

CERRADO SMALL MAMMALS: a dataset of abundance and distribution of marsupials, lagomorphs, and rodents in a neotropical savanna

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Introduction

Patterns in regional distribution and local abundance of species within a biome are central concerns in ecology and biogeography (Brown 1984, Harte et al. 1999, Gaston and Blackburn 2000). However, for the evaluation of the relative importance of the several proposed mechanisms for explaining such patterns [summarized in Gaston et al. (1997) and Gaston and Blackburn (2000)], reliable information on the distribution and abundance of species is needed. This kind of information is crucial to conservation and management of ecosystems, being key element for the understanding of the effects of habitat loss and fragmentation on rates of species extinction; for the creation and management of reserves; and for the identification and quantification of the processes that allow the niche partition by species (Harte et al. 1999). Despite such importance, most systematized information on the abundance and distribution of the species of several taxonomic groups is mostly restricted to temperate (Blackburn et al. 2006, Cardoso et al. 2011) or forest biomes (Bovendorp et al. 2017, Muylaert et al. 2017, Lima et al. 2017). For tropical non-forested ecoregions, such as the savannas of South America, an important part of this type of information remains fragmented and difficult to access in the form of theses, technical reports or unpublished datasets (Cardoso et al. 2011, Figueiredo et al. 2017).

The lack of accessible knowledge about identity, abundance and distribution of tropical species compromises the description of existing biodiversity, the evaluation of their ecological function and services, or predictions about anthropic-related ecological changes (Hortal et al. 2015). Recently, the number of studies with large datasets on biodiversity hotspots has been increasing (e.g., Wilman et al. 2014, Bovendorp et al. 2017, Figueiredo et al. 2017, Muylaert et al. 2017, Lima et al. 2017). In the Neotropical region, however, the published information about abundance, richness and distribution of species in large datasets

published is almost restricted to forested biomes (e.g., Bovendorp et al. 2017, Casas et al. 2017, Figueiredo et al. 2017, Muylaert et al. 2017, Raub et al. 2017).

Two large savanna ecoregions occur in South America: the Venezuelan Llanos and the Cerrado. The Venezuelan Llanos occupy an area of 240,000 km² in northern South America or 25% of Venezuelan territory and contains approximately one-fifth of its total vascular plant diversity (Huber et al. 2006). The largest non-forested ecoregion of the Neotropical region is the Cerrado (Veblen et al. 2007). This ecoregion covers about two million km² or 21% of Brazilian territory (Klink and Machado 2005); about of 30,178 km² or 2.7% of Bolivian territory (Villarroel and Munhoz 2016), and 3,000 km² or 1.3% of Paraguayan territory (Keman et al. 2010). It is the most diverse savanna in the world, particularly in terms of the number of plant species, with about 10,000 species (Myers et al. 2000). It is possibly also the most threatened tropical savanna in the world, with 48% of its native vegetation cover already lost and only 19.8% remaining undisturbed (Strassburg et al. 2017). Besides plants, this savanna harbors a high diversity of several other groups of organisms, including at least 1355 species of tetrapods [209 anurans (Valdujo et al. 2012); 267 species of lizards and snakes (Nogueira et al. 2011); 837 species of birds (Silva 1999); and 251 species of mammals (Paglia et al. 2012)]. For the components of this group, the only large dataset published with information about abundance, richness and distribution of species is for snakes (Guedes et al. 2017). For other vertebrates, such as mammals, there are no large datasets of this kind available.

A major component of the mammalian fauna is comprised by non-volant small mammals. These animals form a diverse and ecologically important group of vertebrates in several terrestrial biomes (e.g. Tyndale-Biscoe 1979, Jaksic 1986, Kelt et al. 1996, Korpimäki and Krebs 1996, Williams et al. 2002) and it is not different in the Cerrado, where this group is composed of at least 26 marsupials, 1 lagomorph and 78 rodents (Paglia et al.

2012). In the present study, considering the current gap in systematized information for this biodiversity hotspot and the ecological importance of non-volant small mammals, we compiled a dataset of 96 studies (published articles, book chapters, theses, dissertations, monographs, symposium articles and original unpublished data) comprising 446 sites that cover the whole extension of the Cerrado, from northeastern Brazil to northeastern of Bolivia and eastern of Paraguay. This dataset includes 2,599 records of 24,283 individuals, representing 55 genera and at least 118 species of non-volant small mammals belonging to three orders: Didelphimorphia, Lagomorpha and Rodentia. Moreover, we compiled information about sampled localities, vegetation type and relative abundance (captures/trap nights) of each community/site sampled. The CERRADO SMALL MAMMALS represents the largest dataset of studies of non-volant small mammals for tropical ‘open’ ecoregions.

METADATA

CLASS I. DATA SET DESCRIPTORS

A. Data set identity:

Title: Cerrado small mammals: a dataset of abundance and distribution of marsupials, lagomorphs and rodents in a Neotropical savanna

B. Data set and metadata identification codes:

Suggested Data Set Identity Codes: CERRADO-SM_Capture.csv, CERRADO-SM_Reference.csv, CERRADO-SM_Study_site.csv

C. Data set description

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Abstract: Patterns in distribution and local abundance of species within a biome are central concerns in ecology and allow the understanding of the effects of habitat loss on rates of species extinction; provide support for the creation and management of reserves; and contribute to the identification and quantification of the processes that allow niche partitioning by species. However, despite the importance in the conservation and management of the ecosystems, most systematized information on the abundance and distribution of small mammals is restricted to the northern hemisphere or forest ecosystems. For tropical biomes, an important part of this information remains dispersed and difficult to access in the form of theses, technical reports or unpublished datasets. Here we present a comprehensive dataset of abundance and richness of small mammals in the Cerrado, the largest Neotropical savanna. This dataset includes 2,599 records of 446 sites from 96 studies. Despite more than 50% of references in this dataset are peer-reviewed journal articles, 45.78% of communities were compiled from theses. The dataset comprises 24,283 individuals of 55 genera and at least 118 species of small mammals including 29 marsupials, two lagomorphs (one exotic) and 87 rodents (three exotic). Local species richness ranged from one to 26 species (5.82 ± 3.55 , average species richness \pm SD). We observed hyper-dominance of a few species; the 10 most abundant species in this dataset represented 60.19% of all recorded individuals. The hairy-tailed bolo mouse (*Necromys lasiurus*) represented over than 20% of all individuals and occurred at more than 50% of sites. Furthermore, we identified 18 environments, 16 native vegetation types, and two anthropic environments. Typical savanna and gallery forest were the most frequently sampled vegetation types (comprising 46.94% of all sampled sites) and the most speciose ones (57 species for typical savanna and 53 species for gallery forest). The information contained on this dataset can be used to analyze ecological questions as relationship between local abundance and regional

distribution, relevance of local and regional factors on community structuring, and the role of phylogenetic mechanisms on community assembling. It can also be useful in conservation efforts in this biodiversity hotspot.

D. Key words: biodiversity hotspot, tropical savanna, biodiversity dataset, Rodentia, Didelphimorphia, Lagomorpha, species richness, abundance, communities, non-forested ecoregion.

E. Description: This dataset includes 2,599 records of 446 sites of small mammals present in 96 studies spread across the Cerrado, from northeastern Brazil to northeastern of Bolivia and eastern of Paraguay (Fig. 1). Based on distribution of communities of small mammals compiled in this dataset, we identified a highly concentrated spatial distribution of studies, which were conducted mainly in the central portion of the Cerrado (District Federal and surrounding areas) (Fig. 1). Moreover, we identified gaps of knowledge on species richness and abundance of small mammals in this ecoregion, mainly on its northeastern and northwestern portions (Fig. 1). Based on the polygons used to define the limits of the Cerrado ecoregion (Olson et al. 2001, IBGE 2004), some community sites compiled are located outside of it (Fig. 1). Although we decided to maintain them in the dataset because they are located in vegetation types of Cerrado ecoregion in ecotones areas with adjacent ecoregions.

The references compiled in our dataset are dominated by peer-reviewed journal articles (57.29%), followed by theses (29.17%), symposium articles (6.25%), unpublished data (5.21%), and book chapters (2.08%). Considering the year of publication, the oldest study was from 1980 and we observed four distinct periods in terms of publications: 1) the period from 1980 to 1987, composed mainly by articles (11 articles, 13.19% of all published studies) and one thesis; 2) from 1988 to 1994, when there was a decrease of studies with a

hiatus of articles (only one published in 1991), four theses and a book chapter published; 3) from 1995 to 2009, when there was a resumption of studies in the Cerrado, with about 37% of all studies having been published in this period (19 articles, ten theses, four symposium articles and a book chapter); and 4) from 2010 to 2017 we observed a marked increase in studies, when about 43% of all studies were published, possibly due to the consolidation of research groups and postgraduate programs in the region (Fig. 2). Furthermore, we observed, from 1989 to 2017, an increase of unpublished theses and symposium (Fig. 3). This relevant portion of information about abundance and richness of small mammals in the Cerrado is restricted to this gray literature, which is not easily recovered. This pattern is more explicit when we plotted the number of sites sampled by year in which the data began to be collected. Theses included in this dataset represent about of 45.8% of all sites sampled that contain information about starting year of the study and articles represent about 43.4% (Fig. 3).

We registered in the current dataset 24,283 individuals, representing 55 genera and at least 118 species (excluding uncertain taxonomic records) of non-volant small mammals belonging to three orders: Didelphimorphia with 14 genera and 29 species, Rodentia with 42 genera and 87 species, and Lagomorpha with 2 genera and 2 species. Comparing our dataset with checklist of mammals of Cerrado (Paglia et al. 2012), we registered 32 new species for the Cerrado, most part of them are described occurring in adjacent biomes (Amazon and Atlantic forest) and in Cerrado areas in Bolivia and Paraguay. Furthermore, we do not registered 19 species previous listed in checklist of mammals of the Cerrado (Paglia et al. 2012). Most of them are rodents of families Caviidae, Ctenomyidae and Sciuridae (Paglia et al. 2012).

The species richness of sites in dataset ranged from one to 26 species, with 5.83% of sites being composed of one species, 86.10% of sites ranging in richness from two to ten species, and 8.07% being composed by more than ten species (Fig. 4). Regarding total

species abundance, the ten most abundant species on dataset represent 60.2% of all recorded individuals. Eight of them are sigmodontine rodents [*Necromys lasiurus* (n = 4,939 individuals), *Calomys tener* (n = 1,499), *Oligoryzomys nigripes* (n = 1,316), *Calomys expulsus* (n = 1,207), *Hylaeamys megacephalus* (n = 709), *Cerradomys scotti* (n = 701), *Cerradomys subflavus* (n = 675), *Oxymycterus delator* (n = 661)] and two are didelphids [*Gracilinanus agilis* (n = 2,126), *Didelphis albiventris* (n = 783)]. Moreover, the observed pattern for species occurrence was similar to abundance, with eight rodents [*Necromys lasiurus* (n = 224 sites), *Calomys tener* (n = 134), *Cerradomys scotti* (n = 129), *Calomys expulsus* (n = 118), *Hylaeamys megacephalus* (n = 107), *Oligoryzomys nigripes* (n = 105), *Oligoryzomys fornesi* (n = 70), *Rhipidomys macrurus* (n = 69)], and two didelphids [*Gracilinanus agilis* (n = 158), *Didelphis albiventris* (n = 134)] among the ten most widespread species (Fig. 5). Thus, only one species (*Necromys lasiurus*) occurred in more than 50% of the localities (Fig. 6).

Based on IUCN Red List Categories and Criteria (2012), most of species are classified as Least Concern (62.8%) but we recorded three species classified as Endangered (*Euryoryzomys lamia*, *Microakodontomys transitorius*, *Trinomys moojeni*), one as Near Threatened (*Thylamys macrurus*), one as Vulnerable (*Thylamys karimii*) and one as Extinct in the Wild (*Juscelinomys candango*) (Table 1). Compared to the dataset of small mammals of Atlantic Forest (Bovendorp et al. 2017), we registered a higher number of invasive species (*Lepus capensis*, *Mus musculus*, *Rattus norvergicus* and *Rattus rattus*) but with a lower relative abundance (0.41% of all individuals registered) and a more restrict occurrence (3.81% of the localities).

We identified 18 distinct environments, 16 native vegetation types (wet grassland ‘campo úmido’, open grassland ‘campo limpo’, montaintop grassland ‘campo de altitude’, rocky grassland ‘campo rupestre’, mound field ‘campo de murundú’, shrubby grassland

‘campo sujo’, palm wet grassland ‘vereda’, open savanna ‘campo cerrado’, rocky savanna ‘cerrado rupestre’, typical savanna ‘cerrado *sensu stricto*’, dense woodland ‘carrasco’, savanna woodland forest ‘cerradão’, deciduous seasonal forest ‘floresta estacional decídua’, semideciduous seasonal forest ‘floresta estacional semidecidual’, gallery forest ‘mata de galeria’, and riverine forest ‘mata ciliar’ [ciliary forest]) and two anthropic environments (crop/pasture and human disturbed environment) for 87.89% of sites in our database (Fig. 7). Starting in 1995, we observed an increase in number of studies in all vegetation types with a bulk of studies in typical savanna (six studies) in the 2013-2014 period (Fig. 8). The five vegetation types that were sampled more frequently represented about 71% of all sampled sites (forest formations: gallery forest, 21.68%; semideciduous seasonal forest, 9.69%; savanna woodland forest – ‘cerradão’, 8.16%; and non-forest formations: typical savanna – ‘cerrado *sensu stricto*’, 25.26%; wet grassland – ‘campo úmido’, 5.87%; Fig. 9). Based on the relative cover of different environments in the Cerrado (Projeto MapBiomas 2018), we observed that crop and pasture areas currently represent more than 45% of total area of this ecoregion but only five percent of studies compiled in our dataset were conducted in these habitat types (Fig. 10). Regarding species richness, the habitat with the highest species richness is typical savanna, with 57 species, followed by gallery forest (N=53), semideciduous seasonal forest (S=45), and savanna woodland forest (N=41) (Fig. 11). This pattern could be consequence of widespread distribution of typical savanna areas in the Cerrado. The relative importance of the families according to species richness varies among habitats. Didelphidae is more representative in forested formations while most part of species in grassland and savanna habitats are sigmodontine rodents (Fig. 11).

The information contained on this dataset can be used to analyze ecological questions as relationship between local abundance and regional distribution, relevance of local and regional factors on community structuring, and the role of phylogenetic mechanisms on

community assembling. It can also be useful in conservation efforts in this biodiversity hotspot.

CLASS II. RESEARCH ORIGIN DESCRIPTORS

A. Overall project description

Identity: A compilation of small mammals captured in the Cerrado of Brazil, Bolivia and Paraguay.

Period of Study: Dates of source publications range from 1980–2017.

Objectives: Our objectives were: (1) to summarize information about small mammal studies in the Cerrado ecoregion, focusing on species richness and abundance; (2) to identify differences of sampling effort between vegetation type in the Cerrado; (3) to identify geographic gaps on the knowledge of small mammal communities of the Cerrado to guide future sampling efforts.

Abstract: Same as above.

Sources of funding: The compilation of this data set was supported by grants and scholarships from Coordination of Improvement of Higher Level Personnel (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – CAPES) for the postdoctorate scholarship (AFM, NFC), the Brazilian National Council for Scientific and Technological Development (Conselho Nacional de Desenvolvimento Científico e Tecnológico – CNPq) for the Research Productivity Grant (EMV, No. 308153/2007-3; ARP, No. 307519/2015-5), and São Paulo

Research Foundation (Fundação de Apoio à Pesquisa do Estado de São Paulo – FAPESP; 09/16009-1 ARP).

B. Specific subproject description

Ecoregion description: The Cerrado is the second largest Neotropical ecoregion (Veblen et al. 2007), covering about 2.0 million km² (Klink and Machado 2005), and the most diverse savanna in the world, particularly in terms of the number of plant species (Myers et al. 2000). The climate is tropical and markedly seasonal ('AW' [Köppen 1948]) continental climate) with a warm-wet season between October and April (Eiten 1972), in which 90% of the annual precipitation of 1100-1600 mm occurs (Miranda et al. 1993). This high biological diversity is related to the high habitat heterogeneity, as the Cerrado is composed of a mosaic of vegetation formation ranging from open grassland, to typical savanna crossed by forest formations (Eiten 1972). Furthermore, the Cerrado supports at least 10,000 plant species (Myers et al. 2000); 780 fishes (MMA 2002); 209 anurans (Valdujo et al. 2012); 267 squamate species (Nogueira et al. 2011); 837 birds (Silva 1999); and 251 native mammals including 26 didelphids, one lagomorph and 98 rodents (Paglia et al. 2012).

Historically, the Cerrado has been identified as a biome in most scientific literature and by the Brazilian government (Ministry of Environment – MMA and Instituto Brasileiro de Geografia e Estatística – IBGE). There are, however, some authors that do not consider the Brazilian Cerrado to be a biome but a complex of three biomes: tropical grassland (open grasslands), savanna (with different degrees of arboreal cover) and forest (savanna woodland forest ['cerradão']). More recently, the concept of ecoregion began to be used to describe 'a relatively large unit of land containing a distinct assemblage of natural communities and species, with boundaries that approximate the original extent of natural communities' (Olson

et al. 2001). Thus, we adopted this concept to identify the Cerrado and this ecoregion encompasses Central Brazil, northeastern Paraguay and eastern Bolivia (Olson et al. 2001).

Despite the Cerrado importance for global biodiversity, it is one of the most threatened tropical savannas in the world, with 48% of its native vegetation cover already lost and only 19.8% remaining undisturbed (Strassburg et al. 2017). Thus, based on high level of plant endemism (44% of flora is endemic, Klink and Machado 2005), habitat loss, and fragmentation (Klink and Machado 2005), the Cerrado is classified as one of the global biodiversity hotspots (Myers et al. 2000). In the last decade, deforestation rates in the Cerrado were 2.5 times higher than in the Amazon and only 7.5% of the ecoregion is composed of legally protected areas (Strassburg et al. 2017). The major threats to Cerrado biodiversity are soil and ecosystem degradation and biological invasions (Klink and Machado 2005).

Data compilation: Data was obtained from published literature including 96 papers, theses, scientific conferences and unpublished data. We searched for potential studies in the following sources: (i) online academic databases (e.g., ISI Web of Knowledge, Google Scholar, Scielo, Scopus, JStore) (ii) digital libraries of State and Federal Brazilian universities, (iii) references cited in literature, and (iv) email contacts with local experts. The searches were performed with the following key words: small mammal(s), rodents, marsupials, survey(s), inventory(ies), community(ies), assemblage(s) and Cerrado; searches were conducted in English, Portuguese and Spanish.

Research Methods: We included in this database, studies that reported small-mammal species, abundance, sampling design, trapping methods, strata sampled, effort and vegetation type sampled. Lack of information was filled with NA. We included geographical information for each community when provided (latitude, longitude, locality, municipality,

state and country). Furthermore, we recorded the publishing information of each study (author, title, year, journal, volume, number of issue, pages, place of publication).

Small mammal information (occurrence and abundance) were compiled from published sources (Mello 1980, 1982, Alho 1981, Valle et al. 1982, Borchert and Hansen 1983, Dietz 1983, Paula 1983, Fonseca and Redford 1984, Linardi et al. 1984, Alho and Pereira 1985, Ernest and Mares 1986, Nitikman and Mares 1987, Engel 1989, Lacher et al. 1989, Vieira 1989, Henriques and Alho 1991, Oliveira 1993, Reis 1993, Gettinger and Ernest 1995, Bonvicino et al. 1996, 1997, 2002, 2005, 2012, 2014, Anciães et al. 1997, Gastal 1997, Reis and Marinho-Filho 1998, Vieira and Marinho-Filho 1998, Talamoni and Dias 1999, Vieira 1999, Carvalho 2000, Henriques et al. 2000, Talamoni et al. 2000, Briani 2001, Lyra-Jorge et al. 2001, Palma 2002, Rodrigues et al. 2002, Bonvicino and Bezerra 2003, Carmignotto 2004, Amaral 2005, Ribeiro and Marinho-Filho 2005, Santos Filho 2005, Vieira et al. 2005, Bernardes 2006, Baumgarten 2007, Becker et al. 2007, Cáceres et al. 2007, 2010, 2011, Lustosa et al. 2007, Moreira et al. 2008, Oliveira 2008, Saranholi et al. 2008, Bezerra et al. 2009, Emmons 2009, Bruna et al. 2010, de Figueiredo et al. 2010, Godoi et al. 2010, Hannibal and Cáceres 2010, Martin 2010, Mendonça 2010, Santos and Henriques 2010, Silva 2010, Carmignotto and Aires 2011, Quaresma et al. 2011, Rocha et al. 2011, 2014, Rodrigues et al. 2011, Câmara and Oliveira 2012, Santos-Filho et al. 2012, Saraiva et al. 2012, Smith et al. 2012, Travassos da Rosa et al. 2012, Gheler-Costa et al. 2013, Owen 2013, Passamani and Cerboncini 2013, Silva 2013, Cardoso 2014, Carmignotto et al. 2014, Moreira and Teixeira 2014, Silva 2014, Vieira 2014, Camargo 2015, Cazetta 2015, Favacho et al. 2015, Hannibal et al. 2015, Ribeiro 2015, Camargo 2016, Carvalho 2016, Santos 2017) and our own unpublished data.

Taxonomic data: We followed the taxonomic arrangements and identified species of didelphids according to Voss and Jansa (2009) and Gardner (2007), lagomorphs according to Ruedas and Salazar-Bravo (2007) and rodents according to Patton et al. (2015) and Pardiñas et al. (2016). We added one column with the current scientific name based on the literature aforementioned where the application of the current valid name was possible (e.g., unambiguous changes on genus and species names; species originally identified as sp. or spp. were sometimes identifiable by the information on the geographic distribution or karyotype).

However, for some specimens we could not update the species name because on the source of information these specimens were identified only at genus level, and this genus was revised and divided in several new genera potentially occurring in the same geographic region (e.g., *Oryzomys*, Weksler et al. 2006). In these cases, we filled the cell in column ‘Actual_species_name’ with NA. Also, eight species are presented on the dataset as undescribed species (sp. nov.). Five of them, an echimyid rodent of the *Thrichomys* genus and four cricetid rodent of the genera *Akodon*, *Calomys* and *Oligoryzomys*, were originally presented by Carmignotto (2004) as respectively *Thrichomys* sp2, *Akodon* sp1, *Akodon* sp2, *Calomys* sp2 and *Oligoryzomys* sp1. Bonvicino et al. (2005) originally presented two sigmodontine rodents of genus *Oligoryzomys* as *Oligoryzomys* sp1 and *Oligoryzomys* sp2.

C. Data Limitations and Potential Enhancements

Summarize information of all species of a diverse group as small mammals present in an extensive and megadiverse ecoregion in a single document is particularly challenging for several reasons, most of which related to high diversity of this group, species biology and sampling. In terms of limitations, neotropical non-volant small mammals is a highly diverse group composed by species with unique life history traits and, consequently, occupying quite

different niches. Furthermore, these species are prone to exhibit high spatio-temporal variability (including seasonal variation) in population dynamics.

Moreover, due to the highly diversity of life history traits of neotropical small mammals, studies and inventories of this group are inherently biased (Santos-Filho et al. 2006), since the proportion of small mammal communities sampled is influenced by several factors, including trap type, trap configuration and spacing, and capture effort. Thus, the information in the database is derived from several sources and their intrinsic heterogeneity must be considered in comparative analysis.

Our dataset reflects the current limitation on available information regarding distribution of small mammals throughout the Cerrado. This ecoregion has been unevenly sampled, with a concentration of the studies in central-southeastern portion of this ecoregion, mainly in the Brazilian Federal District and its surroundings (Fig. 1). Furthermore, extensive areas of this ecoregion remain understudied, such as northwestern and northeastern parts of the Cerrado, with few studies in the states of Bahia, Piauí, Mato Grosso, Pará, Maranhão, and in Bolivia and Paraguay (Fig. 1).

Despite these limitations, we recognize the effort of researchers who carried out these studies. Furthermore, this is the largest dataset of studies of small mammals for a tropical non-forested ecoregion. We expect that, based on this database, the community of scientists can analyze ecological questions as relationship between local abundance and regional distribution, relevance of local and regional factors on community structuring, and the role of phylogenetic mechanisms on community assembling. It can also be useful in conservation efforts in this biodiversity hotspot.

CLASS III. DATA SET STATUS AND ACCESSIBILITY

A. Status

Latest update: December 2017

Latest Archive date: December 2017

Metadata status: Last update December 2017, version submitted

Data verification: André F. Mendonça searched and read studies for inclusion on this dataset, assessing in detail those articles that fulfilled the criteria for inclusion. André F. Mendonça and Nicholas F de Camargo analyzed dataset and elaborated the figures. Alexandre R. Percequillo reviewed taxonomic status of specimens in dataset. Emerson M. Vieira coordinated the data inclusion on this dataset. The other authors compiled unpublished data collected by their research projects and other research activities for inclusion in the dataset. Data is mostly from published sources. We searched for extreme values, corrected any transcription errors and homogenized the taxonomic information.

B. Accessibility

Contact person: André F. Mendonça or Emerson M. Vieira, Laboratório de Ecologia de Vertebrados, Departamento de Ecologia, Instituto de Ciências Biológicas, Universidade de Brasília, Campus Darcy Ribeiro, CP 04457, Brasília DF, CEP 70919-970, Brazil

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Copyright restrictions: None.

Proprietary restrictions: Please cite this data paper when the data are used in publications. We also request that researchers and teachers inform us of how they are using the data.

Costs: None.

CLASS IV. DATA STRUCTURAL DESCRIPTORS

A. Data Set File

Identity: CERRADO_SM_Study_Site.csv

CERRADO_SM_Reference.csv

CERRADO_SM_Capture.csv

Size: 2599 records, CERRADO_SM_Study_Site.csv (68 KB);

CERRADO_SM_Reference.csv (20 KB); and CERRADO_SM_Capture.csv (487 KB).

Format and storage mode: comma-separated values (.csv)

Header information: See column descriptions in section B.

Alphanumeric attributes: Mixed.

Data Anomalies: If no information is available for a given record, this is indicated as 'NA'.

B. Variable information

1) **Table 2.** Site Information

2) **Table 3.** Reference Information

3) **Table 4.** Capture Information

CLASS V. SUPPLEMENTAL DESCRIPTORS

A. Data acquisition

1. Data request history: None

2. Data set updates history: None

3. Data entry/verification procedures

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Tables

Table 1. Conservation status of small mammal species reported in the Cerrado dataset based on IUCN criteria.

IUCN conservation status	Small mammals
Critically endangered (CR)	0
Endangered (EN)	3
Vulnerable (VU)	1
Near Threatened (NT)	2
Least Concern (LC)	81
Data Deficient (DD)	14
Not evaluated (NE)	28

Table 2. Site information. Description of the fields related with the study sites information.

Type of information	Field	Description	Levels	Example
SITE INFORMATION	id	Link between the study site to the complete information table	cer01- cer446	cer01
	Reference_number	The reference number which report small mammal communities	1-96	1
	Country	Country of the study	Brazil Bolivia Paraguay	Brazil
	State	State of the study		BA
	Municipality	Municipality of the study		Jaborandi
	Study_location	Specific location of the study		Fazenda Jatobá, Jaborandi, BA
	Latitude	Decimal		-15.9930556

		coordinates		
Longitude	Decimal coordinates			-45.9641667
Precision	Precision of the given coordinate	Precise Not-Precise	Precise	
Vegetation type original name	Original name of vegetation in Portuguese		cerrado <i>sensu stricto</i>	
Vegetation type	Cerrado vegetation type		typical savanna	
Protect_area	If the study is inside to the protected areas	Yes No	No	

Table 3. Reference information. Description of the fields related with reference information of each study.

Type of information	Field	Description	Levels	Example
REFERENCE INFORMATION	Reference_number	The reference number which report small mammal communities	1-96	20
	Reference	Extended information of the reference		Vieira EM (1999) Small mammal communities and fire in the Brazilian Cerrado. Journal of Zoology 249: 75-81
	Publication_year	Year of publication		1999
	Type of publication	Type of publication	Article Book Thesis Symposium article Unpublished	Article

Table 4. Capture information. Description of the fields related with the complete capture information.

Type of information	Field	Description	Levels	Example
CAPTURE INFORMATION	id	Field that links the study site to the complete information table	cer01-cer446	cer01
	Reference_number	The reference number which reports small mammal communities	1-96	1
	Month_start	Month when the survey started	January-December	March
	Year_start	Year when		1999

	the survey started		
Month_finish	Month when the survey finished	January- December	July
Year_finish	Year when the survey finished		2000
Total_of_months	Number of months used to sample small mammal		16
Sampling_design	Design used to capture small mammal	Random Grid Line transect	Grid
Effort	Total traps-type per night used to capture		2692

	small mammal		
Method	Trap type used to capture small mammal	Live traps Pitfall traps Direct observation	Live traps
Strata_sampling	Trap height for sampling small mammal	Ground Understory Canopy	Ground
Strata_sampling	Order taxonomic classificati on	Didelphimorp hia Rodentia Lagomorpha	Rodenti a
Genus	Genus taxonomic classificati on		<i>Necrom</i> <i>ys</i>
Species_name_on_p	Species taxonomic		<i>Bolomys</i> <i>lasiurus</i>

	aper	classification on reported on paper	
	Actual_species_name	Species taxonomic classification on reviewed by specialist	<i>Necromys</i> <i>lasiurus</i>
	Species_origin	If the species is native or introduced in Brazil	Native
	Species_origin Individuals_captured	Total of individuals captured for every trap type	1
	Abundance_(ind/trap-nights)	Number of individuals captured by trap- night	0.00048

	Paper related voucher specimens in collection or museum	Yes No	No
Voucher_Specimens			

Figures:

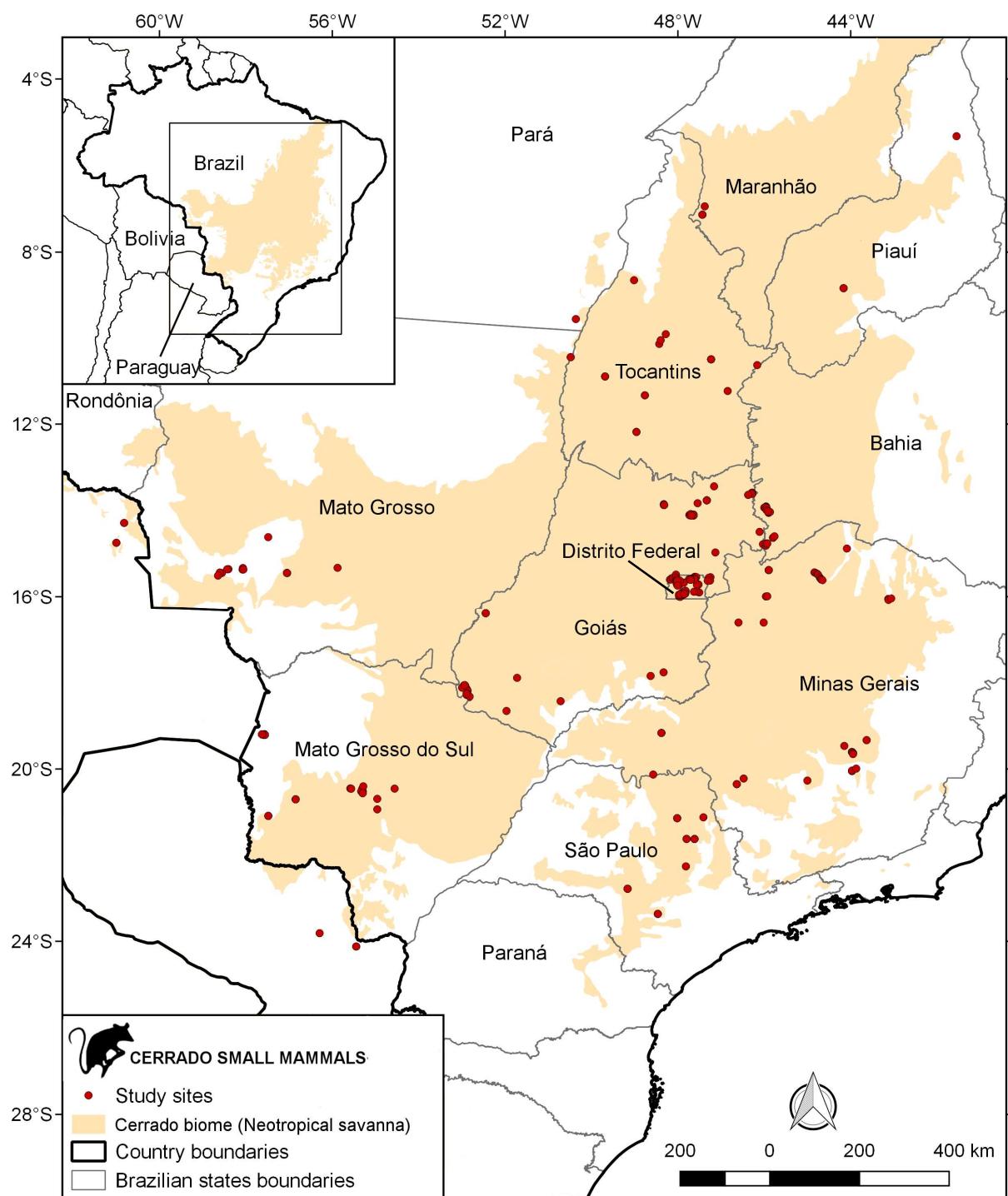


Fig. 1. Distribution of the small-mammal community records (total number of sampled sites = 446) within the Cerrado (neotropical savanna) ecoregion.

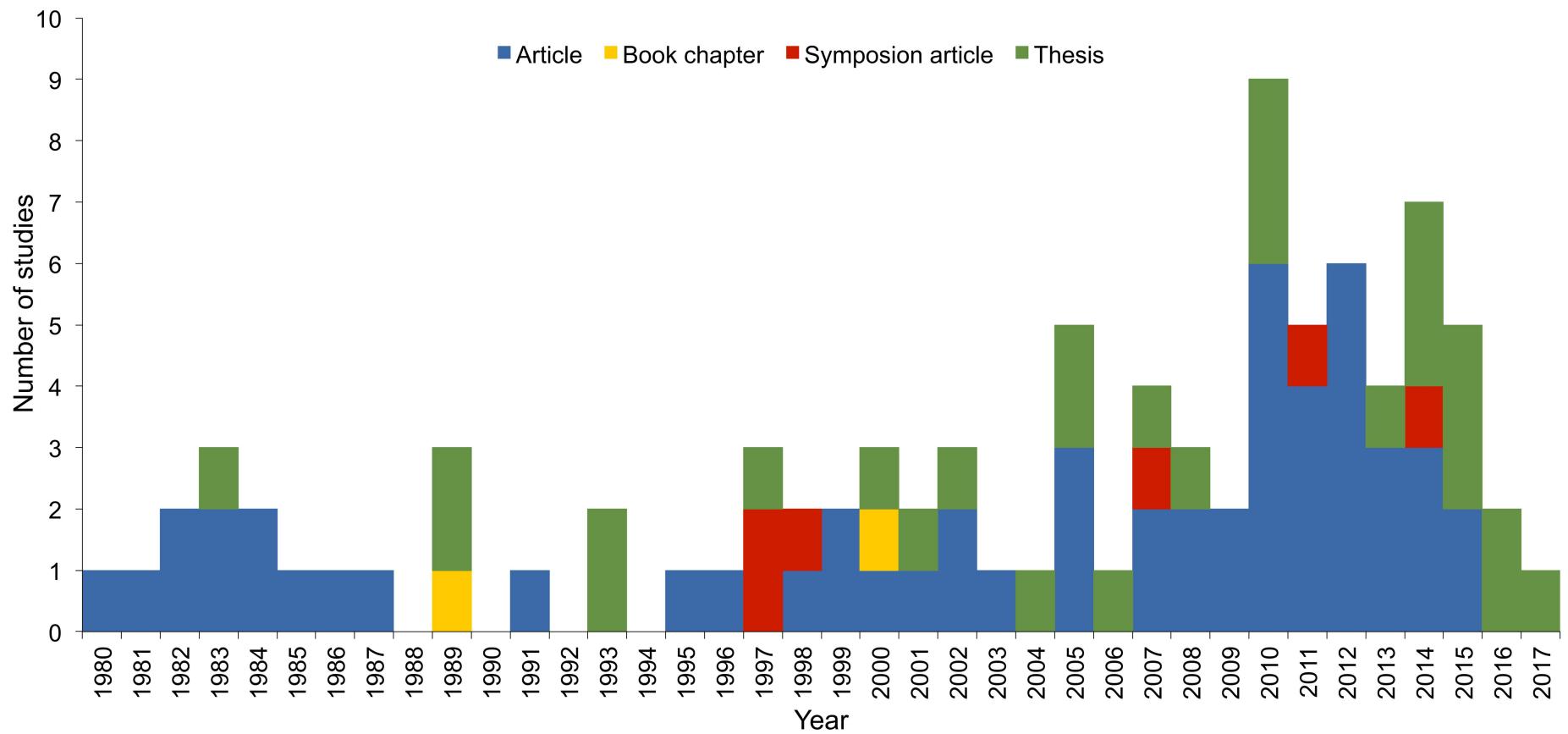


Fig. 2. Number of studies per year in the Cerrado ecoregion. The year represents when each study was published (total number of studies = 91).

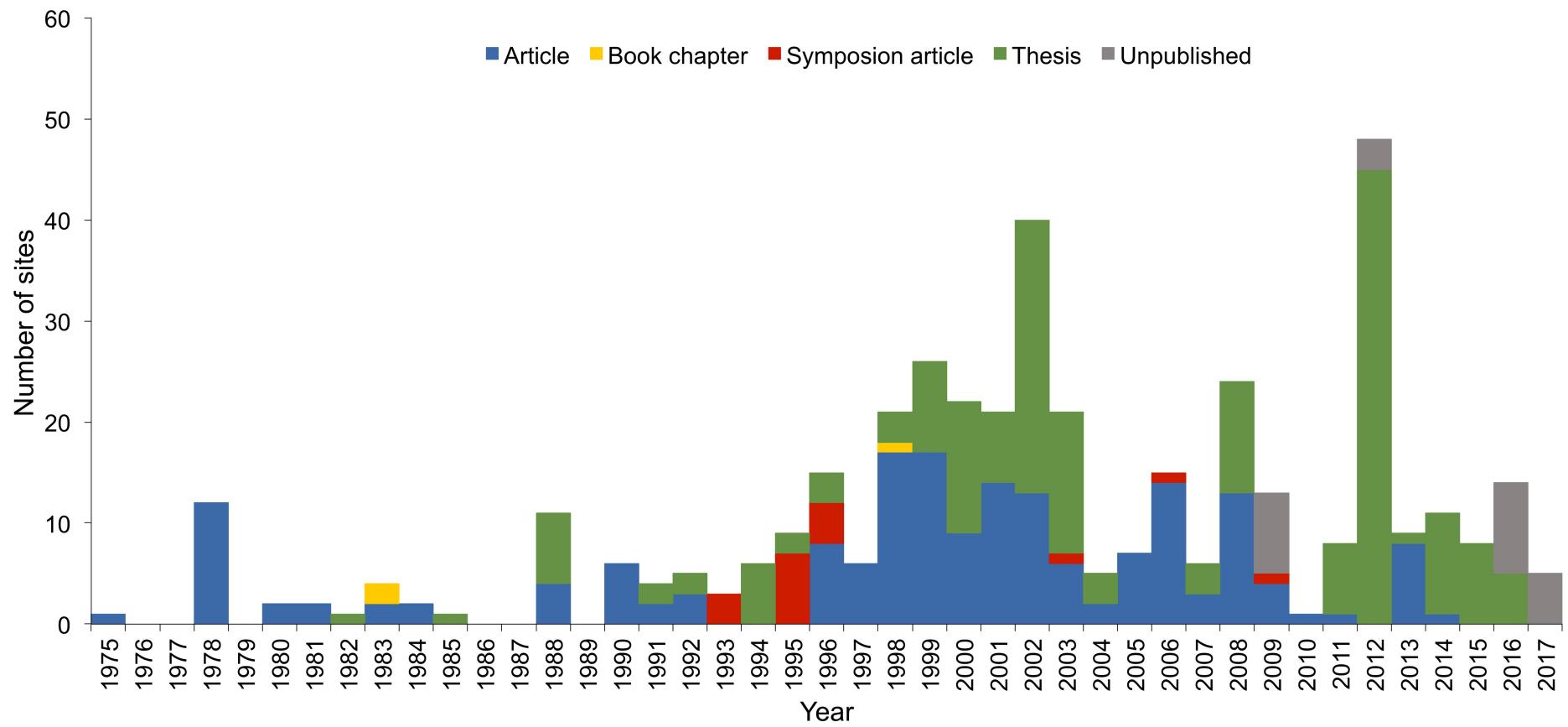


Fig. 3. Number of sites whose small-mammal communities were sampled per year ($n = 412$ sites whose sampling start date was clearly indicated in the original study) in the Cerrado ecoregion. The year represent when the data collection started in each site.

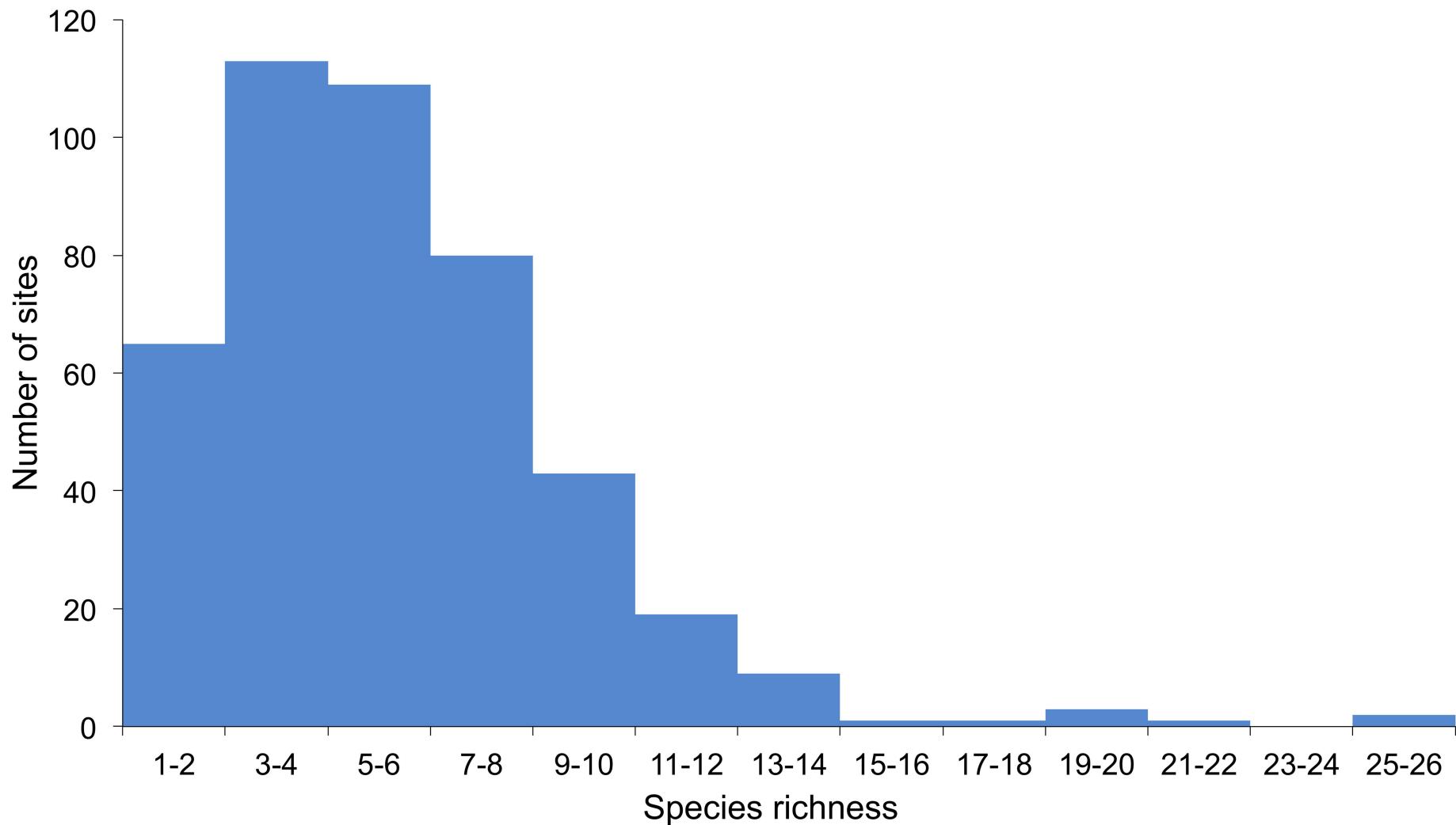


Fig. 4. Number of sites sampled for small mammals ($n = 446$ sites) per species richness on each site in the Cerrado ecoregion.

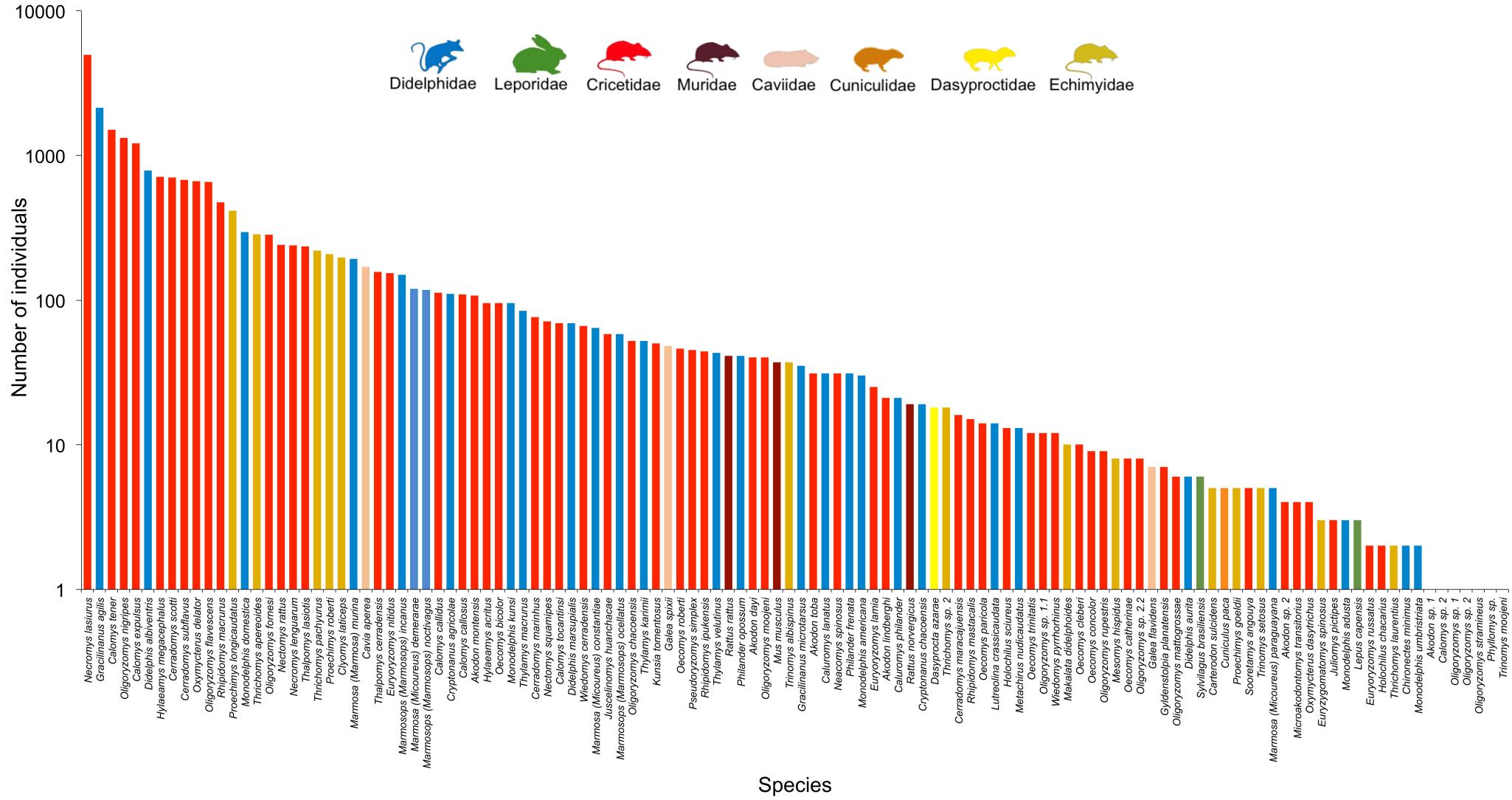


Fig. 5. Abundance of small mammals for each species sampled in the Cerrado ecoregion.



Fig. 6. Treemap of number of sites where each species occurred in the Cerrado ecoregion. 1 = *Akodon lindberghi*, 2 = *Carterodon sulcidens*, 3 = *Metachirus nudicaudatus*, 4 = *Necromys lenguarum*, 5 = *Philander frenata*, 6 = *Trinomys albispinus*, 7 = *Cuniculus paca*, 8 = *Galea flavidens*, 9 = *Makalata didelphoides*, 10 = *Marmosa (Micoureus) paraguayana*, 11 = *Oecomys catherinae*, 12 = *Oecomys concolor*, 13 = *Oligoryzomys flavescens*, 14 = *Rhipidomys mastacalis*, 15 = *Thrichomys* sp. 2, 16 = *Akodon dayi*, 17 = *Chironectes minimus*, 18 = *Euryzygomatomys spinosus*, 19 = *Holochilus chacarius*, 20 = *Hylaeamys acritus*, 21 = *Juliomys pictipes*, 22 = *Juscelinomys huanchacae*, 23 = *Lepus capensis*, 24 = *Mesomys hispidus*, 25 = *Oecomys trinitatis*, 26 = *Oligoryzomys mattogrossae*, 27 = *Oxymycterus dasytrichus*, 28 = *Microakodontomys transitorius*, 29 = *Monodelphis adusta*, 30 = *Monodelphis umbistriata*, 31 = *Rattus norvergicus*, 32 = *Rhipidomys ipukensis*, 33 = *Sooretamys angouya*, 34 = *Thrichomys laurentius*, 35 = *Akodon* sp1, 36 = *Akodon* sp2, 37 = *Calomys* sp2, 38 = *Oligoryzomys rupestris*, 39 = *Oligoryzomys* sp1, 40 = *Oligoryzomys* sp1.1, 41 = *Didelphis aurita*, 42 = *Euryoryzomys russatus*, 43 = *Gyldenstolpia planatensis*, 44 = *Oligoryzomys* sp2, 45 = *Phyllomys* sp., 46 = *Proechimys goeldii*, 47 = *Oligoryzomys* sp2.2, 48 = *Oligoryzomys stramineus*, 49 = *Trinomys moojeni*, 50 = *Trinomys setosus*.

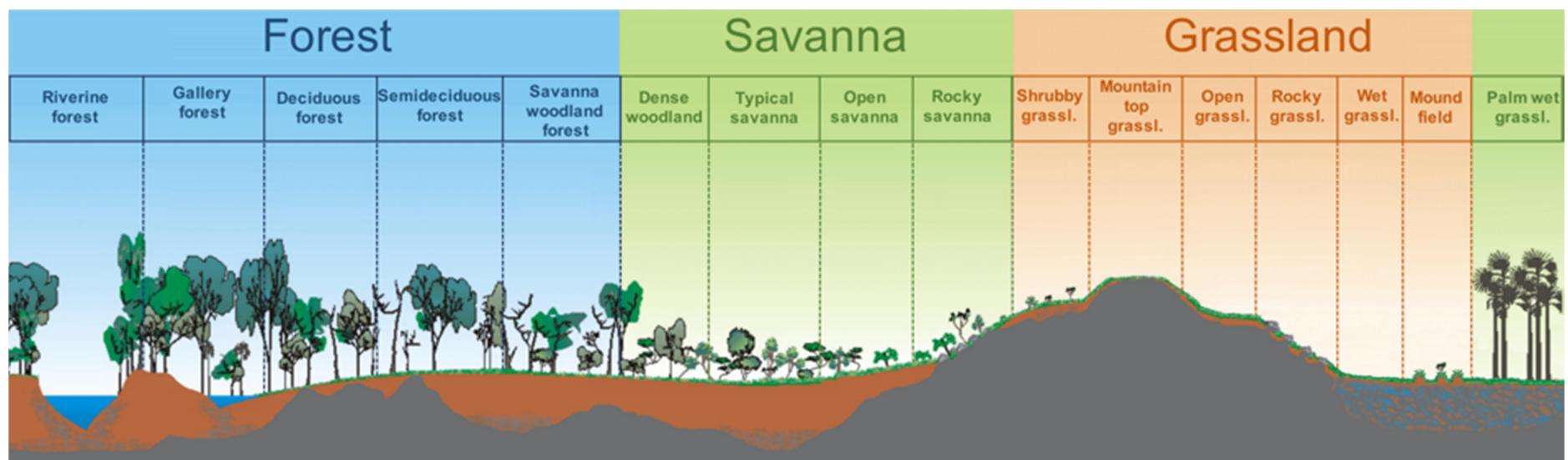


Fig. 7. Schematic vegetation profile of native vegetation types compiled in the dataset (modified of Ribeiro and Walter 2008).

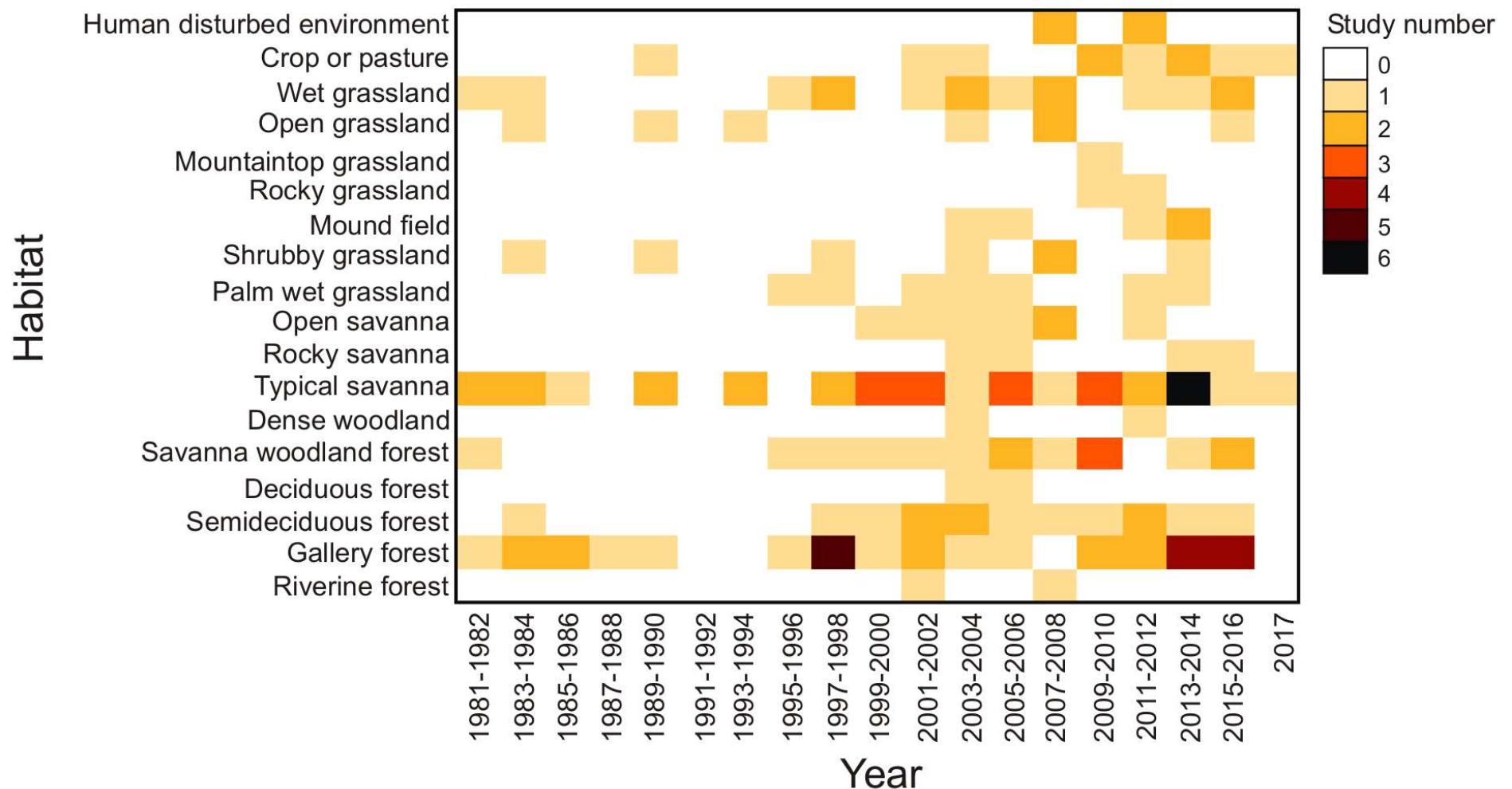


Fig. 8. Heatmap of number of studies conducted in different habitat types and year in the Cerrado ecoregion. The intensity of the color shade indicates the number of studies.

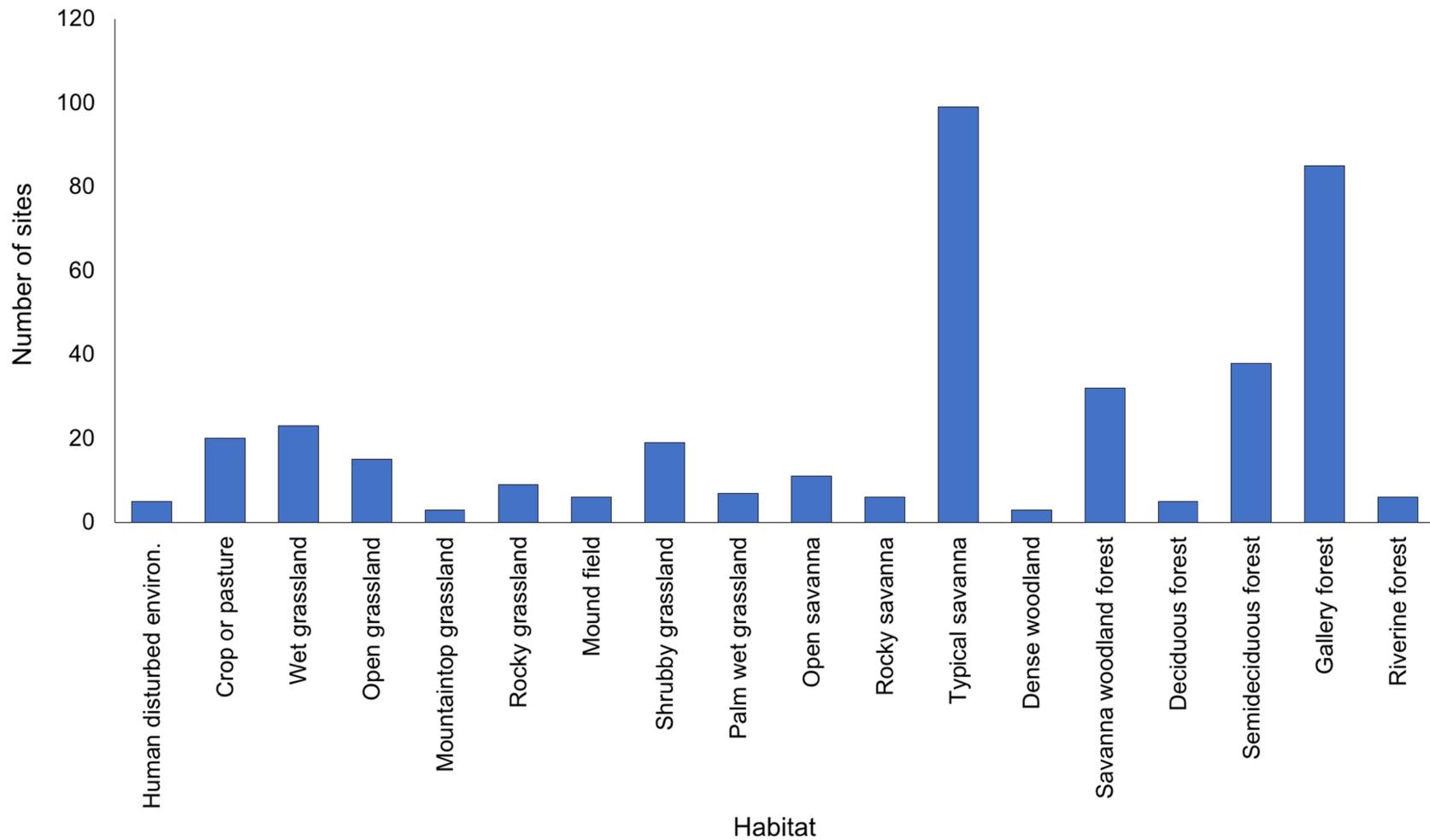


Fig. 9. Number of sites sampled for small mammals ($n = 392$ sites whose habitat type was clearly indicated in the original study) by studies conducted in different habitat types in the Cerrado ecoregion.

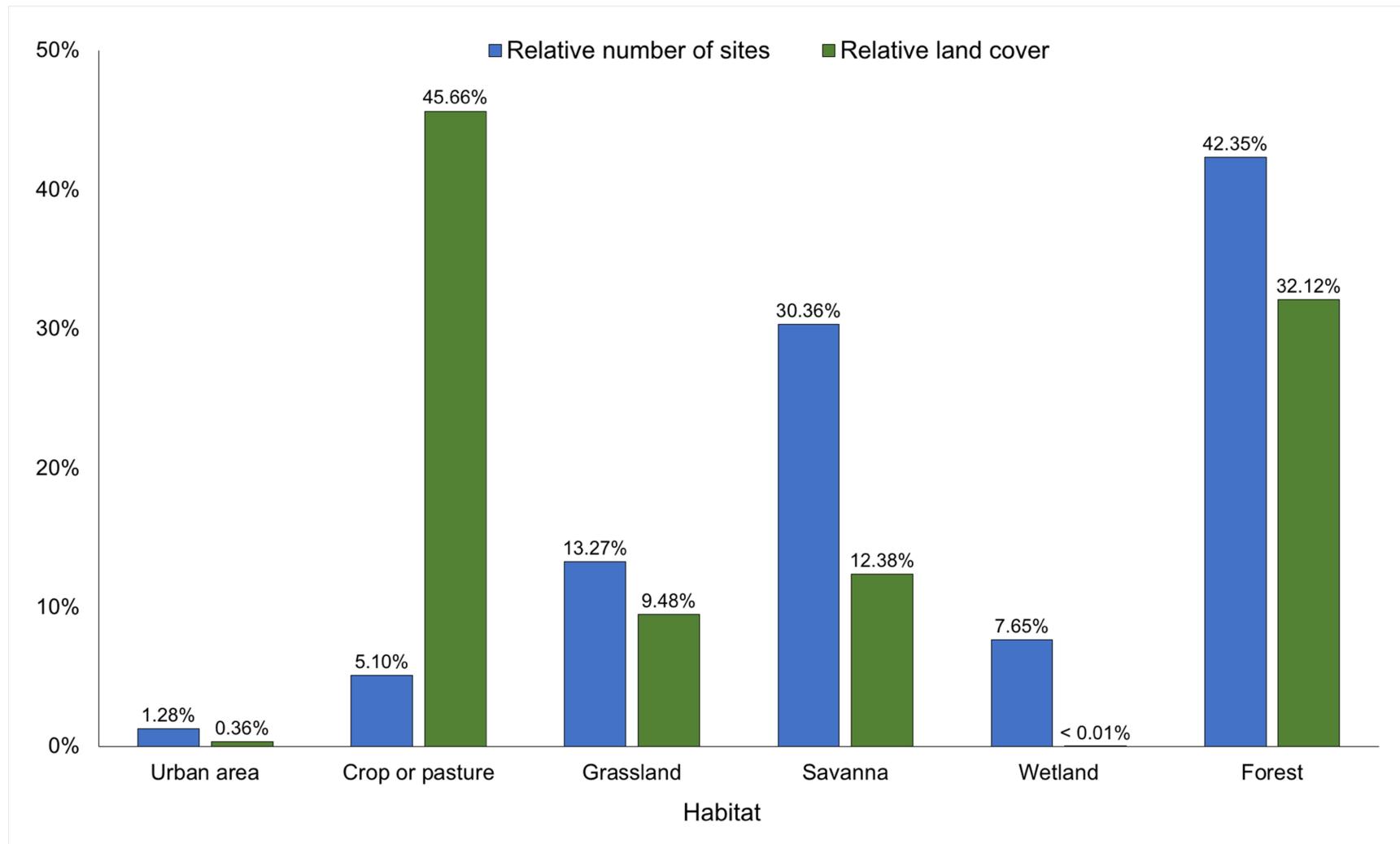


Fig. 10. Relative number of sites sampled for small mammals (n = 392 sites whose habitat type was clearly indicated in the original study) and relative land cover of different habitat types (Projeto MapBiomas 2018) in the Cerrado ecoregion.

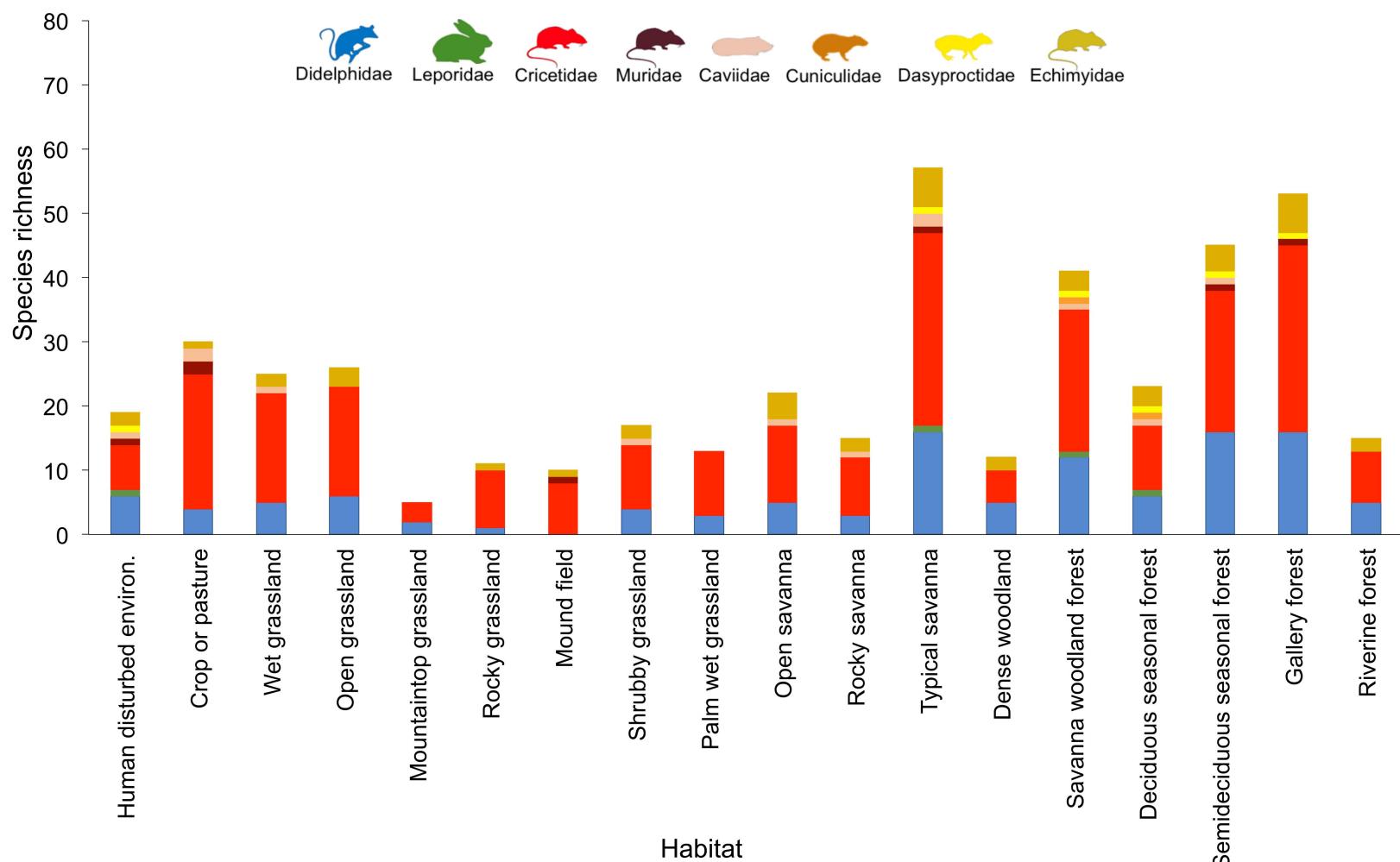


Fig. 11. Species richness of small mammals families in different habitat types ($n = 392$ sites whose habitat type was clearly indicated in the original study) in the Cerrado ecoregion.

Literature cited

- Alho, C. J. R. 1981. Small mammal population of Brazilian Cerrado: the dependence of abundance and diversity on habitat complexity. *Revista Brasileira de Biologia* 41:223–230.
- Alho, C. J. R., and L. A. Pereira. 1985. Population ecology of a Cerrado rodent community in central Brazil. *Revista Brasileira de Biologia* 45:597–607.
- Amaral, P. S. T. 2005. Estudo das populações e comunidades de pequenos mamíferos em fragmentos de cerradão no Brasil central. Universidade de Brasília.
- Anciães, M., M. M. Guimarães, A. Guimarães, M. L. Reis, and J. S. Marinho-Filho. 1997. Diversidade e parâmetros populacionais de pequenos mamíferos do Brasil central. Pages 153–156 in L. L. Leite and C. H. Saito, editors. Contribuição ao conhecimento ecológico do Cerrado. Departamento de Ecologia/UnB, Brasília.
- Baumgarten, L. C. 2007. Dinâmica populacional de aves de rapina e suas presas em áreas abertas de Cerrado. Universidade Estadual de Campinas.
- Becker, R. G., G. Paise, L. C. Baumgarten, and E. M. Vieira. 2007. Estrutura de comunidades de pequenos mamíferos e densidade de *Necromys lasiurus* (Rodentia, Sigmodontinae) em áreas abertas de Cerrado no Brasil. *Mastozoología Neotropical* 14:157–168.
- Bernardes, M. L. 2006. Estudo de uma comunidade de pequenos mamíferos, com enfoque na variação da população de *Bolomys lasiurus* (Lund, 1841), em uma área de cerrado no estado de Minas Gerais. Pontifícia Universidade Católica de Minas Gerais.
- Bezerra, A. M. R., A. P. Carmignotto, and F. H. G. Rodrigues. 2009. Small non-volant mammals of an ecotone region between the Cerrado hotspot and the Amazonian rainforest, with comments on their taxonomy and distribution. *Zoological Studies* 48:861–874.

- Blackburn, T. M., P. Cassey, and K. J. Gaston. 2006. Variations on a theme: sources of heterogeneity in the form of the interspecific relationship between abundance and distribution. *Journal of Animal Ecology* 75:1426–1439.
- Bonvicino, C. R., and A. M. Bezerra. 2003. Use of regurgitated pellets of barn owl (*Tyto alba*) for inventoring small mammals in the Cerrado of central Brazil. *Studies on Neotropical Fauna and Environment* 38:1–5.
- Bonvicino, C. R., R. Cerqueira, and V. Soares. 1996. Habitat use by small mammals of upper Araguaia River. *Revista Brasileira de Biologia* 56:761–767.
- Bonvicino, C. R., S. R. Freitas, and P. S. D'Andrea. 1997. Influence of bordering vegetation, width, and state of conservation of gallery forest on the presence of small mammals. Page in L. L. Leite and C. H. Saito, editors. *Contribuição ao conhecimento ecológico do Cerrado*. Departamento de Ecologia/UnB, Brasília.
- Bonvicino, C. R., A. Lazar, M. M. O. Corrêa, M. Weksler, A. da C. Paula, and A. M. R. Bezerra. 2014. Conservation units in the core area of the Cerrado domain: an overview on the small nonvolant mammals (Rodentia and Didelphimorphia). *Heringeriana* 8:202–221.
- Bonvicino, C. R., B. Lemos, and M. Weksler. 2005. Small mammals of Chapada dos Veadeiros national park (Cerrado of central Brazil): ecologic , karyologic , and taxonomic considerations. *Brazilian Journal of Biology* 65:395–406.
- Bonvicino, C. R., S. M. Lindbergh, M. B. Faria, and A. M. R. Bezerra. 2012. The eastern boundary of the Brazilian Cerrado: a hotspot region. *Zoological Studies* 51:1207–1218.
- Bonvicino, C. R., S. M. Lindbergh, and L. S. Maroja. 2002. Small non-flying mammals from conserved and altered areas of Atlantic Forest and Cerrado: comments on their potential use for monitoring environment. *Brazilian Journal of Biology* 62:765–774.
- Borchert, M., and R. L. Hansen. 1983. Effects of flooding and wildlife on valley side wet

- campo rodents in central Brazil. *Revista Brasileira de Biologia* 43:229–240.
- Bovendorp, R. S., N. Villar, E. F. de Abreu-Junior, C. Bello, A. L. Regolin, A. R. Percequillo, and M. Galetti. 2017. Atlantic small-mammal: a dataset of communities of rodents and marsupials of the Atlantic forests of South America. *Ecology* 98:2226.
- Briani, D. C. 2001. Efeito de curto prazo do fogo em comunidades de pequenos mamíferos do Cerrado do Brasil central: abundância das espécies e hábitos alimentares. Universidade Estadual de São Paulo.
- Brown, J. H. 1984. On the relationship between abundance and distribution of species. *The American Naturalist* 124:255–279.
- Bruna, E. M., J. F. Guimarães, C. T. Lopes, P. Duarte, A. C. L. Gomes, S. C. S. Belentani, R. Pacheco, K. G. Facure, F. G. Lemos, and H. L. Vasconcelos. 2010. Mammalia, Estação Ecológica do Panga, a Cerrado protected area in Minas Gerais state, Brazil. Check List 6:668–675.
- Cáceres, N. C., M. R. Bornschein, W. H. Lopes, and A. R. Percequillo. 2007. Mammals of the Bodoquena Mountains, southwestern Brazil: an ecological and conservation analysis. *Revista Brasileira de Zoologia* 24:426–435.
- Cáceres, N. C., M. N. Godoi, W. Hannibal, and V. L. Ferreira. 2011. Effects of altitude and vegetation on small-mammal distribution in the Urucum mountains, western Brazil. *Journal of Tropical Ecology* 27:279–287.
- Cáceres, N. C., R. P. Nápoli, J. Casella, and W. Hannibal. 2010. Mammals in a fragmented savannah landscape in south-western Brazil. *Journal of Natural History* 44:491–512.
- Câmara, E. M. V. C., and L. C. Oliveira. 2012. Mammals of Serra do Cipó National Park, southeastern Brazil. Check List 8:355–359.
- Camargo, A. C. L. 2016. Partição de nicho isotópico por pequenos mamíferos em formações florestais de uma savana neotropical. Universidade de Brasília.

- Camargo, N. F. 2015. Uso dos estratos verticais por pequenos mamíferos em formações florestais do Cerrado brasileiro: padrões de diversidade, relação com a disponibilidade de recursos, seleção de habitat e habilidade de locomoção arborícola das espécies. Universidade de Brasília.
- Cardoso, P., T. L. Erwin, P. A. V. Borges, and T. R. New. 2011. The seven impediments in invertebrate conservation and how to overcome them. *Biological Conservation* 144:2647–2655.
- Cardoso, R. M. 2014. Detecção molecular de espécies de Leishmania em mamíferos de unidades de conservação e entorno do Distrito Federal, Brasil. Universidade de Brasília.
- Carmignotto, A. P. 2004. Pequenos mamíferos terrestres do bioma Cerrado: padrões faunísticos locais e regionais. Universidade de São Paulo.
- Carmignotto, A. P., and C. C. Aires. 2011. Mamíferos não voadores (Mammalia) da Estação Ecológica Serra Geral do Tocantins. *Biota Neotropica* 11:307–322.
- Carmignotto, A. P., A. M. R. Bezerra, and F. H. G. Rodrigues. 2014. Nonvolant small mammals from a southwestern area of Brazilian Cerrado : diversity, habitat use, seasonality, and biogeography. *Therya* 5:535–558.
- Carvalho, E. C. 2016. Assembleia de pequenos mamíferos em uma região de Cerrado no norte de Minas Gerais. Universidade Federal de Lavras.
- Carvalho, V. S. 2000. Comunidades de pequenos mamíferos não voadores em duas áreas de Cerrado com diferentes graus de alteração, no Parque Estadual Serra do Rola-Moça, município de Nova Lima, MG, Brasil. Pontifícia Universidade Católica de Minas Gerais.
- Casas, L. F., A. M. Aldana, F. Henao-Diaz, B. Villanueva, and P. R. Stevenson. 2017. Specific gravity of woody tissue from lowland Neotropical plants: differences among forest types. *Ecology* 98:1474.
- Cazetta, T. C. 2015. A ocorrência de fogo media a remoção de sementes por pequenos

- roedores em habitats florestais neotropicais. Universidade de Brasília.
- Dietz, J. M. 1983. Notes on the natural history of some small mammals in central Brazil. *Journal of Mammalogy* 64:521–523.
- Eiten, G. 1972. The Cerrado vegetation of Brazil. *Botanical Review* 38:201–341.
- Emmons, L. H. 2009. Long-term variation in small mammal abundance in forest and savanna of Bolivian Cerrado. *Biotropica* 41:493–502.
- Engel, L. A. 1989. Estudo populacional de roedores em áreas cultivadas do Cerrado no núcleo rural do Rio Preto (Brasília, Distrito Federal). Universidade de Brasília.
- Ernest, K. A., and M. A. Mares. 1986. Ecology of *Nectomys squamipes*, the neotropical water rat, in central Brazil: home range, habitat selection, reproduction and behaviour. *Journal of Zoology* 210:599–612.
- Favacho, A. R. de M., M. N. Andrade, R. C. de Oliveira, C. R. Bonvicino, P. S. D'Andrea, and E. R. S. de Lemos. 2015. Zoonotic *Bartonella* species in wild rodents in the state of Mato Grosso do Sul, Brazil. *Microbes and Infection* 17:889–892.
- Figueiredo, G. G., A. A. Borges, G. M. Campos, A. M. Machado, F. P. Saggioro, G. S. Sabino Júnior, S. J. Badra, A. A. A. Ortiz, and L. T. M. Figueiredo. 2010. Diagnosis of hantavirus infection in humans and rodents in Ribeirão Preto, state of São Paulo, Brazil. *Revista da Sociedade Brasileira de Medicina Tropical* 43:348–354.
- Figueiredo, M. S. L., C. S. Barros, A. C. Delciellos, E. B. Guerra, P. Cordeiro-Estrela, M. Kajin, M. R. Alvarez, P. H. Asfora, D. Astúa, H. G. Bergallo, R. Cerqueira, L. Geise, R. Gentile, C. E. V. Grelle, G. E. Jack-Ximenes, L. C. Oliveira, M. Weksler, and M. V. Vieira. 2017. Abundance of small mammals in the Atlantic Forest (ASMAF): a data set for analyzing tropical community patterns. *Ecology* 98:2981.
- Fonseca, G. A. B., and K. H. Redford. 1984. The mammals of IBGE's Ecological Reserve, Brasília, and an analysis of the role of gallery forests in increasing diversity. *Revista*

- Brasileira de Biologia 44:517–523.
- Gastal, M. L. A. 1997. Ecologia de comunidades de pequenos mamíferos em matas de galeria de Brasília. Universidade de Brasília.
- Gaston, K. J., and T. M. Blackburn. 2000. Pattern and process in macroecology. Page (K. J. Gaston and T. M. Blackburn, Eds.) *Pattern and Process in Macroecology*. Blackwell Publishing.
- Gaston, K. J., T. M. Blackburn, and J. H. Lawton. 1997. Interspecific abundance-range size relationships: an appraisal of mechanisms. *The Journal of Animal Ecology* 66:579–601.
- Gettinger, D. D., and K. A. Ernest. 1995. Small-mammal community structure and the specificity of ectoparasite associations in central Brazil. *Revista Brasileira de Biologia* 55:331–341.
- Gheler-Costa, C., G. Sabino-Santos, L. S. Amorim, L. M. Rosalino, L. T. M. Figueiredo, and L. M. Verdade. 2013. The effect of pre-harvest fire on the small mammal assemblage in sugarcane fields. *Agriculture, Ecosystems and Environment* 171:85–89.
- Godoi, M. N., N. L. Cunha, and N. C. Cáceres. 2010. Efeito do gradiente floresta-cerrado-campo sobre a comunidade de pequenos mamíferos do alto do Maciço do Urucum, oeste do Brasil. *Mastozoologa Neotropical* 17:263–277.
- Guedes, T. B., R. J. Sawaya, A. Zizka, S. Laffan, S. Faurby, R. A. Pyron, R. S. Bérnils, M. Jansen, P. Passos, A. L. C. Prudente, D. F. Cisneros-Heredia, H. B. Braz, C. de C. Nogueira, and A. Antonelli. 2017. Patterns, biases and prospects in the distribution and diversity of Neotropical snakes. *Global Ecology and Biogeography*:14–21.
- Hannibal, W., and N. C. Cáceres. 2010. Use of vertical space by small mammals in gallery forest and woodland savannah in south-western Brazil. *Mammalia* 74:247–255.
- Hannibal, W., V. V Figueiredo, H. W. P. Claro, A. C. Carvalho, G. P. Cabral, R. F. Oliveira, H. F. Aquino, F. V Viana, T. F. Silveiro, and J. J. S. Filho. 2015. Mamíferos não

- voadores em fragmentos de Cerrado no sul do estado de Goiás , Brasil. Boletim da Sociedade Brasileira de Mastozoologia 74:103–109.
- Harte, J., A.Kinzig, J.Green, and J. Harta. 1999. Self-similarity in the distribution and abundance of species. Science 284:334–336.
- Henriques, R. P. B., and C. J. R. Alho. 1991. Microhabitat selection by two rodent species in the Cerrado of central Brazil. Mammalia 55:49–56.
- Henriques, R. P. B., M. X. A. Bizerril, and A. R. T. Palma. 2000. Changes in small mammal populations after fire in a patch of unburned cerrado in central Brazil. Mammalia 64:173–185.
- Hortal, J., F. de Bello, J. A. F. Diniz-Filho, T. M. Lewinsohn, J. M. Lobo, and R. J. Ladle. 2015. Seven shortfalls that beset large-scale knowledge of biodiversity. Annual Review of Ecology, Evolution, and Systematics 46:523–549.
- Huber, O., R. D. de Stefano, G. Aymard, and R. Riina. 2006. Flora and vegetation of the Venezuelan Llanos: a review. Pages 95–120 in R. T. Pennington, G. P. Lewis, and J. A. Ratter, editors. Neotropical savannas and seasonally dry forests: plant diversity, biogeography, and conservation. CRC Press, Boca Raton, FL.
- IBGE. 2004. Mapa de biomas do Brasil. Escala 1:5.000.000. Rio de Janeiro.
- Jaksic, F. 1986. Predation upon small mammals in shrublands and grasslands of southern South America: ecological correlates and presumable consequences. Revista Chilena de Historia Natural 59:209–221.
- Kelt, D. A., J. H. Brown, E. J. Heske, P. A. Marquet, S. R. Morton, J. R. W. Reid, K. A. Rogovin, and G. Shenbrot. 1996. Community structure of desert small mammals: comparisons across four continents. Ecology 77:746–761.
- Keman, B. S., W. Cordero, A. M. M. Sienra, and J. V. Marín. 2010. Report on biodiversity and tropical forests in Paraguay. Page Tropical Forests and Biodiversity Assessment

(FAA 118 & 119).

Klink, C. A., and R. B. Machado. 2005. Conservation of the Brazilian cerrado. *Conservation Biology* 19:707–713.

Köppen, W. 1948. *Climatología: con un estudio de los climas de la Tierra*. Fondo Cultural Económica, Mexico City, Mexico.

Korpimäki, E., and C. J. Krebs. 1996. Predation and population cycles of small mammals: a reassessment of the predation hypothesis. *BioScience* 46:754–764.

Lacher, T. E., M. A. Mares, and C. J. R. Alho. 1989. The structure of a small mammal community in a central Brazilian savanna. Pages 137–162 in K. H. Redford and J. F. Eisenberg, editors. *Advances in Neotropical Mammalogy*. Sandhill Crane Press, Gainesville.

Lima, F., G. Beca, R. L. Muylaert, C. N. Jenkins, M. L. L. Perilli, A. M. O. Paschoal, R. L. Massara, A. P. Paglia, A. G. Chiarello, M. E. Graipel, J. J. Cherem, A. L. Regolin, L. G. R. Oliveira Santos, C. R. Brocardo, A. Paviolo, M. S. Di Bitetti, L. M. Scoss, F. L. Rocha, R. Fusco-Costa, C. A. Rosa, M. X. Da Silva, L. Hufnagell, P. M. Santos, G. T. Duarte, L. N. Guimarães, L. L. Bailey, F. H. G. Rodrigues, H. M. Cunha, F. M. Fantacini, G. O. Batista, J. A. Bogoni, M. A. Tortato, M. R. Luiz, N. Peroni, P. V. De Castilho, T. B. Maccarini, V. P. Filho, C. De Angelo, P. Cruz, V. Quiroga, M. E. Iezzi, D. Varela, S. M. C. Cavalcanti, A. C. Martensen, E. V. Maggiorini, F. F. Keesen, A. V. Nunes, G. M. Lessa, P. Cordeiro-Estrela, M. G. Beltrão, A. C. F. De Albuquerque, B. Ingberman, C. R. Cassano, L. C. Junior, M. C. Ribeiro, and M. Galetti. 2017. ATLANTIC-CAMTRAPS: a dataset of medium and large terrestrial mammal communities in the Atlantic Forest of South America. *Ecology* 98:2979–2979.

Linardi, P. M., J. R. Botelho, D. P. Neves, and H. C. Cunha. 1984. Sobre alguns ectoparasitos de roedores silvestres de Belo Horizonte, MG. *Revista Brasileira de Biologia* 44:215–

- Lustosa, G. S., F. H. R. Leite, F. N. Marques-Oliveira, and M. P. D. Santos. 2007. Análise da composição e riqueza de pequenos mamíferos em três fitofisionomias na fazenda Bonito, município de Castelo do Piauí. Pages 1–2Anais do VIII Congresso de Ecologia do Brasil. Caxambu, MG.
- Lyra-Jorge, M. C., V. R. Pivello, S. T. Meirelles, and M. de Vivo. 2001. Riqueza e abundância de pequenos mamíferos no em ambientes de cerrado e floresta, na reserva cerrado Pé-de-Gigante, Parque Estadual de Vassununga (Santa Rita do Passa Quatro, SP). *Naturalia* 26:287–302.
- Martin, P. S. 2010. Distribuição e abundância de mamíferos neotropicais não voadores de pequeno porte em paisagem silvicultural da bacia do Alto Paranapanema, SP. Escola Superior de Agricultura “Luiz de Queiroz.”
- Mello, D. A. 1980. Estudo populacional de algumas espécies de roedores do Cerrado (norte do município de Formosa, Goiás). *Revista Brasileira de Biologia* 40:843–860.
- Mello, D. A. 1982. Roedores, marsupiais e triatomídeos silvestres capturados no município de Mambaí - Goiás. Infecção natural pelo *Trypanosoma cruzi*. *Revista de Saúde Pública* 16:282–291.
- Mendonça, A. F. 2010. Comunidades de pequenos mamíferos e uso do espaço em uma paisagem heterogênea de Cerrado e *Pinus* spp. Museu Nacional/UFRJ.
- Miranda, A. C., H. S. Miranda, I. de F. O. Dias, and B. F. de S. Dias. 1993. Soil and air temperatures during prescribed cerrado fires in central Brazil. *Journal of Tropical Ecology* 9:313–320.
- Moreira, J. C., E. G. Manduca, P. R. Gonçalves, R. Stumpf, C. G. C. Pinto, and G. Lessa. 2008. Mammals, Volta Grande Environmental Unity, Triângulo Mineiro, states of Minas Gerais and São Paulo, southeastern Brazil. *Check List* 4:349–357.

- Moreira, M. T., and C. Teixeira. 2014. Pequenos mamíferos não voadores em um fragmento particular em São Sebastião do Oeste - MG. Pages 1–7Anais do V Congresso Brasileiro de Gestão Ambiental. Belo Horizonte, MG.
- Muylaert, R. L., R. D. Stevens, C. E. L. Esbérard, M. A. R. Mello, G. S. T. Garbino, L. H. Varzinczak, D. Faria, M. de Moraes Weber, P. Kerches Rogeri, A. L. Regolin, H. F. M. de Oliveira, L. de M. Costa, M. A. S. Barros, G. Sabino-Santos, M. A. Crepaldi de Morais, V. S. Kavagutti, F. C. Passos, E.-L. Marjakangas, F. G. M. Maia, M. C. Ribeiro, and M. Galetti. 2017. Atlantic bats: a dataset of bat communities from the Atlantic Forests of South America. *Ecology* 98:3227.
- Myers, N., R. A. Mittermeier, C. G. Mittermeier, G. A. da Fonseca, and J. Kent. 2000. Biodiversity hotspots for conservation priorities. *Nature* 403:853–858.
- Nitikman, J. Z., and M. A. Mares. 1987. Ecology of small mammals in a gallery forest of Central Brazil. *Annals of the Carnegie Museum* 56:75–95.
- Nogueira, C., S. Ribeiro, G. C. Costa, and G. R. Colli. 2011. Vicariance and endemism in a Neotropical savanna hotspot: Distribution patterns of Cerrado squamate reptiles. *Journal of Biogeography* 38:1907–1922.
- Oliveira, F. C. G. 2008. Avaliação preliminar de impacto ambiental sobre a fauna de pequenos mamíferos e suas taxas de infecção por *Trypanosoma cruzi* e hantavírus na área de influência da Usina Hidrelétrica Espora, Aporé - GO. Universidade Católica de Goiás.
- Oliveira, P. S. 1993. Estudos de duas comunidades de pequenos mamíferos do Cerrado, na Reserva Ecológica do IBGE (RECOR), Brasília - DF. Universidade de Brasília.
- Olson, D. M., E. Dinerstein, E. D. Wikramanayake, N. D. Burgess, G. V. N. Powell, E. C. Underwood, J. A. D'amico, I. Itoua, H. E. Strand, J. C. Morrison, C. J. Loucks, T. F. Allnutt, T. H. Ricketts, Y. Kura, J. F. Lamoreux, W. W. Wettenberg, P. Hedao, and K. R.

- Kassem. 2001. Terrestrial ecoregions of the world: a new map of life on Earth. BioScience 51:933–938.
- Owen, R. D. 2013. Ecology of small terrestrial mammals in an isolated Cerrado patch, eastern Paraguay: communities, species, and effects of ENSO, precipitation, and fire. Mastozoología Neotropical 20:97–112.
- Paglia, A. P., G. A. B. Fonseca, A. B. Rylands, G. Herrmann, L. M. S. Aguiar, A. G. Chiarello, Y. L. R. Leite, L. P. Costa, S. Siciliano, and M. C. M. Kierulff. 2012. Lista Anotada dos Mamíferos do Brasil/Annotated Checklist of Brazilian Mammals. 2^a Edição. Occasional Papers in Conservation Biology 6:1–76.
- Palma, A. R. T. 2002. Estrutura de comunidades de pequenos mamíferos no Cerrado. Universidade de Brasília.
- Pardiñas, U. F. J., P. Teta, J. Salazar-Bravo, P. Myers, and C. A. Galliari. 2016. A new species of arboreal rat, genus *Oecomys* (Rodentia, Cricetidae) from Chaco. Journal of Mammalogy 97:1177–1196.
- Passamani, M., and R. A. S. Cerboncini. 2013. The effects of the creation of a hydroelectric dam on small mammals' communities in central Brazil. Neotropical Biology and Conservation 8:9–16.
- Patton, J. L., U. F. J. Pardiñas, and G. D'Elía, editors. 2015. Mammals of South America. Volume 2: rodents. The University of Chicago Press, Chicago, IL, USA.
- Paula, A. da C. 1983. Relações espaciais de pequenos mamíferos em uma comunidade de mata de galeria do Parque Nacional de Brasília. Universidade de Brasília.
- Projeto MapBiomas. Coleção 2.3 da série anual de mapas de cobertura e uso de solo do Brasil. 2018. . <http://mapbiomas.org>.
- Quaresma, P. F., F. D. Rêgo, H. A. Botelho, S. R. da Silva, A. J. Moura, R. G. T. Neto, F. M. Madeira, M. B. Carvalho, A. P. Paglia, M. N. Melo, and C. M. F. F. Gontijo. 2011.

- Wild, synanthropic and domestic hosts of Leishmania in an endemic area of cutaneous leishmaniasis in Minas Gerais state, Brazil. *Transactions of the Royal Society of Tropical Medicine and Hygiene* 105:579–585.
- Raub, F., H. Höfer, and L. Scheuermann. 2017. Spider (Arachnida, Araneae) diversity in secondary and old-growth southern Atlantic forests of Paraná state, Brazil. *Ecology* 98:1975.
- Reis, M. L. 1993. Estudo das comunidades de pequenos mamíferos não voadores em duas áreas de cerrado (sensu stricto), de diferentes tamanhos, inseridas dentro de uma grande floresta plantada na Fazenda Jatobá (Correntina, BA). Universidade de Brasília.
- Reis, M. L., and J. S. Marinho-Filho. 1998. Estudo das comunidades de pequenos mamíferos na Estação Ecológica de Águas Emendadas (ESEC-AE)/DF. Pages 171–197. Anais do Seminário de Pesquisa em Unidades de Conservação.
- Ribeiro, J. F. 2015. Uso do hábitat em diferentes escalas, distribuição da diversidade e nicho isotópico de comunidades de pequenos mamíferos do Cerrado central. Universidade de Brasília.
- Ribeiro, J. F., and B. M. T. Walter. 2008. As principais fitofisionomias do bioma Cerrado. Pages 151–212 in S. M. Sano and S. P. Almeida, editors. *Cerrado: Ecologia e Flora*. Embrapa Cerrados/Embrapa Informação Tecnológica, Brasília.
- Ribeiro, R., and J. S. Marinho-Filho. 2005. Estrutura da comunidade de pequenos mamíferos (Mammalia, Rodentia) da Estação Ecológica de Águas Emendadas, Planaltina, Distrito Federal, Brasil. *Revista Brasileira de Zoologia* 22:898–907.
- Rocha, R. G., E. Ferreira, Y. L. R. Leite, C. Fonseca, and L. P. Costa. 2011. Small mammals in the diet of barn owls, *Tyto alba* (Aves: Strigiformes) along the mid-Araguaia river in central Brazil. *Zoologia* 28:709–716.
- Rocha, R. G., E. Ferreira, I. C. M. Martins, L. P. Costa, and C. Fonseca. 2014. Seasonally

- flooded stepping stones: emerging diversity of small mammal assemblage in the Amazonia-Cerrado ecotone, central Brazil. *Zoological Studies* 53:60–69.
- Rodrigues, A. C., D. A. Silva, P. S. Mata, A. B. Almeida, M. Zortéa, and F. R. Melo. 2011. Levantamento de espécies de pequenos mamíferos em áreas de Cerrado sobre influência da usina de cana-de-açúcar do Grupo Cosan, Unidade Jataí, Jataí, Goiás. Pages 1–3. *Anais do X Congresso de Ecologia do Brasil*. São Lourenço, MG.
- Rodrigues, F., L. Silveira, A. Jácomo, A. P. Carmignotto, A. M. Bezerra, D. Coelho, H. Garbogini, J. Pagnozzi, and A. Hass. 2002. Composição e caracterização da fauna de mamíferos do Parque Nacional das Emas, Goiás, Brasil. *Revista Brasileira de Zoologia* 19:589–600.
- Ruedas, L. A., and J. Salazar-Bravo. 2007. Morphological and chromosomal taxonomic assessment of *Sylvilagus brasiliensis gabbi* (Leporidae). *Mammalia* 71:63–69.
- Santos-Filho, M. 2005. Efeitos da fragmentação sobre a comunidade de pequenos mamíferos em floresta estacional semidecidual submontana no Mato Grosso, Brasil. INPA/UFAM.
- Santos-Filho, M., F. Friero-Costa, A. R. A. Ignácio, and M. N. F. Silva. 2012. Use of habitats by non-volant small mammals in Cerrado in central Brazil. *Brazilian Journal of Biology* 72:893–902.
- Santos-Filho, M., D. Da Silva, and T. Sanaiotti. 2006. Efficiency of four trap types in sampling small mammals in forest fragments, Mato Grosso, Brazil. *Mastozoología Neotropical* 13:217–225.
- Santos, J. L. 2017. Alteração da paisagem modifica comunidade de pequenos mamíferos e predação de sementes no Cerrado. Universidade de Brasília.
- Santos, R. A. L., and R. P. B. Henriques. 2010. Variação espacial e influência do habitat na estrutura de comunidades de pequenos mamíferos em áreas de campo rupestre no Distrito Federal. *Biota Neotropica* 10:31–38.

- Saraiva, D. G., G. F. S. R. Fournier, S. P. Oliveira, M. Ogrzewalska, E. M. V. C. Câmara, C. G. Costa, and J. R. Botelho. 2012. Ectoparasites from small mammals from the Cerrado region in the Minas Gerais state , Brazil. Cuadernos de Investigación UNED 4:21–29.
- Saranholi, B. H., R. C. B. Fonseca, and J. F. S. Lima. 2008. Karyologic survey of not flying small mammals from Tocantins , Brazil. Estudos de Biologia 30:91–97.
- Silva, A. P. 2013. Diversidade de comunidades de pequenos mamíferos de três fitofisionomias do Cerrado no Brasil central: participação de diversidade regional em componentes alfa e beta. Universidade de Brasília.
- Silva, J. M. C. 1999. Birds of Cerrado region, South America. Steenstrupia 21:69–92.
- Silva, M. M. 2014. Estudos dos efeitos da implantação de uma usina hidrelétrica sobre comunidades de mamíferos do Cerrado. Universidade Federal de Minas Gerais.
- Silva, R. R. 2010. Padrões de riqueza e distribuição de espécies de pequenos mamíferos terrestres do Cerrado: uma ferramenta para modelagem e avaliação do sistema de unidades de conservação. Universidade de Brasília.
- Smith, P., H. Pheasey, K. Atkinson, J. Ramakers, and J. Sarvary. 2012. The Didelphimorphia (Didelphidae) of Reserva Natural Laguna Blanca, departamento San Pedro, Paraguay. Acta zoológica liloana 56:141–152.
- Strassburg, B. B. N., T. Brooks, R. Feltran-Barbieri, A. Iribarrem, R. Crouzeilles, R. Loyola, A. E. Latawiec, F. J. B. Oliveira Filho, C. A. de M. Scaramuzza, F. R. Scarano, B. Soares-Filho, and A. Balmford. 2017. Moment of truth for the Cerrado hotspot. Nature Ecology & Evolution 1:99.
- Talamoni, S. A., and M. M. Dias. 1999. Population and community ecology of small mammals in southeastern Brazil. Mammalia 63:167–181.
- Talamoni, S., J. Motta-Junior, and M. Dias. 2000. Fauna de mamíferos da Estação Ecológica de Jataí e da Estação Experimental de Luiz Antônio. Pages 317–329 in J. Santos and J.

- Pires, editors. Estação Ecológica de Jataí. Volume I. RIMA Editora, São Carlos.
- Travassos da Rosa, E. S., D. B. A. Medeiros, M. R. T. Nunes, D. B. Simith, A. D. S. Pereira, M. R. Elkhouri, E. D. Santos, M. Lavocat, A. A. Marques, A. V. G. Via, V. A. Kohl, A. C. P. Terças, P. D'Andrea, C. R. Bonvicino, E. R. Sampaio de Lemos, and P. F. C. Vasconcelos. 2012. Molecular epidemiology of Laguna Negra virus, Mato Grosso state, Brazil. *Emerging Infectious Diseases* 18:982–985.
- Tyndale-Biscoe, C. H. 1979. Ecology of small mammals. Pages 343–379 in D. M. Stoddart, editor. *Ecology of small mammals*. Chapman & Hall, London, UK.
- Valdujo, P. H., D. L. Silvano, G. Colli, and M. Martins. 2012. Anuran Species Composition and Distribution Patterns in Brazilian Cerrado, a Neotropical Hotspot. *South American Journal of Herpetology* 7:63–78.
- Valle, C. M. C., M. C. Alves, I. B. Santos, and J. B. M. Varejão. 1982. Observações sobre a dinâmica de população de *Zygodontomys lasiurus* (Lund, 1941), *Calomys expulsus* (Lund, 1841) e *Oryzomys subflavus* (Wagner, 1842) em vegetação de Cerrado no vale do Rio das Velhas (Prudente de Moraes, Minas Gerais, Br. Lundiana 2:71–83.
- Veblen, T. T., K. R. Young, and A. R. Orme, editors. 2007. *The physical geography of South America*. Oxford University Press, New York, NY.
- Vieira, E. M. 1999. Small mammal communities and fire in the Brazilian Cerrado. *Journal of Zoology* 249:75–81.
- Vieira, E. M., G. Iob, D. C. Briani, and A. R. T. Palma. 2005. Microhabitat selection and daily movements of two rodents (*Necromys lasiurus* and *Oryzomys scotti*) in Brazilian Cerrado, as revealed by a spool-and-line device. *Mammalian Biology* 70:359–365.
- Vieira, E. M., and J. S. Marinho-Filho. 1998. Pre- and post-fire habitat utilization by rodents of Cerrado from central Brazil. *Biotropica* 30:491–496.
- Vieira, J. P. F. A. M. 2014. Comunidades de artrópodes ectoparasitos em pequenos

- mamíferos de um remanescente de Cerrado em região urbana de Campo Grande, Mato Grosso do Sul. Universidade Federal do Mato Grosso do Sul.
- Vieira, M. V. 1989. Dinâmica de populações, variação sazonal de nichos e seleção de microhábitats numa comunidade de roedores de Cerrado brasileiro. Universidade Estadual de Campinas.
- Villarroel, D., and C. B. R. Munhoz. 2016. Campos y sabanas del Cerrado en Bolivia: delimitación, síntesis terminológica y sus características fisionómicas. *Kempffiana* 12:47–80.
- Voss, R. S., and S. a. Jansa. 2009. Phylogenetic relationships and classification of didelphid marsupials, an extant radiation of New World metatherian mammals. *Bulletin of the American Museum of Natural History* 322:1–177.
- Weksler, M., A. Percequillo, and R. Voss. 2006. Ten new genera of oryzomyine rodents (Cricetidae: Sigmodontinae). *American Museum Novitates* 3537:29 pp.
- Williams, S., H. Marsh, and J. Winter. 2002. Spatial scale, species diversity, and habitat structure: small mammals in Australian tropical rain forest. *Ecology* 83:1317–1329.
- Wilman, H., J. Belmaker, J. Simpson, C. de la Rosa, M. M. Rivadeneira, and W. Jetz. 2014. EltonTraits 1.0: Species-level foraging attributes of the world's birds and mammals. *Ecology* 95:2027–2027.