

## **Non-volant mammals of the Estação Biológica de Santa Lúcia and adjacent areas of Santa Teresa, Espírito Santo, Brazil**

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**ABSTRACT:** This paper presents a preliminary inventory of non-volant mammals of Estação Biológica de Santa Lúcia (EBSL) and other remnants of Atlantic forest located in Santa Teresa municipality, southeastern Brazil. In EBSL, 21 species of small mammals were captured in different areas, from March 1989 to February 1990, at irregular intervals, using traps placed on the ground and fixed on branches and tree platforms. The occurrence of the remaining species were confirmed through direct and indirect evidences recorded during diurnal and nocturnal censuses, as well as through a review of the museum specimens collected in Santa Teresa municipality that are deposited in the Museu de Biologia Prof. Mello Leitão. In total, 62 mammal species, excluding bats, were recorded for the study region. This figure equals or exceeds that of most Neotropical sites, and is lower only when compared to the extremely rich mammal fauna of Manu Biosphere Reserve, Peru. Considering only the Atlantic forest, the mammal richness found for Santa Teresa is also higher than all other sites already inventoried, in agreement with previous information on high tree and bird diversity recorded for the study site.

**Key-words:** Atlantic forest, Espírito Santo, mammals, survey.

**RESUMO:** **Mamíferos não voadores da Estação Biológica de Santa Lúcia e arredores, Santa Teresa, Espírito Santo, Brasil.** Este trabalho apresenta um inventário preliminar de mamíferos não voadores da Estação Biológica de Santa Lúcia (EBSL) e outros remanescentes de Mata Atlântica do município de Santa Teresa, ES. Na EBSL, os pequenos mamíferos foram inventariados em três áreas, no período de março de 1989 a fevereiro de 1990, com auxílio de armadilhas colocadas no solo e fixadas em troncos de árvores entre um e dois metros acima do solo, tendo sido capturados

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exemplares de 21 espécies. As demais espécies foram assinaladas com base em contatos visuais e evidências indiretas, bem como a partir do material existente na coleção do Museu de Biologia Prof. Mello Leitão (Santa Teresa - ES). Ao todo, foram encontradas 62 espécies de mamíferos para a região de estudo. Este número se iguala ou excede ao da maioria das localidades neotropicais e é menor apenas que a fauna de mamíferos extremamente rica encontrada em "Manu Biosphere Reserve", Peru. Considerando apenas a Mata Atlântica, a riqueza de mamíferos registrada para Santa Teresa é maior que a de todas as demais localidades já inventariadas, em concordância com informações prévias sobre a alta diversidade arbórea e de aves registrada para a região de estudo.

**Palavras-chave:** Espírito Santo, inventário, mamíferos, Mata Atlântica.

### Introduction

The high biological richness combined with the fast rate of destruction have placed the Tropical forests in the conservation center of attention. Estimates show that more than 200.000 km<sup>2</sup> of Tropical forests are destroyed each year (Myers, 1997), what represents an enormous lost of biological diversity. Although these forests cover only 7% of the earth's surface, they harbor more than half of the biological species (Myers, 1997), most of which still completely unknown.

The Atlantic forest is one of the most threatened of world's Tropical forests (Mittermeier *et al.*, 1982). Yet, this biome has an enormous biological diversity and a very high degree of endemism, being considered by some authorities as more complex and diverse than several Amazonian sites (Brown & Brown, 1992). The Brazilian mammal fauna has 524 species, making this country the top-ranking in the world. Of this total, 250 species occur in the Atlantic forest, 65 species of which are endemics (Fonseca *et al.*, 1996). Rodents and marsupials are especially well represented as 209 species of these two orders occur in Brazil, of which at least 23 marsupials and 79 rodents occur in the Atlantic forest, and 39% and 46%, respectively, are Atlantic forest endemics (Fonseca *et al.*, 1996).

In Espírito Santo, a southeastern Brazilian state, the majority of Atlantic forest remnants are fragments isolated in private properties, and the protected areas are, in general, ecologically small. Yet, the municipality of Santa Teresa has one of the largest areas covered by native forests, totaling ca. 25,000 ha. Recently, Thomaz & Monteiro (1997) demonstrated that the Estação Biológica de Santa Lúcia (EBSL), located within the municipality

of Santa Teresa, has one of the richest community of trees already recorded for the Tropics.

Although the Atlantic forest has a very diverse fauna with several endemic species (Mittermeier *et al.*, 1982; Fonseca & Kierulff, 1989; Stallings, 1989), its mastofauna is still poorly known, with few localities surveyed exhaustively or subjected to long term studies. With the exception of Ruschi (1964, 1965), the first detailed work on small mammals in the montane region of Espírito Santo was conducted by Abravaya (1979), with collections carried out in the Augusto Ruschi Biological Reserve (previously referred to as Nova Lombardia Biological Reserve). Abravaya listed a total of 12 rodent species for that reserve. Some information on mammals of EBSL have been reported by Mendes (1991), Passamani & Mendes (1991), Passamani (1996), Chiarello *et al.* (1997) and Chiarello (1998).

As remarked by Gargaglioni *et al.* (1998), mammal inventories are extremely important for ecological and behavioral researches, and for the elaboration of management plans for Biological reserves, as species of this group are present in several trophic levels and some species have important roles as seed predators and dispersers. This paper presents the partial results of a program for the study of Santa Teresa mammals, including the list of species confirmed for this municipality, as well as a brief discussion on the importance of this region for the preservation of endangered or endemic species.

### Study Area

This study was carried out in Estação Biológica de Santa Lúcia and in other Atlantic forest remnants located within the municipality of Santa Teresa, state of Espírito Santo. The EBSL (19° 57' S, 40° 32' W) has about 440 ha of area and is administered by the Museu de Biologia Prof. Mello Leitão (MBML). Since several neighboring private properties are still heavily forested, however, the reserve's fauna has a total forest area of ca. 600-800 ha. The study region is situated between 550 to 950 m of altitude in geomorphological formations of the Cristaline Complex. The predominant vegetation in the area is the Montane and Sub-montane Rainy Forest, *sensu* Rizzini (1979), characterized by non-deciduous trees with leaf buds without protection against drought (Brasil, 1983). The data collected in EBSL between 1957 and 1997 indicates a mean annual precipitation of 1.868 mm. The climate is *Cfa* of Köppen's classification, and November is the most rainy month, while June is the only month with mean precipitation below

60 mm (Mendes & Padovan, this issue). Thomaz & Monteiro (1997) estimated a mean annual temperature of 19.9o C, with mean of minimum of 14.3o C and mean of maximum about 26o C.

A floristic survey carried out in EBSL (Thomaz & Monteiro, 1997), recorded the presence of 443 tree species of 66 families and 178 genera (perimeter at breast height > 20 cm) in a sampling area of 1.02 ha. This study also showed that Myrtaceae is the dominant family, with a total of 86 tree species, what represents 19.4% of all sampled species. Five new species of trees and possibly a new genus were also found in this area (Thomaz & Monteiro, 1997). Paratypes and holotypes of two new palm species were also collected in EBSL and neighboring areas (Fernandes, 1989; 1996).

### Methods

The mammal inventory was made considering 1) species collected with traps; 2) specimens captured by locals and brought to the MBML; 3) species seen, heard or whose footprints or feces were recorded in the study area during censuses; 4) species that were collected in the Santa Teresa municipality and were deposited in the MBML collection, and 5) published records of species collected in the study region.

Small mammals were captured from March 1989 to February 1990. The trapping was carried out in various habitats of EBSL using galvanized wire traps of small (29 x 13 x 13 cm) and medium sizes (42 x 21 x 21 cm), spaced approximately 20 m one from another along transects. The traps were placed on the ground, in the lower stratum fixed in tree branches (1-2 m high), and in the medium stratum fixed in tree platforms (4 - 16.5 m high). Each morning the traps were baited with banana, pineapple, "Scott Emulsion", peanuts, and sun-dried meat, and were checked the next morning. Captured animals were identified, measured, marked with numbered earrings and then released. Voucher specimens were taxidermized and deposited in the mammal collection of MBML.

Medium and large-sized mammals were surveyed with diurnal and nocturnal censuses conducted along several trails of EBSL and in other two reserves located nearby (Estação Biológica de São Lourenço and Reserva Biológica Augusto Ruschi, with *ca.* 500 ha and 3,600 ha, respectively). Occasional censuses have been carried out in EBSL since 1989, and a more regular and intensive census schedule have been carried out in EBSL and in the other two reserves mentioned above by AGC since 1998. During these censuses, the trails were walked slowly (0.5-1.0 km/h) during early

morning (06:00-10:00 h) and early evening (18:00-22:00 h), and a total of 120 km of trails were censused in the three areas (40 km/reserve). The nomenclature used here follows Fonseca *et al.* (1996).

## Results

### Mammal species confirmed for EBSL

In a total of 21,982 trap night, 21 species of six families were captured during the trapping period, eight of which are marsupials, 12 rodents and one lagomorph (Table 1). Marsupials were the most abundant in the study area, with *Gracilinanus microtarsus* and *Marmosops incanus* the species captured most frequently.

On the basis of direct (visual records) and indirect evidences and through specimens collected in EBSL and deposited in MBML, other 27 mammal species were confirmed for EBSL. In total eight orders, 22 families and 48 species were confirmed for this reserve (Table 1).

Table 1. Mammal species (excluding bats) confirmed for Estação Biológica de Santa Lúcia with the respective form of detection.

Species	Detection form
<b>DIDELPHIMORPHIA</b>	
<b>Didelphidae</b>	
<i>Marmosops incanus</i>	Captured in trap; seen during census
<i>Micoureus demerarae</i>	Captured in trap
<i>Marmosa murina</i>	Captured in trap
<i>Gracilinanus microtarsus</i>	Captured in trap; seen during census
<i>Metachirus nudicaudatus</i>	Captured in trap; seen during census
<i>Didelphis aurita</i>	Captured in trap; seen during census
<i>Philander frenata</i>	Captured in trap; seen during census
<i>Caluromys philander</i>	Captured in trap; seen during census
<b>XENARTHRA (=EDENTATA)</b>	
<b>Dasypodidae</b>	
<i>Dasypus novemcinctus</i>	Seen during census
<b>Myrmecophagidae</b>	
<i>Tamandua tetradactyla</i>	MBML collection

Species	Detection form
<b>Bradypodidae</b>	
<i>Bradypus torquatus</i>	Seen during census
<b>PRIMATES</b>	
<b>Callitrichidae</b>	
<i>Callithrix geoffroyi</i>	Seen during census
<i>Callithrix flaviceps</i>	Seen during census
<b>Cebidae</b>	
<i>Alouatta fusca</i>	Seen during census
<i>Callicebus personatus</i>	Seen during census
<i>Cebus apella</i>	Seen during census
<b>CARNIVORA</b>	
<b>Canidae</b>	
<i>Cerdocyon thous</i>	Seen during census
<b>Procyonidae</b>	
<i>Nasua nasua</i>	Seen during census
<i>Potos flavus</i>	Seen during census
<i>Procyon cancrivorus</i>	MBML collection; footprints
<b>Mustelidae</b>	
<i>Eira barbara</i>	Seen during census
<i>Galictis</i> sp.	Seen during census
<i>Lontra longicaudis</i>	Seen during census, footprints, feces
<b>Felidae</b>	
<i>Leopardus tigrinus</i>	Footprints, feces
<i>Leopardus pardalis</i>	Footprints
<i>Puma concolor</i>	Footprints, feces
<b>PERISSODACTYLA</b>	
<b>Tapiridae</b>	
<i>Tapirus terrestris</i>	Footprints, feces*
<b>ARTIODACTYLA</b>	
<b>Cervidae</b>	
<i>Mazama americana</i>	Seen during census, footprints
<b>Tayassuidae</b>	
<i>Pecari tajacu</i>	Seen during census, footprints
<b>RODENTIA</b>	
<b>Sciuridae</b>	
<i>Sciurus aestuans</i>	Captured in trap; seen during census
<b>Muridae</b>	
<i>Akodon cursor</i>	Captured in trap
<i>Oryzomys intermedius</i>	Captured in trap
<i>Olygoryzomys nigripes</i>	Captured in trap

Species	Detection form
<i>Oecomys trinitatis</i>	Captured in trap
<i>Nectomys squamipes</i>	Captured in trap; seen during census
<i>Delomys dorsalis</i>	Captured in trap
<i>Rhipidomys mastacalis</i>	Captured in trap; seen during census
<i>Oxymycterus hispidus</i>	Captured in trap
<b>Caviidae</b>	
<i>Cavia fulgida</i>	Captured in trap
<b>Erethizontidae</b>	
<i>Sphiggurus villosus**</i>	Seen during census
<b>Hydrochaeridae</b>	
<i>Hydrochaeris hydrochaeris</i>	Seen during census, footprints, feces
<b>Agoutidae</b>	
<i>Agouti paca</i>	Seen during census
<b>Dasyproctidae</b>	
<i>Dasyprocta leporina</i>	Seen during census
<b>Echimyidae</b>	
<i>Trinomys iheringi</i>	Captured in trap; seen during census
<i>Echimys</i> sp.	Captured in trap; seen during census
<i>Kannabateomys amblyonyx</i>	MBML collection; seen during census
<i>Chaetomys subspinosus</i>	Seen during census
<b>LAGOMORPHA</b>	
<b>Leporidae</b>	
<i>Sylvilagus brasiliensis</i>	Captured in trap; seen during census

\* The footprints and feces of tapirs were seen only in July, 1991, but since then no further evidence of the species presence were found in the region.

\*\* The specimens seen in Santa Teresa resemble *S. villosus*, but its correct taxonomy needs a more accurate investigation.

### Other mammal species confirmed for Santa Teresa

Besides the species recorded in EBSL, 14 additional species were confirmed for the municipality of Santa Teresa, totaling 62 species, including 11 marsupials, six xenarthrans (edentates), six primates, 11 carnivores, one perissodactyl, two artiodactyls, 24 rodents and one lagomorph. This total corresponds to approximately 40% of the non-volant mammal species of the Atlantic forest, and 26% of the species (Tables 1 and 2) are Atlantic forest endemics. Of the total recorded for the municipality of Santa Teresa, 77% were recorded in EBSL.

Table 2. Other mammal species (excluding bats) confirmed for the municipality of Santa Teresa with the respective form of detection.

Species	Detection form
<b>DIDELPHIMORPHIA</b>	
<b>Didelphidae</b>	
<i>Monodelphis scalops</i>	MBML collection
<i>Monodelphis americana</i>	Seen during census
<i>Chironectis minimus</i>	MBML collection
<b>XENARTHRA (=EDENTATA)</b>	
<b>Dasypodidae</b>	
<i>Dasypus septencinctus</i>	MBML collection
<i>Euphractus sexcinctus</i>	Seen during census
<b>Bradypodidae</b>	
<i>Bradypus variegatus</i>	Captured by locals when crossing a road*
<b>PRIMATES</b>	
<b>Cebidae</b>	
<i>Brachyteles arachnoides</i>	Seen by Pinto et al. (1993) in RBAR**
<b>CARNIVORA</b>	
<b>Felidae</b>	
<i>Leopardus wiedii</i>	Captured by locals
<b>RODENTIA</b>	
<b>Muridae</b>	
<i>Akodon</i> sp.	MBML collection
<i>Oryzomys ratticeps</i>	Captured by Abravaya (1979)
<i>Oryzomys</i> sp.	MBML collection
<i>Blarinomys breviceps</i>	MBML collection
<i>Delomys sublineatus</i>	MBML collection
<i>Thaptomys nigrita</i>	Captured by Abravaya (1979)

\* We don't know the exact locality for this specimen, but we have seen *B. variegatus* in Espirito Santo state only in lowlands (below 400 m a.s.l.)

\*\* RBAR - Reserva Biológica Augusto Ruschi

## Discussion

In this study, we examined the species richness of EBSL and other adjacent areas utilizing capture-recapture techniques, visual records, indirect evidences, as well as the species deposited in the MBML collection. The combination of these techniques have been effective to determine accurately the species composition of non-volant mammals, as used in other studies of



the Tropical region (Eisenberg *et al.*, 1979; Emmons, 1984; Fonseca & Kierulff, 1989; George *et al.*, 1988; Glanz, 1982; Pine, 1973; Rabinowitz & Nottingham, 1989; Stallings, 1989). This list is still preliminary, however, as further studies utilizing additional kind of traps, sampling in other areas, as well as more intensive censuses in all habitat types, would certainly reveal additional species. Also, if Chiroptera were included, the species richness of the study region would increase substantially, since bats, together with rodents, dominate the mammal diversity in the Tropics (Fleming, 1975; Eisenberg, 1978; Voss & Emmons, 1996).

The number of mammal species recorded for EBSL demonstrates a high species richness, and, importantly, the majority of these species are listed for the first time in the region. Deserves mention the presence of nine species included in the Brazilian list of endangered species of mammals (Fonseca *et al.*, 1994); some of which have been the subject of detailed ecological and behavioral studies, such as *Callithrix flaviceps* (Mendes, 1993), *Chaethomys subspinosus* (Chiarello *et al.*, 1997), and *Bradypus torquatus* (Chiarello, 1998a,b). In the Santa Teresa region, marsupials and rodents had the highest richness of species, representing 50% and 30% of the Atlantic forest species, respectively (Fonseca *et al.*, 1996). With the exception of the Manu Biosphere Reserve, Peru (Pacheco *et al.*, 1993), the richness of marsupial and rodent species recorded for Santa Teresa is higher than that reported for other Neotropical sites. Considering also the other orders, only Manu Biosphere Reserve and Belém have higher number of mammal species than Santa Teresa (Table 3). As remarked by Voss & Emmons (1996), the comparison of species lists among study sites is difficult since both methods and sampling effort vary among studies. This is specially true for the other Atlantic forest sites, whose inventories are far from complete. It is likely that more detailed studies carried out in other Atlantic forest sites would reveal equally or perhaps even higher, species richness than that reported from EBSL.

Nevertheless, the data currently available do suggest that Santa Teresa is special in terms of biodiversity, since the richness of mammals found in this region is mirrored by its equally rich bird (Simon, this issue), and tree communities (Thomaz & Monteiro, 1997). Why this is so remains an unanswered question, but is probably related to a combination of favorable biotic and abiotic factors, including the region's topographic and edaphic heterogeneity, and its mild weather, which is characterized by the lack of severe dry seasons, frosts, or extremely hot temperatures.

Table 3 - Number of mammal species (excluding bats, cetaceans and sirenians) recorded for some Tropical forest sites.

Predominant Vegetation	Barro Colorado Island, Panama <sup>1</sup>	Sierra de Chama, Guatemala <sup>2</sup>	La Selva Costa Rica <sup>1</sup>	Cockscomb Basin Belize <sup>3</sup>	Manu Biosphere Reserve	Tapajós Amazonas Brazil <sup>5</sup>	Manaus Amazonas Brazil <sup>1</sup>	Belém Pará Brazil <sup>6</sup>	Rio Doce Minas Gerais Brazil <sup>7</sup>	Fazenda Ipanema São Paulo Brazil <sup>8</sup>	Itatiaia Rio de Janeiro Brazil <sup>9</sup>	Santa Teresa Brazil (this study)
Altitude (m)	90	?	90	0-600	365-3450	?	80	10	230-551	601	350-2700	600-900
Didelphimorpha	6	4	7	4	17	6	9	9	8	8	10	11
Xenarthra	6	2	6	2	7	10	8	10	4	7	5	6
Primates	4	2	3	1	13	12	6	6	6	4	6	6
Carnivora	13	11	13	13	17	13	8	17	8	9	14	11
Perissodactyla	1	0	1	1	1	1	1	1	1	0	1	1
Artiodactyla	4	2	4	3	6	4	4	4	1	3	3	2
Rodentia	14	19	22	14	48	15	17	18	16	16	15	24
Lagomorpha	1	2	2	0	1	1	0	1	1	1	1	1
Total	49	43	58	38	110	62	53	66	45	48	55	62

1. Compiled by Voss & Emmons, 1996; 2. Hendrichs, 1978; 3. Rabinowitz & Nottingham, 1989; 4. Pacheco *et al.*, 1993; 5. George *et al.*, 1988; 6. Pine, 1973; 7. Stallings *et al.*, 1991; 8. Pelzeln, 1883; 9. Avila-Pires & Gouvêa, 1977.

Although the Atlantic forest in Espírito Santo and in Brazil is reduced to less than 10% of its original extent (Câmara, 1991), the Santa Teresa municipality has a privileged conservation status since more than 25% , and perhaps almost 40%, of its surface area is still covered with native forests (Tabacow, 1992; Mendes e Padovan, this issue). The majority of forest remnants of this region are not completely isolated in private properties since the remnants are relatively close to each other, and the area officially protected includes ca. 5,000 ha. The connectivity of these forest remnants is increased by an abundance of *Eucalyptus plantations*, which allow the movements of species with high requirements of space, such as pumas (*Puma concolor*), tapirs (*Tapirus terrestris*), and collared-peccaries (*Tayassu pecari*).

It is important to mention, however, that tapirs and pumas were only occasionally recorded in EBSL, suggesting that these species might be using the area of this reserve for movements to and from other forest remnants in the region. In Santa Teresa, puma footprints are relatively abundant only in Reserva Biológica Augusto Ruschi (ca. 3,600 ha), the only reserve in this region that still have a resident population of collared-peccaries, one of the cat's main prey. Probably, the presence of peccaries, together with capybaras (*Hydrochaeris hydrochaeris*) and pacas (*Agouti paca*), which are abundant in this reserve, might explain why pumas still survive in the reserve's area. Regarding tapirs, however, no convincing evidence of the species presence in the whole region of Santa Teresa has been recorded in the last nine years, suggesting that tapirs might be locally extinct or have a drastically reduced population size.

It is likely that several Atlantic forest species are disappearing before we could understand their role or importance in the forest ecosystem, and some might even be extinguished without been known by scientists. Therefore, it is of fundamental importance that more research be conducted in order to provide the necessary information and to allow that management and conservation actions be implemented to help preserve the species and the environment as a whole.

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### References

- ABRAVAYA, J. P. 1979. *Population Ecology of some Brazilian Rodents*. MSc Thesis. California State University, Northridge.
- ÁVILA-PIRES, F. D. & GOUVÊA, E. 1977. Mamíferos do Parque Nacional de Itatiaia. *Bol. Mus. Nacional*, (N. Ser.), 291: 1-29.
- BRASIL. 1983. Departamento nacional de produção mineral. Projeto RADAM. V.32. Folhas SF23/24 Rio de Janeiro/Vitória, Rio de Janeiro.
- CÂMARA, I. G. 1991. *Plano de Ação para a Mata Atlântica*. Ed. Interação Ltda, São Paulo.
- CHIARELLO, A. G. 1998a. Activity budgets and ranging patterns of the Atlantic forest maned sloth *Bradypus torquatus* (Xenarthra: Bradypodidae). *J. Zool., Lond.*, 246: 1-10.
- CHIARELLO, A. G. 1998b. Diet of the Atlantic forest maned sloth, *Bradypus torquatus* (Xenarthra: Bradypodidae). *J. Zool., Lond.*, 246:11-19.
- CHIARELLO, A. G., PASSAMANI, M. & ZORTÉA, M. 1997. Field observation on the thin-spined porcupine, *Chaetomys subspinosus* (Rodentia; Echimyidae). *Mammalia*, 61: 29-36.
- EISENBERG, J. F. 1978. The density and biomass of tropical mammals. In: M. Soulé & B. Wilcox (eds.). *Conservation Biology*. Sinauer Assoc. Inc., Sunderland, p. 35-55.
- EISENBERG, J. F., O'CONNELL, M. & AUGUST, P. V. 1979. Density, productivity, and distribution of small mammals in two Venezuelan habitats. In: J.F. Eisenberg (ed.). *Vertebrate Ecology in the Northern Neotropics*. Smithsonian Institution Press, Washington, p. 187-207.
- EMMONS, L. H. 1984. Geographic variation in densities and diversities of non-flying mammals in Amazonia. *Biotropica*, 16: 210-222.
- FERNANDES, H. Q. B. 1989. Uma nova espécie de *Euterpe* (Palmae-Arecoideae-Arecacea) do Brasil. *Acta Bot. Brasil.*, 3: 43-49.
- FERNANDES, H. Q. B. 1996. *Bactris timbuiensis* (Palmae), uma espécie nova da Mata Atlântica no Espírito Santo, Brasil. *Bol. Mus. Biol. Mello Leitão*, (N. Ser.), 5:3-14.

- FLEMING, T. 1975. The role of small mammals in tropical ecosystems. *In*: F. B. Golley, K. Petruszewicz and L. L. Ryszkowski (eds.). *Small Mammals: Their productivity and population dynamics*. Cambridge University Press, Cambridge, p. 269-298.
- FONSECA, G. A. B. & KIERULFF, M. C. M. 1989. Biology and natural history of Brazilian Atlantic Forest small mammals. *Bull. Flor. State Mus. Biol. Sci.*, 34: 99-152
- FONSECA, G. A. B., RYLANDS, A. B., COSTA, C. M. R., MACHADO, R. B. & LEITE, Y. L. R. 1994. *Livro Vermelho dos Mamíferos Brasileiros Ameaçados de Extinção*. Fundação Biodiversitas, Belo Horizonte.
- FONSECA, G. A. B., HERMANN, G., LEITE, Y. L. R., MITTERMEIER, R. A., RYLANDS, A. B. & PATTON, J. L. 1996. Lista Anotada dos Mamíferos do Brasil. *Occas. Pap. Cons. Biol.*, 4:1-38.
- GARGAGLIONI, L. H., BATALHÃO, M. E., LAPENTA, M. J., CARVALHO, M. F., ROSSI, R. V. & VERULI, V. P. 1998. Mamíferos da Estação Ecológica de Jataí, Luiz Antônio, São Paulo. *Pap. Avul. Zool.*, 40: 267-287.
- GEORGE, T. K., MARQUES, S. A., DE VIVO, M., BRANCH, L. C., GOMES, N. & RODRIGUES, R. 1988. Levantamento de mamíferos do Parna - Tapajós. *Brasil Florestal*, 63: 33-41.
- GLANZ, W. E. 1982. The terrestrial mammal fauna of Barro Colorado: Censuses and long-term changes. *In*: E. G. Leight, A. S. Rand & D. M. Windsor, (eds.). *The Ecology of a Tropical Forest*. Smithsonian Institution Press, Washington, p. 455-468.
- HENDRICH, H. 1978. Untersuchungen zur Säugetierfauna in einem palaotropischen und einem neotropischen Bergregenwald-gebiet. *Säugetierk. Mitteil.*, 25: 214-225.
- MENDES, S. L. 1993. Distribuição geográfica e estado de conservação de *Callithrix flaviceps* (Primates, Callitrichidae). *In*: M. E. Yamamoto & M. B. Sousa (eds.). *A Primatologia no Brasil - 4*. Sociedade Brasileira de Primatologia, Natal, p. 139-154.
- MITTERMEIER, R. A., COIMBRA-FILHO, A. F.; CONSTABLE, I. D.; RYLANDS, A. B. & VALLE, C. M. 1982. Conservation of primates in the Atlantic Forests of Brazil. *Int. Zoo. Yearbook*, 22: 2-17.
- PACHECO, V., PATTERSON, B.D., PATTON, J.L., EMMONS, L.H., SOLARI, S. & ASCORRA, C.F. 1993. List of mammal species known to occur in Manu Biosphere Reserve, Peru. *Publ. Mus. Hist. Nat. UNMSM*, 44 :1-12.
- PASSAMANI, M., MENDES, S. L. & HOFFMANN, W. A. 1991.

- Levantamento preliminar da fauna de pequenos mamíferos da Estação Biológica de Santa Lúcia, Santa Teresa, ES. *In: Resumos do XVIII Congresso Brasileiro de Zoologia*, Salvador, BA, p.422.
- PASSAMANI, M. 1996. Vertical stratification of small mammals in Atlantic Hill forest. *Mammalia*, 59: 276-279.
- PELZELN, A. 1883. Brasilische Säugethiere - Resultate von Johann Natterer's Reisen in den Jahren 1817 bis 1835. Herausgegeben von der k.k. zoologisch-botnischen Gesellschaft, Wien, Leipzig.
- PINE, R.H. 1973. Mammals (exclusive of bats) of Belém, Pará, Brazil. *Acta Amazonica*, 3: 47-79.
- PINTO, L. P. S., COSTA, C. M. R., STRIER, K. B. & FONSECA, G. A. B. 1993. Habitat density and group size of primates in a Brazilian tropical forest. *Folia Primatol.*, 61:135-143.
- RABINOWITZ, A. & NOTTINGHAM, B. G. J. 1989. Mammals species richness and relative abundance of small mammals in a subtropical wet forest of Central America. *Mammalia*, 53: 217-226.
- RIZZINI, C. T. 1979. *Tratado de Fitogeografia do Brasil: Aspectos Sociológicos e Florísticos*, vol. 2. Ed. Hucitec Ltda & EDUSP, São Paulo.
- RUSCHI, A. 1964. Macacos do Estado do Espírito Santo. *Bol. Mus. Biol. Mello Leitão*, 23A: 1-23.
- RUSCHI, A. 1965. Lista de mamíferos do Estado do Espírito Santo. *Bol. Mus. Biol. Mello Leitão*, 24A :1-40.
- STALLINGS, J. 1989. Small mammals inventories in an Eastern Brazilian Park. *Bull. Flor. State Mus. Biol. Sci.*, 34: 153-200
- STALLINGS, J. R., FONSECA, G. A. B., PINTO, L. P. S., AGUIAR, L. M. S. & SÁBATO, E. L. 1991. Mamíferos do Parque Florestal Estadual do Rio Doce, Minas Gerais, Brasil. *Rev. Bras. Zool.*, 7: 663-677.
- TABACOW, J. 1992. Proposta de Zoneamento Ambiental para o Município de Santa Teresa/ES. Monografia de especialização, UFES, Vitória.
- THOMAZ, L. D. & MONTEIRO, R. 1997. Composição florística da Mata Atlântica de encosta da Estação Biológica de Santa Lúcia, município de Santa Teresa - ES. *Bol. Mus. Biol. Mello Leitão*, 7: 1-86.
- VOSS, R. S. & EMMONS, L. H. 1996. Mammalian diversity in Neotropical lowland rainforests: a preliminary assessment. *Bul. Am. Mus. Nat. History*, 230: 1-115.