Small mammals (Didelphimorphia, Chiroptera and Rodentia) of Espinhaço Range in eastern Brazil: checklist updates and implications for species conservation

Pequenos mamíferos (Didelphimorphia, Chiroptera e Rodentia) da Cadeia do Espinhaço no leste do Brasil: atualização da lista de espécies e implicações para a sua conservação

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Abstract: Brazil stands out for having the greatest diversity of Neotropical mammals. This study conducted a review of the species checklist of small mammals (Didelphimorphia, Chiroptera, and Rodentia) recorded in the Espinhaço Range to expand and update the knowledge about local fauna. Occurrence records for small mammal species of the Espinhaço were obtained from indexed scientific papers published between 2008 and 2022 and a recent survey as part of the Long-Term Ecological Project - PELD Turfeiras da Serra do Espinhaço. The species were classified in relation to their national and global threat category. A total of 115 species were recorded (25 new records), including 20 species of marsupials, 43 of bats, and 52 of rodents, with six species classified as Endangered, eight as Vulnerable, and 13 as Data Deficient. We identified 40 endemic species, four of which were identified as restricted to the Espinhaço Range. The results of this review may provide support and guidance to expand and update the knowledge about the small mammal fauna of Espinhaço. However, further reviews and surveys in undersampled areas, such as the Espinhaço Range, are essential initiatives to define priority areas for conservation and management plans, particularly for endangered species.

Keywords: Mammalia, Atlantic Forest, Cerrado, Caatinga, Endemism, Endangered species.

Resumo: O Brasil se destaca por possuir a maior diversidade de mamíferos Neotropicais. Este estudo realizou uma atualização da lista de espécies de pequenos mamíferos (Didelphimorphia, Chiroptera e Rodentia) registradas na Cadeia do Espinhaço para ampliar e atualizar o conhecimento sobre a fauna local. Os registros de ocorrência de espécies de pequenos mamíferos da Cadeia do Espinhaço foram obtidos a partir de artigos científicos indexados publicados entre 2008 e 2022 e um inventariamento recente como parte do Projeto Ecológico de Longa Duração - PELD Turfeiras da Serra do Espinhaço. As espécies foram classificadas quanto a sua categoria de ameaça nacional e global.

Foram registradas 115 espécies (25 novos registros), incluindo 20 espécies de marsupiais, 43 de morcegos e 52 de roedores, com seis espécies classificadas como ameaçadas, oito como vulneráveis e 13 como dados insuficientes. Identificamos 40 espécies endêmicas, das quais quatro foram identificadas como restritas à Cadeia do Espinhaço. Os resultados desta revisão podem fornecer subsídios e orientações para ampliar e atualizar o conhecimento sobre a fauna de pequenos mamíferos do Espinhaço. No entanto, novas revisões e levantamentos em áreas subamostradas, como a Cadeia do Espinhaço, são iniciativas essenciais para definição de áreas prioritárias para conservação e planos de manejo, particularmente para as espécies ameaçadas.

Palavras-chave: Mamíferos, Mata Atlântica, Cerrado, Caatinga, Endemismo, Espécies ameaçadas.

1. Introduction

Brazil is the fifth largest country in the world and host one of the largest diversity of mammals, with more than 770 described species (Abreu-Jr. et al., 2022). Estimates carried out in the past 20 years indicate that, given the territorial extension and diversity of biomes found in the country, the species richness of Brazilian mammals has been underestimated, a finding supported by the growing number of new species described in recent decades (Costa et al., 2005; Paglia et al., 2012; Geise et al., 2017; Machado et al., 2018). These facts underscore the importance of conducting exhaustive short and long-term field surveys, particularly in undersampled regions such as the northern Espinhaço Range, in order to accurately assess their species composition and their conservation status (Costa et al., 2005; Lessa et al., 2008; Braga et al., 2016; Geise et al., 2017).

The Espinhaço Range in eastern Brazil is the largest continuous orogenic belt in South America, extending for over 1100 km (18.87S; 43.55W), from the Quadrilátero Ferrífero, Minas Gerais state, to Chapada Diamantina, Bahia state (Almeida-Abreu and Renger, 2002; Silveira et al., 2019). The Espinhaço delimits a contact zone between three important Brazilian biomes: to the south, the Cerrado and the Atlantic Forest, which are two biodiversity hotspots, and, to the north, a transition zone between Cerrado, Atlantic Forest, and Caatinga (Giulietti et al., 1997; Mittermeier et al., 2005; Silveira et al., 2019). Given its environmental heterogeneity and the significant differences in faunal composition between its surrounding areas, the Espinhaço is likely to be inhabited by a peculiar mammal fauna (Andrade et al., 2017; Geise et al., 2017). Furthermore, this diversity of vegetation includes contact zones between biomes, with numerous records of threatened and endemic species, as well as cases of sympatry between mammalian species from adjacent biomes, such as between the Cerrado and the Atlantic Forest, and between the Caatinga and the Cerrado (Geise and Astúa, 2009; Lessa e Paula, 2014; Andrade et al., 2017; Geise et al., 2017).

According to Silveira et al. (2019), the Espinhaço Range is internationally known as a UNESCO heritage site because of its biological, cultural, and historical values, and it represents one of the world's megadiversity and endemism centers, particularly for plants, anurans, and birds (Giulietti et al.,

1997; Pugliese et al., 2004; Viana and Mota, 2004; Eterovick, 2005; Silveira et al., 2019). The first inventory of mammalian species for the Espinhaço was conducted more than a decade ago by Lessa et al. (2008). Subsequently, Pereira and Geise (2009) presented a list of species of small non-flying mammals (Didelphimorphia and Rodentia) occurring in the Chapada Diamantina National Park, located at the northernmost region of Espinhaço, Bahia state. More recently, Braga et al. (2016) inventoried the small mammal fauna (Didelphimorphia and Rodentia) of the Ouro Branco Range, on the southern edge of Espinhaço, Minas Gerais State. In addition to these contributions, recent studies including species inventories, taxonomic revisions, and analyses using cytogenetic or molecular tools found increasing levels of endemism and a previously undescribed small mammal fauna in the region (Loss et al. 2015; Braga et al., 2016; Andrade et al., 2017; Geise et al., 2017; Machado et al., 2018). Therefore, it is crucial to compile information accumulated over the past decade to expand the body of knowledge for this taxonomic group and guide conservation and management actions for mammal fauna in the Espinhaço Range.

Aiming to expand and update the knowledge about the mammal fauna of Espinhaço, we present an update of the species list for the orders Didelphimorphia, Chiroptera, and Rodentia based on a systematic literature revision and a recent survey for non-volant mammals in the region. We also provide a general overview of the importance of the Espinhaço for species conservation and discuss the conservation status of endemic species or those with restricted distribution in the three biomes (Caatinga, Cerrado and Atlantic Forest) found on the edges of the Espinhaço Range.

2. Material and methods

Literature review

We conducted a critical review of the literature concerning the distribution and conservation of small mammalian species (Didelphimorphia, Chiroptera, and Rodentia) in the Espinhaço Range. We used three main sources to structure a preliminary list of species: the first species inventory for the Espinhaço Range (Lessa et al., 2008), and two species inventories covering northern and southern portions of the Espinhaço (Pereira e Geise, 2009; Braga et al., 2016, respectively). To review the current literature on occurrence records of small mammals, we searched for scientific studies published in English and Portuguese between 2008 and 2022. Searches were carried out in the following databases: Web of Science© (https://www-webofscience.ez36.periodicos.capes.gov.br/wos/scielo/basic-search), Scientific Electronic Library Online (Scielo - http://www.scielo.br), Scopus (http://www.scopus.com), Periódicos Capes (https://www.periodicos.capes.gov.br), and Google Scholar (https://scholar.google.com.br/). The search strategy consisted of the following descriptors combined using Boolean operators (AND, OR): small mammals, Didelphimorphia, Chiroptera, Rodentia, species richness, Espinhaço Range, Caatinga, Cerrado and Atlantic Forest.

Study selection and data extraction

Study selection was performed in two steps. In the first step, potentially relevant studies were selected by reading the titles and abstracts. In the second step, selected studies were read in full. In the first step, we selected articles that contained the search terms or their synonyms in the title or abstract. Subsequently, duplicate studies were excluded. In the second step, we assessed whether the analyzed studies met the inclusion criteria and used those that did to extract the data.

The following information was extracted from the selected studies: author(s), year of publication, title, biome (Caatinga, Cerrado, and/or Atlantic Forest), species recorded in Conservation Units, conservation status, and records of endemism.

Species were classified according to the risk of extinction using the Official List of Endangered Species of Brazil (ICMBio, 2018) and the International Union for Conservation of Nature's - Red List of Threatened Species (IUCN, 2022). The nomenclature used here follows Abreu-Jr. et al. (2022), complemented by Gardner (2008) for marsupials, Patton et al. (2015) for rodents, and Graipel et al. (2017) for bats. Records of endemism or species presenting restricted distribution follow Graipel et al. (2017) for the Atlantic Forest, Carmignotto & Astúa (2017) for the Caatinga, and Gutierrez e Marinho-Filho (2017) for the Caatinga and Cerrado.

Species inventory

Small non-volant mammals (Didelphimorphia and Rodentia) were sampled with 140 livetraps (models Sherman® and Tomhawk®) distributed in *capões de mata* immersed in a grassland matrix associated to the Espinhaço Range in the Parque Estadual do Rio Preto, MG, as part of the Long-Term Ecological Project - PELD Turfeiras da Serra do Espinhaço, funded by CNPq (protocol no. 441335/2020-9). *Capões de mata* of the altitude's fields in the Espinhaço Range have a similar floristic composition to the semideciduous forests from southeastern Brazil, those associated to the Atlantic Forest domain, despite having been classified in its climate regime as an ombrophilous vegetation. In each *capão* the trapping points were set up either 10 or 15 m apart from each other. There were two livetraps at each trapping point: one on the ground and the other at 1,5 m from the ground on a tree branch (except for the points at the matrix where two traps were set on the ground for each trapping point). Captured animals were identified, marked with numbered tags (Zootech®) and released at the same location. The following data were recorded for each individual: species, ear tag code, sex, weight, and site of capture. This data collection was approved by the Animal Ethics Committee of the Federal University of the Vales do Jequitinhonha and Mucuri (protocol number 17/2022).

3. Results

Literature review

The literature search retrieved 34 studies published between 2008 and 2022 containing occurrence records of small mammals in the Espinhaço Range (Figure 1). Of this total, 19 studies (16 indexed articles and three books) met the inclusion criteria. Altogether, these studies identified 115 species of small mammals occurring in the Espinhaço Range, distributed in 19 families and three orders, including 20 species of marsupials, 43 bats, and 52 rodents (Table 1). The results indicate that the order Rodentia was the most representative, accounting for 45.22 of the recorded species, followed by Chiroptera (37.39%) and Didelphimorphia (17.39%). A total of 25 species were added to the species list published by Lessa et al. (2008), with four new records of marsupials, 11 records of bats, and 10 records of rodents (Table 1).

We identified 18 Protected Areas (PAs) with records of small mammal species on the edges of the Espinhaço Range, 15 of which are located in Minas Gerais state and three in Bahia state. Of the total number of PAs, 15 (83%) are classified as integral protection areas, two (11%) as sustainable use areas, and one (6%) as a special preservation area (Table 1, Fig. 1). Analysis by risk of extinction revealed six species (5%) as endangered (EN), eight (7%) as vulnerable (VU), and 13 (11%) classified as Data Deficient (DD) (Table 1 a, b, c, d, e, f, g, h, i).

Table 1. Small mammal species recorded in the Espinhaço Range, Brazil, their occurrences in biomes in the Range, in protected areas, conservation status, and new records (this study). EN = Endangered; VU = Vulnerable; DD = Data Deficient. Endemic or restricted-range species were categorized as follows: * = Mata Atlântica (MA); ** = Cerrado (Ce); * = Caatinga (Ca). NR = New Records. ICMBIO = Official List of Endangered Species of Brazil; IUCN = International Union for Conservation of Nature's - Red Lists of Threatened Species.**

Taxon	Common name	Biomes	Protected areas	Status		NR
				ICMBIO	IUCN	
Didelphimorphia						
Didelphidae						
Caluromys philander (Linnaeus, 1758)	Woolly Opossum	MA, Ce	PERM, PERP, PNSC, APE-Mutuca, EDPA-Peti, RPPN-Caraça	-	-	-
Caluromys lanatus (Olfers, 1818)	Woolly Opossum	MA, Ce	-	-	-	-
Chironectes minimus (Zimmermann, 1780)	Water Opossum	MA, Ce	-	DD	-	-
Cryptonanus agricolai (Moojen, 1943)	Dwarf Mouse Opossum	Ce, Ca	PESOB	-	DD	X
Didelphis albiventris Lund, 1840	Mouse Opossum	Ce, Ca	PMM, PERM, PERP, PEB, PEPI, PNSC, EEF, PNSV, APE-Mutuca, EDPA-Peti, RPPN-Jambreiro, PESOB, RPPN-Caraça, PNCD	-	-	-
Didelphis aurita Wied-Neuwied, 1826	Big-eared Opossum	MA	PERM, EEF, APE-Mutuca, EDPA-Peti	-	-	-
Gracilinanus agilis (Burmeinster, 1854)	Gracile Opossum	Ce, Ca	PMM, PERM, PERP, PEPI, PNSC, APE-Mutuca, PNCD	-	-	-
Gracilinanus microtarsus (Wagner, 1842)	Gracile Opossum	MA	PESV, EDPA-Peti, RPPN-Caraça, PERP, PNCD	-	-	-
Marmosa demerarae Thomas, 1905	Woolly Mouse Opossum	MA, Ce, Ca	PERM, RPPN-Caraça, PNCD	-	-	X

continuation

Continuation

Taxon	Common name	Biomes	Protected areas	Status		NR
				ICMBIO	IUCN	
Marmosa murina (Linnaeus, 1758)	Mouse Opossum	MA, Ce	PNCD	-	-	X
Marmosa paraguayana Tate, 1931	Woolly Mouse Opossum	MA, Ce	PERP	-	-	-
Marmosops incanus (Lund, 1840)	Gray Slender Opossum	MA, Ce, Ca	PMM, PERM, PERP, PEB, PNSC, PNSV, EEF, EDPA-Peti, RPPN-Jambreiro, RPPN-Caraça, PESOB, PNCD	-	-	-
Metachirus nyosuros Temminck, 1824	Brown Four-eyed Opossum	MA, Ce	PERP, EEF	-	-	-
Monodelphis americana (Müller, 1776)	Three-striped Opossum	MA, Ce	PERP, EEF, EDPA-Peti, PNSV, PESOB, PERM, RPPN-Caraça, PNCD	-	-	-
Monodelphis domestica Wagner, 1852	Short-tailed Opossum	MA, Ce	PEB, PERP, PEPI, PERM, PNSV, PNSC, MNCF, APE-Mutuca, PESOB, RPPN-Caraça, PNCD	-	-	-
Monodelphis iheringi (Thomas, 1888)	Three-striped Opossum	MA*	RPPN-Caraça	-	DD	-
Monodelphis kunsi Pine, 1975	Pygmy Short-tailed Opossum	Ce**	PNSC	-	-	X
Philander quica Temminck, 1824	Four-eyed Opossum	MA	PMM, PERM, EEF, APE-Mutuca, EDPA-Peti, RPPN-Caraça, PERP	-	-	-
Thylamys velutinus (Wagner, 1842)	Fat-tailed Mouse Opossum	Ce**	-	VU	-	-
Thylamys karimii (Petter, 1968)	Fat-tailed Mouse Opossum	Ce, Ca	-	-	VU	-
Chiroptera						

Continuation

Taxon	Common name	Biomes	Protected areas	Status		NR
				ICMBIO	IUCN	
Emballonuridae						
Peropteryx macrotis (Wagner, 1843)	Dog-like Bat	MA, Ce, Ca	PNCD, EPDA-Peti	-	-	-
Peropteryx trinitatis Miller, 1899	Dog-like Bat	MA	PNSC	DD	DD	X
Noctilionidae						
Noctilio leporinus (Linnaeus, 1758)	Buldog Bat	MA, Ce, Ca	MNCF	-	-	-
Mormoopidae						
Pteronotus gymnonotus Natterer, 1843	Big Backed Bat	Ce	MNCF	-	-	-
Phyllostomidae						
Desmodontinae						
Desmodus rotundus (E. Geoffroy, 1810)	Vampire Bat	MA, Ce, Ca	PESV, PNCD, RPPN-Caraça, EPDA-Peti	-	-	-
Diphylla ecaudata Spix, 1823	Hairy-Legged Vampire Bat	MA, Ce, Ca	PERP	-	-	X
Glossophaginae						
Anoura caudifer (E. Geoffroy, 1818)	Tailless Bat	MA, Ce, Ca	MNCF, RPPN-Caraça, EPDA-Peti	-	-	-
Anoura geoffroyi Gray, 1838	Tailless Bat	MA, Ce, Ca	MNCF, RPPN-Caraça, EPDA-Peti	-	-	-
Glossophaga soricina (Pallas, 1766)	Long-tonged Bat	MA, Ce, Ca	PESV, MNCF MNCF, RPPN - Caraça, EPDA-Peti, PNSC	-	-	-
Lonchophylla bokermanni Sazima, Vizotto & Taddei, 1978	Nectar Bat	MA, Ce**, Ca***	PNSC	VU	EN	-
Lonchophylla dekeyseri Taddei, Vizotto & Sazima, 1983	Nectar Bat	Ce**	PNSC	EN	EN	-
Phyllostominae						
Chrotopterus auritus (Peters, 1856)	False Vampire Bat	MA, Ce, Ca	PNCD, RPPN-Caraça, EDPA-Peti	-	-	-

Continuation

Taxon	Common name	Biomes	Protected areas	Status		NR
				ICMBIO	IUCN	
Glyphonycteris behnii (Peters, 1865)	Behn's Bat	Ce	PERP	VU	DD	X
Micronycteris schmidtorum Sanborn,1935	Big-eared Bat	MA, Ce, Ca	PERP	-	-	X
Phyllostomus discolor Wagner, 1843	Pale Spear-nosed Bat	MA, Ce, Ca	PNSV, MNCF	-	-	-
Phyllostomus hastatus (Pallas, 1767)	Greater Spear-nosed Bat	MA, Ce, Ca	PNSV, MNCF, EPDA-Peti	-	-	-
Carollinae						
Carollia perspicillata (Linnaeus, 1758)	Short-tailed Bat	MA, Ce, Ca	PNCD, EEF, PNSV, PEI, MNCF, APE-Mutuca, RPPN-Caraça, EDPA-Peti	-	-	-
Stenodermatinae						
Artibeus fimbriatus Gray, 1838	Fruit-eating Bat	MA, Ca	EPDA-Peti	-	-	-
Artibeus lituratus (Olfers, 1818)	Fruit-eating Bat	MA, Ce, Ca	PESV, RPPN-Caraça	-	-	-
Artibeus obscurus Schinz, 1821	Fruit-eating Bat	MA, Ce, Ca	EPDA-Peti	-	-	-
Artibeus planirostris (Spix, 1823)	Fruit-eating Bat	MA, Ce, Ca	MNCF, PNSC, RPPN-Caraça	-	-	-
Chiroderma doriae Thomas, 1891	Big-eyed Bat	MA, Ce	PERP	-	-	X
Dermanura cinerea (Gervais, 1856)	Fruit-eating Bat	MA, Ce, Ca	PERP	DD	-	X
Platyrrhinus lineatus (E. Geoffroy, 1810)	Broad-nosed Bat	MA, Ce, Ca	PESV, MNCF, RPPN-Caraça	-	-	-
Platyrrhinus recifinus (Thomas, 1901)	Broad-nosed Bat	MA, Ce	EPDA-Peti	-	-	-
Pygoderma bilabiatum (Wagner, 1843)	Broad-nosed Bat	MA, Ce	EPDA-Peti, RPPN-Caraça	-	-	-
Vampyressa pusilla (Wagner, 1843)	Yellow-eared Bat	MA, Ce	EPDA-Peti, RPPN-Caraça	-	DD	-

Continuation

Taxon	Common name	Biomes	Protected areas	Status		NR
				ICMBIO	IUCN	
Sturnira lilium (E. Geoffroy, 1810)	Yellow-shouldered Bat	MA, Ce, Ca	EEF, EPDA-Peti, RPPN-Caraça	-	-	-
Molossidae						
Eumops perotis (Schinz, 1821)	Greater Bonneted Bat	MA, Ce, Ca	RPPN-Caraça	-	-	-
Molossops temminckii (Burmeister,1854)	Dog-faced Bat	MA, Ce, Ca	PERP	-	-	X
Molossus molossus (Pallas, 1766)	Mastiff Bat	MA, Ce, Ca	EPDA-Peti, RPPN-Caraça	-	-	-
Nyctinomops laticaudatus (E. Geoffroy, 1805)	Free-tailed Bat	MA, Ce, Ca	EDPA-Peti	-	-	-
Tadarida brasiliensis (I. Geoffroy, 1824)	Free-tailed Bat	MA, Ce, Ca	RPPN-Caraça	-	-	-
Vespertilionidae						
Eptesicus brasiliensis (Desmarest, 1819)	Brazilian Brown Bat	MA, Ce, Ca	EEF, RPPN-Caraça	-	-	-
Eptesicus chiriquinus Thomas, 1920	Chiriquinan Serotine	MA	PNSC	-	-	X
Eptesicus furinalis (d'Orbigny & Gervais, 1847	Argentinian Brown Bat	MA, Ce, Ca	PNSC	-	-	X
Histiotus velatus (I. Geoffroy, 1824)	Brown Bat	MA, Ce, Ca	EEF, APE-Mutuca	-	DD	-
Lasiurus blossevilli (Lesson & Garnot, 1826)	Red Bat	MA, Ce, Ca	PMM, RPPN-Caraça	-	-	-
Lasiurus cinereus (Beauvois, 1796)	Hoary Bat	MA, Ce, Ca	-	-	-	-
Lasiurus ega (Gervais, 1856)	Southern Yellow Bat	MA, Ce, Ca	PNSC	-	-	X
Myotis nigricans (Schinz, 1821)	Black Myotis	MA, Ce, Ca	PESV	-	-	-
Myotis riparius Handley, 1960	Riparian Myotis	MA, Ce, Ca	PNSC	-	-	X
Myotis ruber (E. Geoffroy, 1806)	Red Myotis	MA, Ca	-	-		-
Rodentia						

Continuation

Taxon	Common name	Biomes	Protected areas	Status		NR
				ICMBIO	IUCN	
Guerlinguetus brasiliensis (Gmelin, 1788)	Squirrel	MA, Ce	PMM, PERP, PEB, PNSC, EEF, APE-Mutuca, RPPN-Jambreiro	-	-	-
Muridae						
Cricetidae						
Sigmodontinae						
Abrawayaomys ruschii Cunha e Cruz, 1979	Ruschis's Rat	MA*	PESOB	-	-	X
Akodon cursor (Winge, 1887)	Cursorial Grass Mouse	MA, Ce, Ca	PMM, PERM, PERP, PEPI, EEF, PNSC, MNCF, APE-Mutuca, APE-Fechos, RPPN-Jambreiro, EDPA-Peti, PNSV, RPPN-Caraça, PNCD	-	-	-
Akodon montensis Thomas, 1913	Montane Grass Mouse	MA, Ce	APE-Mutuca	-	-	-
Castoria angustidens (Winge, 1887)	Rat	MA*	PESOB	-	-	X
Bibimys labiosus (Winge, 1887)	Crimson-nosed Rat	MA*	PESOB	-	-	X
Blarinomys breviceps (Winge, 1887)	Shrew Mouse	MA*	EDPA-Peti, PESOB, RPPN-Caraça	-	-	-
Calassomys apicalis Pardiñas, Lessa, Salazar-Bravo & Câmara, 2014	Withe-tailed Rat	Ce**	PNSV	-	-	X
Calomys tener (Winge, 1887)	Delicate Laucha	MA, Ce, Ca	PERM, PNSC, EEF, APE-Mutuca, PNSV, PESOB, RPPN-Caraça	-	-	-
Cerradomys vivoi Percequillo, Hingst-Zaher & Bonvicino, 2008	Rice Rat	MA, Ce, Ca	PNCD	-	-	X

Continuation

Taxon	Common name	Biomes	Protected areas	Status		NR
				ICMBIO	IUCN	
Cerradomys subflavus (Wagner, 1842)	Rice Rat	MA, Ce	PERP, PNSC, EEF, PNSV, MNCF, PESOB, PERM, RPPN-Caraça	-	-	-
Delomys dorsalis (Hensel, 1872)	Forest Rat	MA*	-	-	-	-
Delomys sublineatus (Thomas, 1903)	Forest Rat	MA*	-	-	-	-
Euryoryzomys lamia (Thomas, 1901)	Buffy-sided Rice Rat	Ce**	-	EN	VU	-
Euryoryzomys russatus (Wagner, 1848)	Russet Rice Rat	MA*	PNSC	-	-	-
Holochilus sciureus Wagner, 1842	Marsh rat	Ce**, Ca***	-	-	-	-
Hylaeamys seuanezi (Lund, 1840)	Forest Rice Rat	MA*	PNSV	-	VU	X
Juliomys pictipes (Osgood, 1933) **	Contrera's Juliomys	MA	EDPA-Peti, RPPN-Caraça	-	-	-
Necromys lasiurus (Lund, 1841)	Hairy-tailed Akrodont	MA, Ce, Ca	PERP, PNSV, PESOB, PNSC, PERM. RPPN-Caraça, PNCD	-	-	-
Nectomys squamipes Brants, 1827	Water Rat	Ma, Ce	PERP, PEB, PNSC, EEF, APE-Mutuca, EDPA-Peti, PNSV,	-	-	-
Nectomys rattus Pelzen, 1883	Water Rat	Ce, Ca	PNCD	-	-	-
Oecomys catherinae Thomas, 1909	Arboreal Rice Rat	MA, Ce, Ca	EDPA-Peti	-	-	-
Oligoryzomys nigripes (Olfers, 1818)	Black-footed Colilargo	MA, Ce, Ca	PNSV, PNSC, PERM, EEF, PERP, RPPN-Caraça, PNCD	-	-	-
Oligoryzomys rupestris Weksler	Rock Outcrop Colilargo	Ce**	PERP, PNCD, PNSV	EN	DD	-

Continuation

Taxon	Common name	Biomes	Protected areas	Status		NR
				ICMBIO	IUCN	
& Bonvicino, 2005						
Oligoryzomys stramineus Bonvicino e Weksler, 1998	Straw-colored Colilargo	Ce**, Ca***	PNSV, PNCD	-	-	X
Oxymycterus dasytrichus (Schinz, 1821)	Atlantic Forest Hocicudo	MA*	PNSC, EEF, PNSV, PNCD	-	-	-
Oxymycterus delator Thomas, 1903	Paraguayan Hocicudo	Ce**, Ca***	PERP, PNSV, APE-Mutuca, PNSC, RPPN-Caraça, PNCD	-	-	-
Oxymycterus rufus (G. Fischer, 1814)	Rufous Hocicudo	Ma*	PESOB,	DD	-	X
*Pseudoryzomys simplex (*Winge, 1887)	False Rice Rat	Ce**, Ca	PNSV, PNCD	-	-	X
*Rhagomys rufescens (*Thomas, 1886*)*	Rufescent Arboreal Mouse	MA*	PESOB,	-	VU	X
Rhipidomys mastacalis (Lund, 1840)	Climbing Mouse	MA, Ce	PMM, PERM, PERP, PEB PNSC, EEF, PNSV, PESOB, RPPN-Mutuca	-	-	-
Rhipidomys macrurus (Gervais, 1855)	Climbing Mouse	Ce, Ca	-	-	-	-
Sooretamys angouya (Fischer, 1814)	Angoya Rice Rat	MA*	-	-	-	-
Thalpomys lasiotis Thomas, 1916 *	Hairy-eared Mouse	Ce	PERP, PNSC, PNSV	EN	-	-
Thaptomys nigrita (Lichtenstein, 1829)	Ebony Grass-Mouse	MA*	RPPN-Caraça	-	-	-
Wiedomys pyrrhorhinos (Wied-Neuwied, 1821)	Red-nose Mouse	Ca***	PNCD	-	-	-
Erethizontidae						
Coendou prehensilis (Linnaeus, 1758)	Brazilian Pocopine	MA, Ce, Ca	PMM, PNSC, PERM, RPPN-Caraça	-	-	-

Continuation

Taxon	Common name	Biomes	Protected areas	Status		NR
				ICMBIO	IUCN	
Coendou spinosus (F. Cuvier, 1823)	Hairy Dwarf Porcupine	MA, Ce	-	-	-	-
Caviidae						
Cavia aperea Erxleben, 1777	Brazilian Guinea Pig	MA, Ce, Ca	PERP, PEB, PNSC, EEF, PNSV, PERM, RPPN-Caraça	-	-	-
Galea spixii (Wagler, 1831)	Yellow-toothed Cavy	Ce**, Ca***	RPPN-Caraça, PNCD	-	-	-
Kerodon rupestris (Wied-Neuwied, 1820)	Rocky Cavy	Ce**, Ca***	PERP, PEB, PEPI, PESV, MNCF, PNCD	VU	-	-
Dasyproctidae						
Dasyprocta azarae Lichtenstein, 1823	Azara's Agouti	Ce, Pt	PERP, PNSV, RPPN- Caraça, PNCD	-	DD	-
Echimyidae						
Euryzygomatomys spinosus (G. Fisher, 1814)	Guiara	MA, Ce	PERP, RPPN-Caraça, PNSV	-	-	-
Kannabateomys amblyonyx (Wagner, 1845)	Atlantic Bamboo Rat	MA, Ce	EDPA-Peti	-	-	-
Phyllomys blainvilii (Jourdan, 1837)	Golden Atlantic Tree-rat	MA, Ca	PNCD	-	-	-
Phyllomys lamarum (Thomas, 1916)	Palid Atlantic Tree-rat	MA, Ca	EEA	-	DD	-
Phyllomys centralis	Tree-rat	Ce	PERP	-	-	-
Thrichomys apereoides (Lund, 1839)	Common Punaré	Ce**, Ca	PERP, PEB, PNSC, PNSV. RPPN-Caraça	-	-	-
Thrichomys inermis (Pictet, 1843)	Highlands Punaré	Ca***	MNCF, PNCD	DD	-	-
Trinomys albispinus (I. Geoffroy, 1838)	Spiny-rat	Ce**, Ca***	MNCF, PNSV, PNCD	-	-	-
Trinomys moojeni (Pessôa, Oliveira & Reis, 1992)	Moojen's Atlantic Spiny-rat	MA*, Ce	PNSC, RPPN-Caraça	EN	EN	-
Trinomys setosus (Desmarest, 1817)	Hairy Atlantic Spiny-rat	MA*	EDPA-Peti, PNSC	-	-	-

Continuation

Legends: PMMU = Parque Municipal de Mucugê; PNCD = Parque Nacional da Chapada Diamantina; MNCF = Monumento Natural da Cachoeira do Ferro Doido; PMM = Parque Municipal das Mangabeiras; PERM = Parque Estadual do Rola Moça; PERP = Parque Estadual do Rio Preto; PEB = Parque Estadual do Biribiri; PEI = Parque Estadual do Itacolomi; PESOB = Parque Estadual da Serra do Ouro Branco; PEPI = Parque Estadual do Pico do Itambé; PNSC = Parque Nacional da Serra do Cipó; PNSV = Parque Nacional das Sempre Vivas; EEA = Estação Ecológica de Acauã; EEF = Estação Ecológica de Fechos; APE-Mutuca = Área de Proteção Especial da Mutuca; EPDA-Peti = Estação de Proteção e Desenvolvimento Ambiental - Peti; RPPN-Caraça = Reserva Particular do Patrimônio Natural do Caraça; RPPN-Jambreiro = Reserva Particular do Patrimônio Natural Jambreiro.

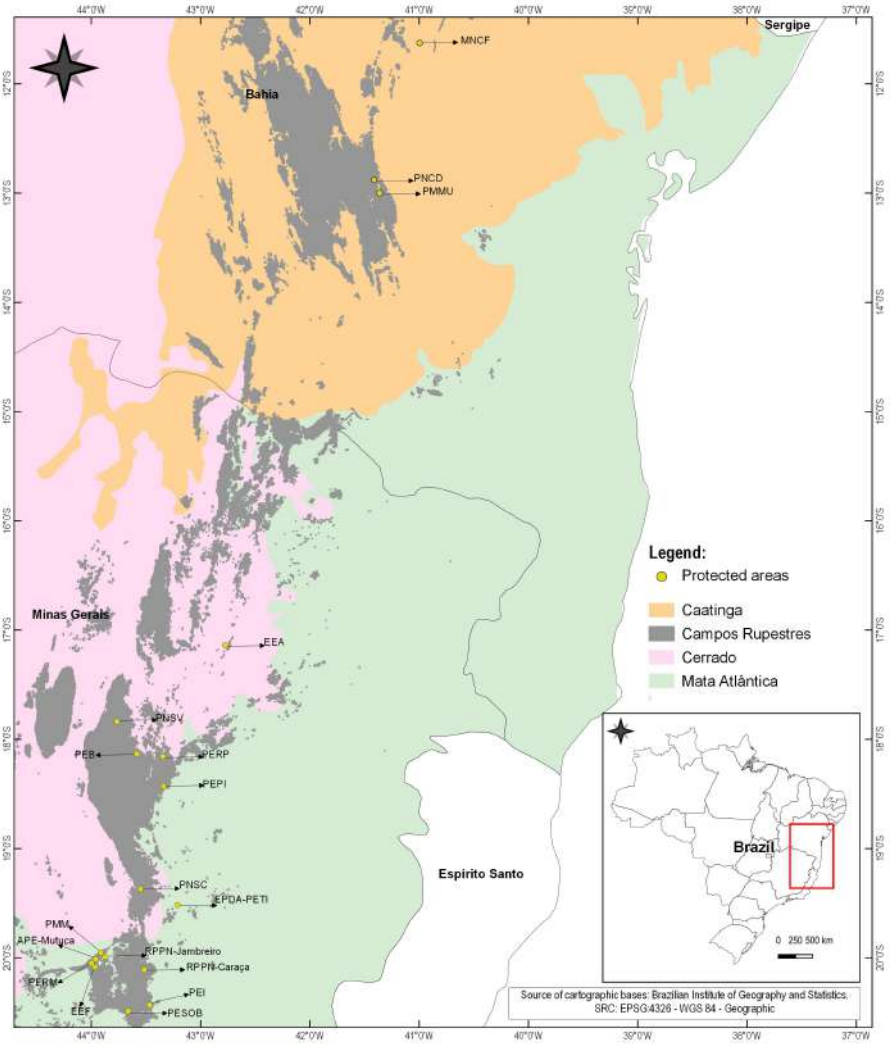

Figure 1. Geographic location of protected areas with records of small mammalian species in the Espinhaço Range, Brazil.

Legends: PMMU = Parque Municipal de Mucugê; PNCD = Parque Nacional da Chapada Diamantina; MNCF = Monumento Natural da Cachoeira do Ferro Doido; PMM = Parque Municipal das Mangabeiras; PERM = Parque Estadual do Rola Moça; PERP = Parque Estadual do Rio Preto; PEB = Parque Estadual do Biribiri; PEI = Parque Estadual do Itacolomi; PESOB = Parque Estadual da Serra do Ouro Branco; PEPI = Parque Estadual do Pico do Itambé; PNSC = Parque Nacional da Serra do Cipó; PNSV = Parque Nacional das Sempre Vivas; EEA = Estação Ecológica de Acauã; EEF = Estação Ecológica de Fechos; APE-Mutuca = Área de Proteção Especial da Mutuca; EPDA-Peti = Estação de Proteção e Desenvolvimento Ambiental - Peti; RPPN-Caraça = Reserva Particular do Patrimônio Natural do Caraça; RPPN-Jambreiro = Reserva Particular do Patrimônio Natural Jambreiro. IBGE (2010).

We also recorded 40 species (three marsupials, two bats and 35 rodents) considered endemic or with distribution restricted to at least one of the biomes in the Espinhaço Range (Atlantic Forest, Caatinga or Cerrado), corresponding to approximately 38% of the total species recorded in the range. The Atlantic Forest had the highest number of records (16 species), followed by Cerrado (15 species) and Caatinga (nine species) (Table 1).

Species inventory

In a total of 3.920 trap-nights we captured four species of marsupials (Didelphidae), and seven species of rodents, being four belong to the family

Cricetidae, two Echimiydae, and one Caviidae. The capture success was 7.04% with 276 captures of 100 individuals (Table 2). We trapped one rodent endemic to the Cerrado biome, *Oxymycterus delator*, and one endemic to the rock outcrops areas (*campos rupestres*) in the Espinhaço Range, the Philotini Endangered rodent *Oligoryzomys rupestris*. We also recorded the recently described rodent for the central Cerrado domain in Brazil, the tree-rat *Phyllomys centralis* (Echymyidae) (Table 1).

Table 2. Small mammals' species (Didelphimorphia and Rodentia) trapped during the present study at Parque Estadual do Rio Preto, in the Espinhaço Range.

Taxon	Captures	Individuals
Didelphimorphia		
Gracilinanus microtarsus	33	17
Metachirus myosuros	2	1
Monodelphis americana	4	4
Phylander quica	4	2
Total	43	24
Rodentia		
Cerradomys subflavus	76	13
Euryzygomatomys spinosus	1	1
Oligoryzomys rupestris	20	15
Oxymycterus delator	10	3
Phyllomys centralis	4	4
Rhipidomys mastacalis	120	38
Cavia aperea	2	2
Total	233	76
Overall total	276	100

Source: Authors

4. Discussion

We identified 115 records of small mammal species (Didelphimorphia, Chiroptera, and Rodentia) in the Espinhaço Range, representing an increase of 20% compared with the previous Checklist published by Lessa et al. (2008). Most of the recorded species (68%) showed wide distribution, occurring in more than one of the three biomes found in the Espinhaço Range (Atlantic Forest, Cerrado and Caatinga) (Paglia et al., 2012; Braga et al., 2016; Andrade et al., 2017; Geise et al., 2017). However, 40 species were identified as endemic or restricted to at least one of these biomes, demonstrating an increase of about 46% (11 species) in such occurrences compared with the previous compilation of Lessa et al. (2008). The increase in the species list provided by this checklist update reinforces the importance of conducting data compilations and exhaustive species surveys, particularly in areas that are still poorly sampled, such as the Espinhaço Range in Brazil (Costa et al., 2005; Lessa et al., 2008; Geise et al., 2017).

Currently, 298 mammal species are recorded in the Atlantic Forest (89 endemic, being 16 species recorded for the Espinhaço Range), 252 in the Cerrado

(33 endemic, 15 for the Espinhaço), and 183 in the Caatinga (11 endemic, nine for the Espinhaço) (Paglia et al., 2012; Graipel et al., 2017; Carmignotto and Astúa, 2017; Gutierrez and Marinho-Filho, 2017). Our results indicated that approximately 35% of the small mammal fauna of the Espinhaço is endemic or with distribution restricted to at least one of the biomes (Atlantic Forest, Cerrado and Caatinga) and occur at the Espinhaço, highlighting the biological importance of the Range. So far, only four species have been registered as endemic to the Espinhaço limits, the rodents *Trinomys moojeni*, *Calassomys apicalis* and *Oligoryzomys rupestris* (Talamoni and Cordeiro Junior, 2008; Oliveira et al., 2017), and the nectar-bat *Lonchophylla bokermanni* (Gutierrez and Marinho-Filho, 2017), usually associated with Cerrado habitats within *campos rupestres* (rock outcrops) at elevations above 1100 m (Lessa et al., 2008; Patton et al., 2015). Moreover, *Lonchophylla bokermanni*, which was previously reported to be restricted to southern Espinhaço Range (Gutierrez and Marinho-Filho, 2017), showed new records in the Caatinga, extending its distribution by about 840 km toward the northern edge of the Espinhaço (Cláudio et al., 2018). We also highlight the record of the tree-rat Phillomys centralis. The collecting localities of the types of *P. centralis* are in the western limit of the Atlantic Forest domain, transitional to Cerrado, Minas Gerais state (Machado et al., 2018). Therefore, the specimens reported in this paper represent the first record of P. centralis in the central Cerrado Domain, at the *campos rupestres* in the southern Espinhaço. These records reinforce the need to carefully reassess the biome fauna endemicity suggested for some species of small mammals in Brazil, considering the species capability to occur in different environments (Geise and Astúa, 2009; Geise et al., 2017).

The importance of species lists increases when conservation status is considered (Geise et al., 2017). Of the 13 species identified as threatened in the Espinhaço Range, three were not recorded in PAs, the marsupials *Thylamys velutinus* (VU), *T. karimii* (VU), and the rodent *Euryoryzomys lamia* (EN) (ICMBio, 2018; IUCN, 2022). We also highlight the occurrence of two species (*Trinomys moojeni* and *Lonchophylla dekeyseri)* classified as endangered in both, the national list (ICMBio, 2022) and the international red list (IUCN, 2022). The rodent T. moojeni is restricted to the southern edge of the Espinhaço Range, with records in only two PAs (Parque Nacional da Serra do Cipó and Reserva Particular do Caraça, Minas Gerais State) (Câmara and Oliveira, 2012). Similarly, the nectar bat L. dekeyseri, endemic to the Brazilian Cerrado (Gutierrez and Marinho-Filho, 2017), has been recorded in a single PA in the southern edge of the Espinhaço Range (Parque Nacional da Serra do Cipó), being considered rare in inventories (ICMBio, 2018).

Of note, 13 species were classified as DD in the Official List of Endangered Species of Brazil (ICMBio, 2018) and/or in the IUCN Red List (IUCN, 2022), such a lack of knowledge undermines conservation initiatives and regional analyses (Costa et al., 2005; Geise et al., 2017). Thus, it's crucial to investigate in detail the mammalian fauna of the Espinhaço Range, and to know more precisely the species distribution in the region (Lessa et al., 2008; Braga et al, 2016; Geise et al., 2017). Identification of DD species (22% of the total recorded species) and those under some degree of threat (VU or EN) further reinforces the importance of the creation and maintenance of PAs (particularly integral protected areas)

as places of refuge and protection for mammalian fauna and other taxonomic groups distributed along the Espinhaço Range (Drummond et al., 2005; Lessa et al., 2008; Andrade et al., 2017). Of the 13 species at risk, 69% (VU and EN) were found to occur in only eight integral protected areas on the edges of the Espinhaço Range (six in Minas Gerais and two in Bahia). The Espinhaço Range covers an area of about 150,000 km2; however, the sum of areas of these eight PAs amounts to 3519 km2, accounting for only 2.4% of the total area of the range (Lessa et al., 2008). Protected areas are the most efficient place for biodiversity conservation, in this sense the small area covered by integral PAs in Espinhaço Range may be insufficient to protect its high biodiversity, particularly small mammals' fauna (Silva e Bates, 2002; Rocha et al., 2005; Lessa et al., 2008).

Finally, it should be noted that, of the 121 UCs located in the Espinhaço Range, studies were identified in only 18 units, and these were concentrated in the southern portion of the Serra (15 UCs), while only three UCs are in the far north, in the region of Chapada Diamantina. In this way, we highlight the lack of studies on the fauna of small mammals in the central region and around north of the mountain range.

The creation of new integral PAs may be a long-term solution for the conservation of mammal diversity in the Espinhaço Range. Furthermore, integral PAs should be created considering the already existing set of protected areas, including their representativeness, connectivity, and use of natural resources by local communities (Lessa et al., 2008; Leal et al., 2008). The lack of basic scientific knowledge represents a great threat to the mammal's conservation in Espinhaço Range, especially regarding information on taxonomy, systematics, geographical distribution, and natural history of species (Costa et al., 2005; Lessa et al., 2008). After all, it is extremely important to expand scientific knowledge on mammalian fauna sheltered in the PAs along this important mountain range in eastern Brazil.

5. Conclusion

Our results reported in this checklist update are an important source of information, contributing to expanding and updating the knowledge about the mammalian fauna in the most extensive mountain range in Brazil. In this region, the major threat to small mammals' conservation is the scarcity of basic scientific knowledge. Therefore, exhaustive long-term field surveys (such as the Long-Term Ecological Project - PELD Turfeiras da Serra do Espinhaço) are important initiatives in order to define priority areas for conservation and management plans for some threatened species. Finally, existing knowledge gaps make conservation initiatives difficult, since knowledge about the mammalian fauna is still unevenly distributed, concentrated mainly in the southern portion of the Espinhaço Range.

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REFERENCES

Abreu-Jr., E.F.; Casali, D.M.; Garbino, G.S.T.; Libardi, G.S.; Loretto, D.; Loss, A.C.; Marmontel, M.; Nascimento, M.C.; Oliveira, M.L.; Pavan, S.E. & Tirelli, F.P. (2022). Lista de Mamíferos do Brasil. Version 2021#1 (April). Comitê de Taxonomia da Sociedade Brasileira de Mastozoologia.

Almeida-Abreu, P.A.; Renger, F.E. (2002). Serra do Espinhaço Meridional: um orógeno de colisão do Mesoproterozóico. Brazilian Journal of Geology, 32 (1): 1-14.

Andrade, P.C.B.; Lessa, L.G.; Geise, L.; Pacheco, M.A.C. (2017). Survey of small mammals (Rodentia and Didelphimorphia) in a Cerrado reserve: Central Espinhaço mountain range, Brazil. Oecologia Australis, 21 (2): 147–155.

Braga, C.A.C.; Drummond, L.O.; Pires, M.R.S. (2016). Inventário de pequenos mamíferos (Rodentia e Didelphimorphia) da serra de ouro branco: Porção sul da cadeia do espinhaço, Minas Gerais, Brasil. Oecologia Australis, 20 (1): 69–80.

Câmara, E.M.V.C. & Oliveira, L.C. (2012). Mammals of Serra do Cipó national park, Southeastern Brazil. Check List, 8 (3): 355–359.

Carmignotto, A.P. & Astúa, D. (2017). Mammals of the Caatinga: Diversity, Ecology, Biogeography, and Conservation. *In:* Silva, J.M.C., Leal, I.R., Tabarelli, M. (eds) Caatinga. Springer, Cham. p. 211-254.

Cláudio, V.C.; Silveira, G.C.; Farias, S.G.; Maas, A.S.; Oliveira, M.B.; Lapenta, M.J.; Alvarez, M.R.; Dias, D. & Moratelli, R. (2018). First record of *Lonchophylla bokermanni* (Chiroptera, Phyllostomidae) for the caatinga biome. Mastozoologia Neotropical, 25 (1): 43–51.

Costa, L.P., Leite, Y.L.R., Mendes, S.L. & Ditchfield, A.D. (2005). Conservação de mamíferos no Brasil. Megadiversidade, 1(3):103-112.

Talamoni, S.A., Couto, D., Cordeiro-Junior, D.A. & Diniz, F.M. (2008). Diet of some species of Neotropical small mammals. Mammalian Biology, 73: 337-341.

Drummond, G.M.; Martins, C.S.; Machado, A.B.M.; Sebaio, F.A. & Antonini, Y. (orgs.). (2005). Biodiversidade em Minas Gerais: um atlas para sua conservação. Fundação Biodiversitas. Belo Horizonte.

Eterovick, P.C.; Carnaval, A.C.O.Q.; Borges-Nojosa, D.M.; Silvano, D.L.; Segalla, M.V. & Sazima, I. (2005). Amphibian declines in Brazil: an overview. Biotropica: The Journal of Biology and Conservation, 37(2): 166-179.

Gardner, A.L. (2008). Mammals of South America: marsupials, xenarthrans, shrews, and bats. The University of Chicago Press, Chicago and London.

Geise, L. & Astúa, D. (2009). Distribution extension and sympatric occurrence of G*racilinanus agilis* and *G. microtarsus* (Didelphimorphia, Didelphidae), with cytogenetic notes. Biota Neotropica, 9 (4): 269–276.

Geise, L.; Pereira, L.G.; Astúa, D.; Aguieiras, M.; Lessa, L.G.; Asfora, P.H.; Dourado, F. & Esberárd, C.E.L. (2017). Terrestrial mammals of the Jequitinhonha river basin, Brazil: A transition area between Atlantic Forest and Cerrado. Mastozoología Neotropical, 24(1): 95–119.

Giulietti, A.M.; Pirani, J.R. & Harley, R.M. (1997). Espinhaço range region. *In:* Davis, S.D. (ed). Centres of plant diversity: a guide and strategy for their conservation. Cambridge, IUCN Publication Unity, Reino Unido. pp. 397-404.

Graipel, M.E.; Cherem, J.J.; Monteiro-Filho, E.L.A. & Carmignotto, A.P. (2017). Mamíferos da Mata Atlântica. *In:*Monteiro-Filho, E.L.A. & Conte, C.E. (Org.). Revisões em Zoologia: Mata Atlântica. Ed. UFPR, Curitiba. Pp. 391- 482. ISBN 978-85-8480-092-6.

Gutierrez, E. E. & Marinho-Filho, J. (2017). The mammalian fauna's endemic to the Cerrado and Caatinga. ZooKeys, 644: 105-157.

Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio). (2018). Livro Vermelho da Fauna Brasileira Ameaçada de Extinção: Volume II – Mamíferos.ICMBio, Brasília, Distrito Federal.

International Union for Conservation of Nature e Union international (IUCN). (2020). [The IUCN Red List of Threatened Species]. Version 2020-1.

Leal, K.P.G.; Batista, I.R.; Santiago, F.L.; Costa, C.G. & Câmara, E.M.V.C. (2008). Mamíferos Registrados em três Unidades de Conservação na Serra do Espinhaço: Parque Nacional da Serra do Cipó, Parque Nacional das Sempre Vivas e Parque Estadual da Serra do Rola-Moça. Sinapse Ambiental, p. 40–50.

Lessa, L.G.; Costa, B.M.A.; Rossoni, D.M.; Tavares, V.C.; Dias, L.G.; Júnior, E.A.M. & Silva, J.A. (2008). Mamíferos da Cadeia do Espinhaço: riqueza, ameaças e estratégias para conservação. *Megadiversidade*, 4 (1-2): 218-232.

Lessa, L.G. & De Paula, C.S. (2014). Community structure of small mammals in an area of riparian savanna in Parque Estadual do Rio Preto, Minas Gerais, Brazil. Neotropical Biology and Conservation, 9 (2): 98–104.

Loss, A.C.; Pacheco, M.A.C.; Leite, Y.L.R.; Caldara-Junior, V. & Lessa, L.G. (2015). Range extension and first record of *Euryzygomatomys spinosus* (Rodentia, Echimyidae) in the Brazilian Cerrado. Check List: the journal of biodiversity data, 11(5): 1–7.

Machado, L. F.; Loss, A. C.; Paz, A.; Vieira, E.M. ; Rodrigues, F.P.; Marinho-Filho, J. (2018). Phylogeny and biogeography of *Phyllomys* (Rodentia: Echimyidae) reveal a new species from the Cerrado and suggest Miocene connections of the Amazon and Atlantic Forest, *Journal of Mammalogy*, 99 (2): 377–396.

Mittermeier, R.A.; Fonseca, G.A.B.; Rylands,A.B. & Brandon, K. (2005). Uma breve história da conservação da biodiversidade no Brasil. Megadiversidade, 1 (1):14-21.

Oliveira, C.N.S.; Carvalho, R.F.; Pacheco, M.A.C.M.; Lessa, L.G. (2017). A new record of Calassomys apicalis (Rodentia, Cricetidae) in the Espinhaço Mountain Range, Brazil. Revista Brasileira de Zoociências, 18(3): 45-50.

Paglia, A.P.; Fonseca, G.A.B. da; Rylands, A. B.; Herrmann, G.; Aguiar, L. M. S.; Chiarello, A. G.; Leite, Y. L. R.; Costa, L. P.; Siciliano, S.; Kierulff, M. C. M.; Mendes, S. L.; Tavares, V. C.; Mittermeier, R. A. & Patton, J. L. (2012). *Lista Anotada dos Mamíferos do Brasil/Annotated Checklist of Brazilian Mammals*. 2ª Edição / 2nd Edition. Occasional papers in conservation biology, 6:76pp. Conservation International, Arlington, VA. 76pp.

Patton, J.L.; Pardiñas, U.F.J. & D'elía, G. (Eds.). (2015). Mammals of South America, volume 2: rodents. University of Chicago Press, Chicago and London.

Pereira, L.G. & Geise, L. (2009). Non-flying mammals of Chapada Diamantina (Bahia, Brazil). Biota Neotropica, 9 (3): 185–196.

Pugliese, A.; Pombal, J.P. & Sazima, I. (2004). A new species of *Scinax* (Anura: Hylidae) from rocky montane fields of the Serra do Cip, Southeastern Brazil. Zootaxa, 688(1):-1–15.

Rocha, W.J.S.F.; Juncá, F. A.; Chaves, J. M. & Funch, L. (2005). Considerações finais e recomendações para conservação. *In:* Jucá, F.A, Funch, L.; Rocha, W. (Eds) Biodiversidade e conservação da Chapada Diamantina. Ministério do Meio Ambiente, Brasília, 410–435.

Silva, J.M.C. & Bates, J.M. (2002). Biogeographic patterns and conservation in the South America Cerrado: A tropical savanna hotspot. BioScience, 52(3): 225-233.

Silveira, F.A.O.; Barbosa, M.; Beiroz, W.; Callisto, M.; Macedo, D.R.; Morellato, L.P.C.; Neves, F.S.; Nunes, Y.R.F.; Solar, R.R. & Fernandes, G.W. (2019). Tropical mountains as natural laboratories to study global changes: A longterm ecological research project in a megadiverse biodiversity hotspot. Perspectives in Plant Ecology, Evolution and Systematics, 38: 64-73.

Viana, P.L. & Mota, R.C. (2004). Redescoberta de *Panicum brachystachyum* Trin. (Poaceae) na Cadeia do Espinhaço, Minas Gerais, Brasil. Lundiana: International Journal of Biodiversity, 5(1): 29–31.