies brasileiras ameaçadas de extinção. A região de Picinguaba, a qual faz parte do Parque Estadual da Serra do Mar, é uma relevante unidade de conservação na Mata Atlântica, que contribui para a preservação de uma grande diversidade de espécies de mamíferos.

**Palavras-chave:** Carnivora, Didephimorphia, levantamento de mamíferos, Mata Atlântica, Parque Estadual da Serra do Mar.

## Introduction

The Brazilian Atlantic forest is recognized as the fourth biodiversity hotspot in the world due to its high endemism, species richness and habitat loss (Myers *et al.*, 2000). Serra do Mar, a steep mountain range reaching up to 2000 m of altitude in southeastern Brazil, has been identified as one of the highest biodiversity and most threatened areas in the Atlantic forest (CEPF, 2001). Part of this area (315,390 hectares) is protected since 1977 as a state park, Parque Estadual da Serra do Mar, encompassing great habitat heterogeneity, varying from mangroves, restingas (sand dune habitat), swamps, humid tropical forests to altitudinal vegetation. It has been considered the largest continuous block of pristine vegetation in the Atlantic forest (Instituto Florestal, 2006).

Picinguaba is located in the northern part of Parque Estadual da Serra do Mar, in the municipality of Ubatuba, state of São Paulo, between the two most populated cities in Brazil: São Paulo and Rio de Janeiro. Knowledge on the mammal fauna of Picinguaba is still incipient, especially regarding small mammals, although the area is easily accessible (Instituto Florestal, 2006). The present study aims to enlist the non-volant mammal fauna of Picinguaba based on field surveys and examination of museum specimens.

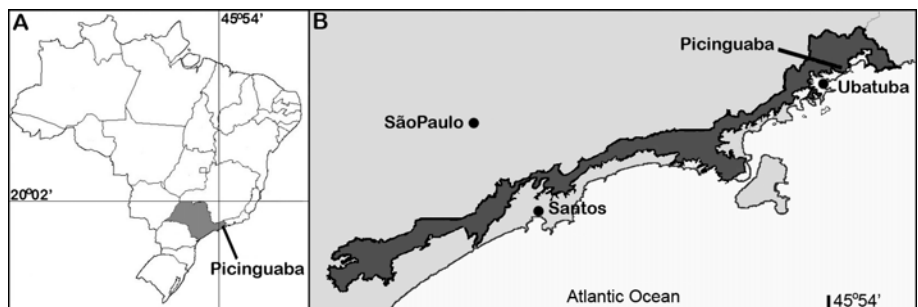
## Methods

The area sampled here (Figure 1) includes three vegetation types:

the submontane evergreen broadleaf forest, lowland evergreen broadleaf forest, and arboreal to shrub/herbaceous meadows. The annual mean temperature varies from 20° to 24°C and the annual precipitation ranges from 1500 to 4000 mm, characterizing the humid tropical climate in the Ubatuba region. The close proximity of the Serra do Mar to the coast is responsible for the high rainfall, even during the winter because of orographic effects (for a more detailed description of the area, see Instituto Florestal, 2006).

We conducted a field survey to capture small mammals from April 7 to 15, 2002 at two sampling points in Picinguaba: “sede” (23°22’S 44°50’W), with an effort of 720 trap-nights and “casa de farinha” (23°20’S 44°50’W), with 960 trap-nights. Sherman (30.5 x 9.5 x 8 cm and 38 x 12 x 10 cm) and Tomahawk (41 x 14.5 x 14.5 cm) live-traps, baited with bacon, peanut butter, and banana or manioc, were placed 20 m apart and alternated on the ground and at 2 m height in two transect lines (90 and 120 live-traps each), totalizing 1680 trap-nights. In addition, small rodents and marsupials were caught in pitfall traps separated by drift fences set for the herpetological survey by Paulo A. Hartmann. Pitfall traps were settled in eight lines with eight 103-liter pails, 10 m apart. Pitfalls remained open for eight days near to the areas where live traps were installed, at “sede”, “casa de farinha”, “restinga”, and “trilha do Vietnã” (Hartmann, 2005).

We calculated the collector’s curve, based on the cumulative number of species recorded with trapping effort, and both live- and pitfall traps were considered in this analysis. Species were identified by morphological



**Figure 1.** Map of the study area. **A)** Map of Brazil showing the state of São Paulo in gray and indicating Picinguaba; **B)** Map of coastal São Paulo showing the Parque Estadual da Serra do Mar along the coast in dark gray and the city of Ubatuba, indicating Picinguaba area. Modified from Instituto Florestal (2006).

analysis of skins and skulls whenever possible and Sigmodontinae rodents were also karyotyped for identification. All animals collected were prepared and had their skeleton cleaned. These specimens have been deposited at Museu Nacional, Universidade Federal do Rio de Janeiro (MN). Taxonomic arrangement and nomenclature follows Reis *et al.* (2006) and Wilson & Reeder (2005). We also examined material housed at MN, Museu de Zoologia da Universidade de São Paulo (MZUSP), and Museum of Vertebrate Zoology, University of California, Berkeley (MVZ), including specimens from Picinguaba and from the municipality of Ubatuba with no precise locality.

## Results

We captured 53 specimens of five marsupial and eight rodent species during the study (Table 1). Eight species were trapped only in live-traps: *Didelphis aurita*, *Micoureus paraguayanus*, *Philander frenatus*, *Euryoryzomys russatus*, *Nectomys squamipes*, *Oxymycterus dasythrichus*, an undescribed species referred to as *Rhipidomys* sp. in the present paper, and *Trinomys iheringi*. Three species were trapped only in pitfall traps: *Monodelphis americana*, *Rhagomys rufescens*, and *Phyllomys pattoni*. Two species were trapped in both kinds of traps: *Metachirus nudicaudatus* and *Oecomys catherinae*. Noteworthy occurrences include an individual of *R. rufescens* captured in a pitfall trap (see Pinheiro *et al.*, 2004) and specimens of an undescribed species of *Rhipidomys*. The collector's curve shows an increasing cumulative number of species, with no tendency of stabilizing by the eightieth night, when trapping effort was highest (Figure 2).

We recorded 14 other species based on museum specimens, adding up to 27 species of non-volant terrestrial mammals at Picinguaba, including representatives of Didelphimorphia, Carnivora, and Rodentia (Tables 1 and 2). Three species (*Leopardus trigrinus*, *L. pardalis*, and *R. rufescens*) are listed in both the Brazilian and the state of São Paulo endangered species lists (Machado *et al.*, 2005; State of São Paulo Decree 42838, February 4<sup>th</sup>, 1998).

## Discussion

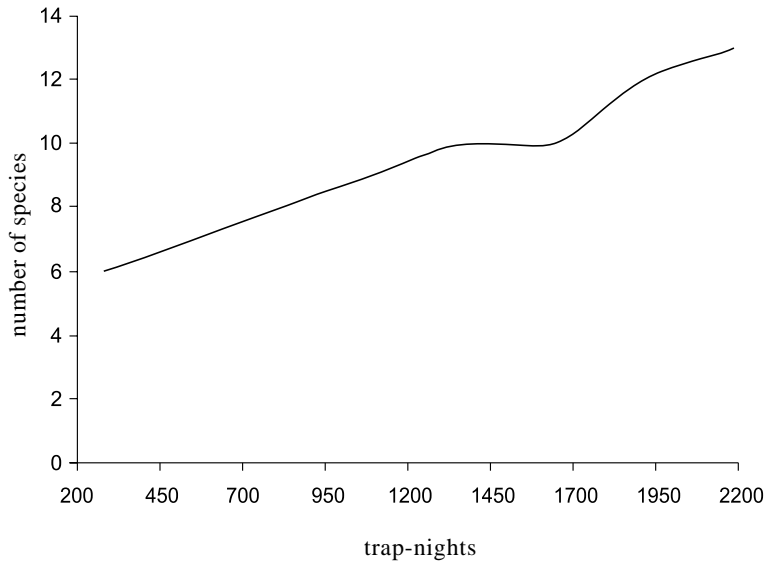
Parque Estadual da Serra do Mar is a relevant protected area,

contributing to the conservation of the high mammal species diversity in the Atlantic Forest. 111 mammal species have been catalogued in the whole park (Instituto Florestal, 2006), corresponding to 40% of the mammal fauna known to occur in the Atlantic Forest. In the present study, we used diversified sampling methods (live- and pitfall traps), resulting in a significant species diversity at Picinguaba, including some small mammal species that have not been recorded before in the park (e.g., *Rhipidomys* sp. and *R. rufescens*). Cytogenetic analyses may also have contributed to uncover species diversity, since this technique helps distinguishing cryptic species (Geise *et al.*, 1998).

The collector's curve did not stabilize, indicating that additional trapping effort would increase species richness. This is congruent with the fact that seven other small mammal species have been registered only from museum

**Table 1.** Number of individuals (N) of non-volant small mammals captured during field survey at Picinguaba, Ubatuba, São Paulo. Trap types: Sh=Sherman, Tm=Tomahawk, Pt=pitfall. Trap position: G=ground, T=tree. Trap site: S=sede, CF=casa de Farinha, V=Vietnã, R=Restinga. Karyotype: 2n=diploid number and AN=number of autosomal arms.

Taxon	N	Trap type and position					Site				Karyotype 2n (AN)
		Sh G	Sh T	Tm G	Tm T	Pt	S	CF	V	R	
<b>Didelphimorphia</b>											
<b>Didelphidae</b>											
<i>Didelphis aurita</i>	1			1			1				
<i>Metachirus nudicaudatus</i>	4	1		1		2	2	1		1	
<i>Micoureus paraguayanus</i>	2		2					2			
<i>Monodelphis americana</i>	1					1		1			
<i>Philander frenatus</i>	1			1			1				
<b>Rodentia</b>											
<b>Cricetidae</b>											
<i>Euryoryzomys russatus</i>	25	13	1	11			5	20			80
<i>Oecomys catherinae</i>	7		3			2	2	5	2		60 (62/64)
<i>Nectomys squamipes</i>	1	1					1				56 (56)
<i>Oxymycterus dasytrichus</i>	3	3					3				54
<i>Rhagomys rufescens</i>	1					1				1	
<i>Rhipidomys</i> sp.	3		2		1		1	2			44 (48/50)
<b>Echimyidae</b>											
<i>Phyllomys pattoni</i>	1					1				1	
<i>Trinomys iheringi</i>	3	2		1				3			60
<b>Total</b>	53	20	8	15	3	7	19	31	2	1	



**Figure 2.** Collector's curve of small mammals trapped at Picinguaba, Parque Estadual da Serra do Mar, in April 2002, considering both live- and pitfall traps.

collections: *Guerlinguetus aestuans*, *Akodon cursor*, *Oligoryzomys nigripes*, *Sooretamys angouya*, *Euryzygomatomys spinosus*, *Kannabateomys amblyonyx*, and *Trinomys dimidiatus*.

According to Tribe (1996), three species of *Rhipidomys* occur in the southeastern Atlantic Forest, including *R. mastacalis* and *Rhipidomys incertae sedis*. These two taxa are not easily distinguishable by their morphological attributes (Tribe, 1996). Geise (1995) and Pereira *et al.* (2001) show karyotypic differences between *R. mastacalis* ( $2n=44$  FN=74) and *Rhipidomys* sp. ( $2n=44$  FN=48–50), and the same karyotype ( $2n=44$  FN=48) has been found in specimens collected at Picinguaba.

A striking result was the collection of a specimen of the rufescent mouse *R. rufescens* (Pinheiro *et al.*, 2004), a species listed as vulnerable in official lists of threatened fauna. This mouse has been considered one of the rarest species of South American mammals, with only a few other recent records (Percequillo *et al.*, 2004; Pardini & Umetsu, 2006; Steiner-Souza *et al.*, 2008; Umetsu *et al.*, 2006). Based on museum collections, we also recorded other endangered mammals from Ubatuba that are likely to occur at Picinguaba, such as *L. pardalis* and *L. tigrinus*, threatened mainly by habitat loss (Table 2). *M. americana* is also on the endangered species list as data deficient, showing the importance of field

**Table 2.** Non-volant mammals from Ubatuba, São Paulo, based on field survey and museum specimens from Museu Nacional, Rio de Janeiro (MN), Museu de Zoologia da Universidade de São Paulo (MZUSP), and Museum of Vertebrate Zoology, University of California, Berkeley (MVZ). Other acronyms are field numbers of L. Geise (LG), P. S. Pinheiro (PSP), Laboratório de Vertebrados, Universidade Federal do Rio de Janeiro (PI). \* Specimen released in the field.

Taxa	Field number	Museum number	Locality
<b>Didelphimorphia</b>			
<b>Didelphidae</b>			
<i>Didelphis aurita</i>	PSP 27	MN 69872	Picinguaba
<i>Marmosops incanus</i>		MN 50667	Picinguaba
<i>Metachirus nudicaudatus</i>	PSP 11, 35, 39, 47	MN 69868, 69876, 69877, 69880	Picinguaba
<i>Micoureus paraguayanus</i>	PSP 32, 46	MN 69874, 69879	Picinguaba
<i>Monodelphis americana</i>	PSP 34	MN 69875	Picinguaba
<i>Philander frenatus</i>	PSP 3	MN 69866	Picinguaba
<b>Carnivora</b>			
<b>Felidae</b>			
<i>Leopardus pardalis</i>		MZUSP 1805	No precise locality
<i>Leopardus tigrinus</i>		MZUSP 1877	No precise locality
<b>Mustelidae</b>			
<i>Eira barbara</i>		MZUSP 1807	No precise locality
<i>Galictis cuja</i>		MZUSP 1808	No precise locality
<b>Procyonidae</b>			
<i>Procyon cancrivorus</i>		MZUSP 1806	No precise locality
<b>Rodentia</b>			
<b>Sciuridae</b>			
<i>Guerlinguetus aestuans</i>		MVZ 182070	Fazenda Capricórnio
<b>Cricetidae</b>			
<i>Euryoryzomys russatus</i>	PSP 2, 6–8, 10, 13–16, 21–16, 30, 31, 33*, 36*, 37, 43–45, 48, 49	MN 70101–70115, 70117–70124	Picinguaba
<i>Oligoryzomys nigripes</i>	PI 9	MN 48051	Picinguaba
<i>Oecomys catherinae</i>	PSP 1, 5, 12, 19, 38, 42, 53		Picinguaba
<i>Nectomys squamipes</i>	PSP 50		Picinguaba
<i>Sooretamys angouya</i>		MN 24401	Praia Dura
<i>Akodon cursor</i>	LG 64–66, 94–100	MN 55727, 55728, 48069	Picinguaba
<i>Oxymycterus dasytrichus</i>	PSP 4, 17, 18	MN 5268	Córrego Cachoeira Grande
		MN 69867, 69869, 69870	Picinguaba
<i>Rhagomys rufescens</i>	PSP 52	MN 65545	Picinguaba
<i>Rhipidomys</i> sp. nov.	PSP 9, 28, 40		Picinguaba
<b>Caviidae</b>			
<i>Cavia aperea</i>		MZUSP 1831	No precise locality
<b>Echimyidae</b>			
<i>Kannabateomys amblyonyx</i>		MZUSP 1821	No precise locality
<i>Phyllomys pattoni</i>	PSP 51		Picinguaba
<i>Euryzomatomys spinosus</i>		MN 31560	Córrego Cachoeira Grande
<i>Trinomys dimidiatus</i>		MN 33731	Córrego Cachoeira Grande
<i>Trinomys iheringi</i>	PSP20, 29, 41	MN 69871, 69873, 69878	Picinguaba

efforts like this, and the continuing need of mammal surveys to better understand Atlantic Forest diversity and conservation status. Picinguaba is an ecological corridor connecting several protected areas, and conservation efforts must be done at different spatial and temporal scales to safeguard this important biodiversity hotspot.

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