Zoological Studies **51**(7): 1207-1218 (2012)

Zoological Studies

The Eastern Boundary of the Brazilian Cerrado: A Hotspot Region

Cibele R. Bonvicino[1,2,*], Scott M. Lindbergh[3], Michel Barros Faria[4], and Alexandra M.R. Bezerra[5]

[1]*Programa de Genética, Instituto Nacional de Câncer, Rio de Janeiro, CEP 20231-050, RJ, Brazil*

[2]*Laboratório de Biologia e Parasitologia de Mamíferos Reservatórios Silvestres, IOC, Fiocruz, CEP 21045-900, Rio de Janeiro, RJ, Brazil*

[3]*Sucuri Consultoria Ambiental, Brasília, DF, Brazil*

[4]*Pós Graduação em Genética, Universidade Federal do Rio de Janeiro, CEP 21944-970, Rio de Janeiro, RJ, Brazil*

[5]*Departamento de Zoologia, Universidade de Brasília, CEP 70910-900, Brasília, DF, Brazil*

(Accepted April 6, 2012)

Cibele R. Bonvicino, Scott M. Lindbergh, Michel Barros Faria, and Alexandra M.R. Bezerra (2012) The eastern boundary of the Brazilian Cerrado: a hotspot region. *Zoological Studies* **51**(7): 1207-1218. The non-flying small-mammal fauna of the eastern Cerrado domain of central Brazil, Trijunção region, Bahia and Goiás States, was surveyed and karyotyped in the dry and wet seasons. Four marsupial and 15 rodent species were captured, 5 of which are endemic to the Cerrado morphoclimatic domain. Some species were captured only in the dry season, and others only in the wet season. Species showed different habitat use during the year. Dry-season trap success was higher in wetland habitats, while rainy-season trap success was higher in dry habitats. These findings suggest that the season influences the presence and/or activity of some species in the different physiognomies. The geographic distribution of small rodents endemic to the Cerrado and the high number of endemic species in the study region point to the eastern Cerrado as another hotspot of this domain.
http://zoolstud.sinica.edu.tw/Journals/51.7/1207.pdf

Key words: Cerrado, Endemism, Karyotype, Non-volant small mammals.

The Cerrado domain, with its many endemic species, is located almost exclusively in central Brazil (IBGE 2004). It is subjected to high levels of human activity (Myers et al. 2000) and is also considered among the 25 most important terrestrial hotspots. Some 10,000 plant species, 227 mammal species, 837 bird species, 120 reptile species, and 150 amphibian species recorded there (Myers et al. 2000, Marinho-Filho et al. 2002, Carmignotto et al. 2012) demonstrate its extraordinary biodiversity. Some authors list 25 endemic Cerrado mammal species (11%), mainly small rodents and marsupials (Carmignotto et al. 2012). The non-volant small-mammal fauna is underestimated, mainly due to high morphologic similarities among congeneric species. This scenario makes karyotypic analysis a very useful tool for confirming identifications and disclosing the underlying biodiversity (Langguth and Bonvicino 2002, Bonvicino 2003, Gonçalves et al. 2005).

The vegetational diversity of the Cerrado domain is attributed to its mosaic of discrete and highly variable physiognomic characteristics, which range from forests to grasslands (Eiten 1983). Despite the heterogeneity of the vegetative composition in different Cerrado regions and high local endemism, taxonomic and ecologic studies on small-mammal communities are concentrated in the center of the Cerrado domain (Distrito Federal and Goiás and Tocantins States, e.g., Mares and Ernest 1995, Bonvicino et al. 1996 2005, Ribeiro and Marinho 2005, Bezerra et al. 2009 2010), with few reports on the western (Cáceres et al. 2007) or eastern portions (Pereira and Geise 2009) of the

*To whom correspondence and reprint requests should be addressed. Tel: 55-21-32076586. E-mail:cibelerb@inca.gov.br

domain.

In this study, we sampled small mammals near the eastern limit of the Cerrado domain. We discuss the endemism of the small rodent species evinced. Additionally, we hope to contribute to the increasing knowledge on non-volant small mammals of the Cerrado, by providing data on the karyology and comments about geographic distributions and natural histories of the species surveyed.

MATERIALS AND METHODS

Study area

Habitat types of the Cerrado found in the study area are campo úmido (CU), an open seasonally flooded grassland with no shrubs or arboreal cover; campo cerrado (CC), an open arboreal savanna with bushes and an arboreal cover of < 15% of the total vegetation; campo de murundum (CM), an open seasonally wet grassland with islands of dense vegetation; cerrado *sensu stricto* (CE), the most characteristic vegetation type of the Cerrado and a dense savanna dominated by shrubs and trees, often 3-8 m tall, and a 15%-40% arboreal cover; semideciduous forest (SD), a forest formation where ~50% of the trees lose their leaves in the dry season; gallery forest (GF), an evergreen forest along watercourses; and vereda (VE), a wet grassland with buriti palm trees, generally associated with the CU (Eiten 1992). Also sampled were carrasco (CO), which is comprised of slender and hard shrubs ~1.5 m tall, typical of the Caatinga domain (Eiten 1983); and 2 human-modified habitats, a *Pinus* sp. plantation (P) and human buildings (HU). Soils in this region are sandy.

The study region has a typical Cerrado tropical pluviometric index with 70% of the rain falling from Nov. to Mar. (Nimer 1989). Rainfall drains into the Rio Formoso, a left-bank tributary of the Rio São Francisco. It is located in Bahia (BA) and Goiás (GO) States, where these meet with Minas Gerais State, and this represents the eastern limit of the Cerrado domain (Fig. 1). The 4 general localities and habitats sampled in each were the (1) São Francisco da Trijunção farm, Cocos municipality, BA including CC (14°49'S, 45°58'W) and CU (14°49'S, 45°58'W); (2) Região da Trijunção farm, Jaborandi municipality, BA, including SD (14°47'S, 45°51'W), CE (14°46'S, 45°56'W), CC, 2 VE tracts (14°46'S, 45°56'W and 14°47'S, 45°57'W), CM (14°48'S, 45°58'W), P (14°46'S, 45°58'W), and HU (14°46'S, 45°56'W); (3) Paredão Vermelho farm, Sítio da Abadia municipality, GO including GF (14°47'S, 46°02'W);

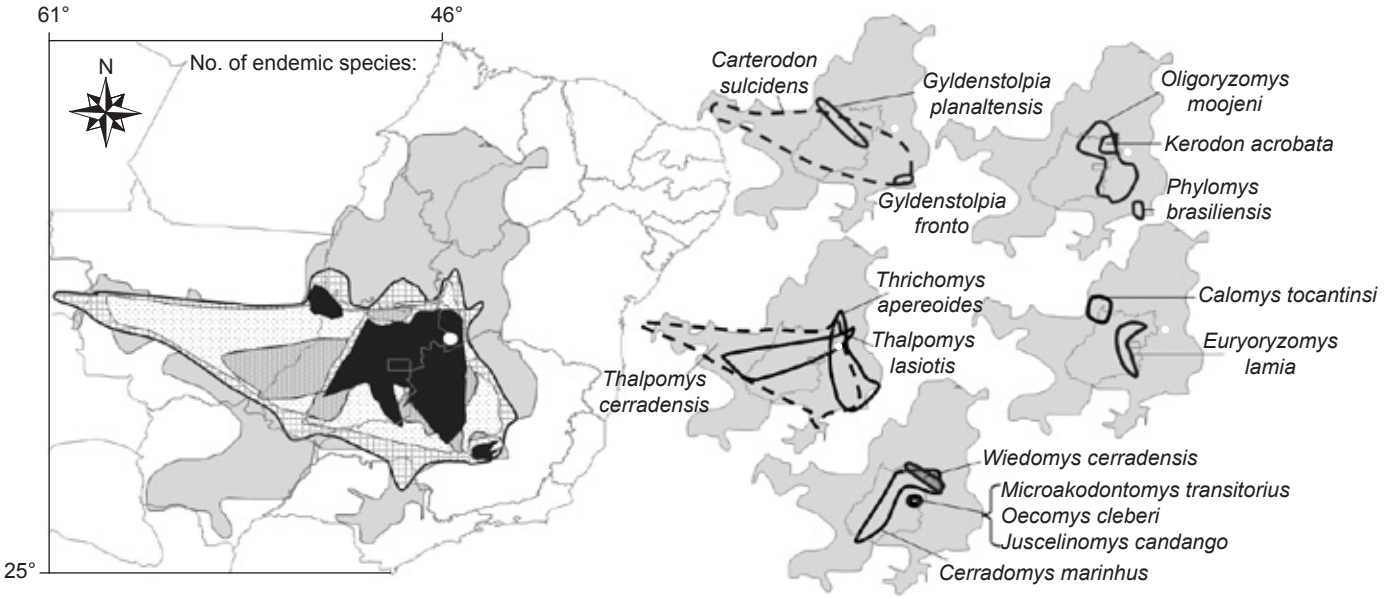

Fig. 1. Map showing the collecting region (white circle) within the limits of the Cerrado domain (gray area) modified from IBGE (1993) and distributions of the 16 endemic species of small rodents from the Cerrado (modified from Bonvicino et al. 2008). On the left, gray areas represent the occurrence of endemic species, from one in the lightest gray to four or more endemic species in darker gray.

and (4) Leite Verde farm, Jaborandi, including CO (14°36'S, 45°46'W).

Sampling procedures

Surveys were performed in each locality during the end of the dry season (LD) (30 Aug. to 13 Sept. 1998), early rainy season (W) (23-31 Oct. 1999), and early dry season (ED) (20-27 Apr. 2010). Sherman® (23 × 9 × 8 cm, Sherman® Folding Traps, Tallahassee, FL, USA) and Tomahawk (43 × 12.5 × 15.5 cm, Tomahawk Live Traps®, Hazelhurst, WI, USA) live traps were placed 10-15 m apart from one another in linear transects. Bait consisted of a mixture of bacon, banana, peanut butter, and oat flakes. Discrepancies in trapping efforts were mainly due to availability of vegetation types (Table 1). In the 1st 2 expeditions, transects were placed in the same places to compare small-mammal fauna in different seasons, but the CU was below the water table in W and was not sampled. The 1st expedition occurred just after wildfires had scorched much of the area, including the VE and CU. Comparative success of capture was expressed as a percentage (%) calculated by dividing the total number of individuals of each species caught in each habitat by the effort applied in that habitat (numbers of Sherman and Tomahawk traps used).

Females were considered reproductive when in rodents, the embryos were tactile in the uterus and in marsupials, there was an offspring in the pouch, and both were considered to be nursing when an animal had milk in its breasts.

Identification, nomenclature, and voucher specimens

To confirm species identifications, some specimens were karyotyped in the field following Andrade and Bonvicino (2003). Voucher species were or will be deposited in the mammal collections of the Museu Nacional, Univ. Federal do Rio de Janeiro (MN). The abbreviation, CRB, refers to the field number of Cibele R. Bonvicino. Taxonomic nomenclature and species distributions follow Wilson and Reeder (2005) and Bonvicino et al. (2008) for rodents and Gardner (2008) for marsupials. When additional data are included, they are cited in the respective species account.

RESULTS

In total, 200 individuals belonging to 4 marsupial and 15 rodent species were collected (Table 1) in the course of 7651 trap-nights. The overall mean trapping success was 2.6% (2.6% in the early dry season, 2.8% in the late dry season, and 2.2% in the rainy season).

The following account summarizes the species of non-volant small mammals collected in the study area.

Didelphimorphia

Cryptonanus agricolai (Moojen, 1943) is characterized by 2*n* = 14, FNa = 24 (Voss et al. 2005). Only 1 male specimen was captured in the VE (Table 1). This species is distributed in

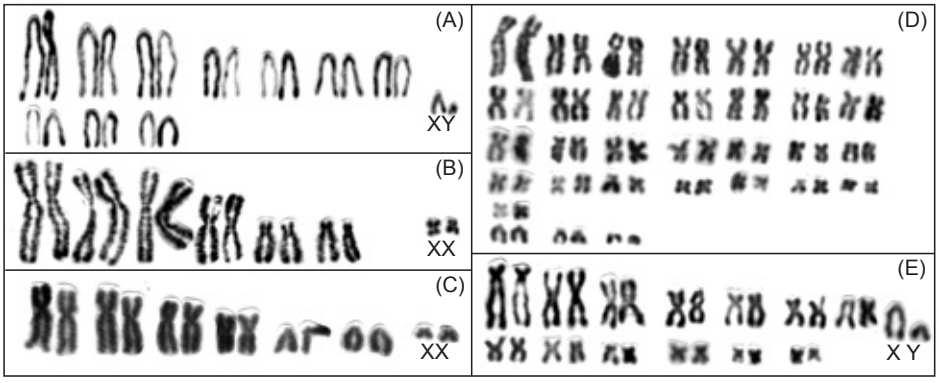

Fig. 2. Conventional Giemsa staining of the chromosome complements of (A) *Didelphis albiventris* (male CRB 1870) with 2*n* = 22 and FNa = 20, (B) *Gracilinanus agilis* (female MN 66014) with 2*n* = 14 and FNa = 24, (C) *Thylamys karimii* (female CRB 2867) with 2*n* = 14 and FNa = 20, (D) *Galea spixii* (female MN 66032) with 2*n* = 64 and FNa = 118 or 120, and (E) *Thrichomys apereoides* (male MN 66022) with 2*n* = 28 and FNa = 52.

Table 1. Summary of species and specimens captured per vegetation types. The habitats are described in "Materials and Methods" as follows: GF, gallery forest; SD, semideciduous forest; CE, cerrado *sensu stricto*; CC, campo cerrado; VE, vereda; CM, campo de murundum; CU, campo úmido; P, *Pinus* plantation; CO, carrasco; and HU, human buildings. T, total specimens. Seasons: ED, early dry season; LD, late dry season; and W, wet season. NS, not sampled

	GF	SD			CE			CC			VE		
	ED	ED	LD	W	ED	LD	W	ED	LD	W	ED	LD	W
DIDELPHIMORPHIA													
Cryptonanus agricolai											1		
Didelphis albiventris				2								1	1
Gracilinanus agilis	1		3	3	3							3	
Thylamys karimii					1								
RODENTIA													
Caviidae: Caviinae													
Galea spixii			5	2						2			
Echimyidae: Eumysopinae													
Thrichomys apereoides			6	8	4			2		2			
Cricetidae: Sigmodontinae													
Calomys expulsus			2		1								
Calomys tener			4								1		
Cerradomys marinhus												21	16
Cerradomys scotti			1		1			1			1		
Necromys lasiurus			2									1	
Nectomys squamipes													2
Oecomys bicolor group	5												
Oligoryzomys fornesi												5	
Oxymycterus delator											2	24	
Rhipidomys aff. *macrurus*	1			1	1								
Thalpomys cerradensis					1								
Thalpomys lasiotis													
Wiedomys cerradensis				3									
No. of specimens	7	NS	23	19	12	NS	NS	3	0	4	6	55	19
Trapping effort	400	NS	981	393	698	172	40	200	322	460	347	1237	598
Capture success (%)	1.7	NS	2.3	4.1	2.4	0	0	1.5	0	0.9	1.4	4.4	3.1

	CM			CU			P			CO	HU	T
	ED	LD	W	ED	LD	W	ED	LD	W	ED	W	
DIDELPHIMORPHIA												1
Cryptonanus agricolai												1
Didelphis albiventris												4
Gracilinanus agilis										8		21
Thylamys karimii												1
RODENTIA												
Caviidae: Caviinae												
Galea spixii												9
Echimyidae: Eumysopinae												
Thrichomys apereoides												22
Cricetidae: Sigmodontinae												
Calomys expulsus												3
Calomys tener			2	1				1				9
Cerradomys marinhus												37
Cerradomys scotti								5				9
Necromys lasiurus			1		1							5
Nectomys squamipes												2
Oecomys bicolor group												5
Oligoryzomys fornesi		1						1				7
Oxymycterus delator				20								46
Rhipidomys aff. *macrurus*											3	6
Thalpomys cerradensis												1
Thalpomys lasiotis		7			5							12
Wiedomys cerradensis												3
No. of specimens	NS	8	3	21	6	NS	NS	7	0	8	3	204
Trapping effort	NS	460	360	354	249		NS	118	104	158		7651
Capture success (%)	NS	1.7	0.8	4.8	2.4	NS	NS	5.9	0	5.5		2.6

Caatinga and Cerrado (Voss et al. 2005). This species was diagnosed by the absence of a secondary foramen ovale, which is present in *Gracilinanus agilis* (Voss et al. 2005), a similar sympatric species in the study area. *Cryptonanus agricolai* differs from other species of the genus by the combination of characters such as a whitish ventral fur, small molars, and a complete anterior cingulum on M3 (Voss et al. 2005).

Didelphis albiventris Lund, 1840 has a karyotype of 2*n* = 22, FNa = 20 (Fig. 2A). Four specimens were captured in the VE and SD (Table 1), with females lactating in Sept. (1 with 11 young) and Oct. (2 with 7 young each). This widespread species occurs in domains of Caatinga, Cerrado, Pantanal, Pampa, and the western limit of Atlantic Forest. White ears easily differentiate it from *D. marsupialis* Linnaeus, 1758 and *D. aurita* (Wied-Neuwied, 1826), which respectively occur in the western and eastern Cerrado (Carmignotto 2005).

Gracilinanus agilis (Burmeister, 1854) has a karyotype of 2*n* = 14, FNa = 24 (Fig. 2B). Twenty-one specimens were captured in the GF, SD, CE, VE, and CO (Table 1), with 1 pregnant female in Sept., and 2 post-weaning females in Oct. This widespread species occurs in the Caatinga, Cerrado, and Pantanal domains. It can be mistaken for other genera but differs from species of *Marmosa* Gray, 1821 and *Marmosops* Matschie, 1916 principally by its smaller head and body size (Gardner 2008). As to species presently found in the region, *G. agilis* differs from *Thylamys karimii* (Wagner, 1843) by the tail being longer than the head and body length (Gardner 2008), and from *C. agricolai* by the presence of a secondary foramen ovale (Voss et al. 2005).

Thylamys karimii (Wagner, 1842) has a karyotype of 2*n* = 14, FNa = 20 (Fig. 2C). One female specimen was captured in the CE. This non-pregnant female was captured in the early dry season. It is common in the area in regurgit. Barn Owl (*Tyto alba*) pellets (Bonvicino and Bezerra 2003). *Thylamys karimii* differs from *T. velutinus* by its brownish dorsum and whitish venter, while *T. velutinus* is reddish-brown dorsally and grayish ventrally; *T. karimii* also shows larger posterolateral palatal foramina and more-developed supraorbital ridges (Carmignotto and Monfort 2006). See above, in the *G. agilis* section, for morphologic comparisons between the genera *Thylamys* and *Gracilinanus*.

Rodentia: Caviidae: Caviinae

Galea spixii (Wagler, 1831) has a karyotype of 2*n* = 64, FNa = 118 or 120, and the X sexual chromosome was not identified (Fig. 2D). Nine specimens were captured in the SD and CC in sandy soils without rocks (Table 1). In the late dry season, 2 adult females were pregnant with 1 offspring each. One male and 1 female were juveniles. In the rainy season, 1 female was pregnant with 2 embryos, one was lactant, and another one was not reproductive. This species is restricted to the southwestern Caatinga and eastern Cerrado domains and is distinguished from other congeneric species occurring in the Cerrado by a set of morphometric characters (Bezerra 2008).

Rodentia: Echimyidae: Eumysopinae

Thrichomys apereoides (Lund, 1839) has a karyotype of 2*n* = 28, FNa = 52 (Fig. 2E). Two karyotypes were attributed to *Thr. apereoides sensu* Braggio and Bonvicino (2004). Topotypes from Lagoa Santa showed 2*n* = 28 and FNa = 50 (Pessôa et al. 2004), differing from those herein described by 1 pericentric inversion. This difference is similar to that found between *Thr. laurentius* (2*n* = 30, FNa = 54) and *Thrichomys* sp. (2*n* = 30, FNa = 56), suggesting that *Thr. apereoides* from the type locality and the one listed here might be different taxa. Twenty-two specimens were captured in the SD, CC, and CE (Table 1). All 3 adult females were pregnant with 2, 3, and 5 embryos, respectively, in the late dry season. In the rainy season, 2 females were pregnant with 4 and 3 embryos; 2 other females were juveniles. This species, a Cerrado endemic, has a long furry tail, grayish dorsum, whitish venter, and a ring of white hairs around the eyes.

Rodentia: Cricetidae: Sigmodontinae

Calomys expulsus (Lund, 1841) has a karyotype of 2*n* = 66, FNa = 68 (not shown), as in Svartman (1989) and Bonvicino and Almeida (2000). Three specimens were captured in the SD and CE (Table 1). In the late dry season, 2 females were pregnant with 6 and 3 embryos each. This widespread species from the Cerrado and Caatinga is sympatric with *Cal. tener* in the study area; it differs in having a larger body size, darker grayish-brown general coloration, and cranial characters such as a wider palate and 1st upper

molar, and more-projected anterior zygomatic plate board resulting in a larger zygomatic notch (Bonvicino and Almeida 2000).

Calomys tener (Winge, 1887) has a karyotype of 2*n* = 66, FNa = 66 (Fig. 3E). This karyotype was first described for specimens from Itapetininga, São Paulo State, under the identification *Calomys* sp. (Yonenaga 1975). Later, it was associated with *Cal*. *tener* (Svartman 1989). Nine specimens were captured in the SD, VE, CM, CU, and P (Table 1). One female was pregnant in Sept. (dry season) with 3 embryos. *Calomys tener* occurs in the central and southeastern Cerrado and transitional areas between the Caatinga and Atlantic Rainforest. It is sympatric with *Cal. expulsus* in the study area (see explanation in *Cal. expulsus*). *Calomys tener* is similar in external morphology to *Thalpomys lasiotis*, differing by a spot of post-auricular white hairs (Bonvicino et al. 2008). The dorsal coloration of this species varies from yellowish to light orangish-brown across its distribution.

Cerradomys marinhus (Bonvicino 2003) has a karyotype of 2*n* = 56, FNa = 54 (Fig. 3I). This karyotype was first reported for specimens identified as *Oryzomys* sp. n. 5 (Bonvicino and Moreira 2001) and afterwards was attributed to *Oryzomys marinhus* topotypes (Bonvicino 2003), and later this species was included in the genus *Cerradomys* (Weksler et al. 2006). Thirty-seven specimens were captured only in the VE (Table 1). In the late dry season, four of 8 adult females were pregnant, two with 4 embryos, one with 3 embryos, and another with 2 embryos. One female and 5

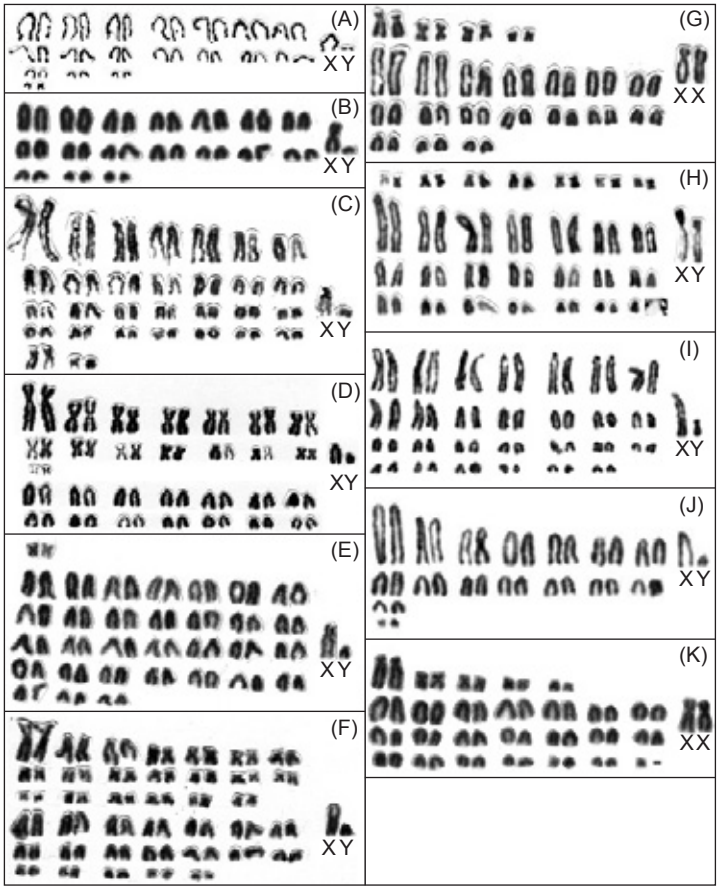

Fig. 3. Conventional Giemsa staining of the chromosome complements of (A) *Thalpomys lasiotis* (male MN 62657) with 2*n* = 38 and FNa = 38, (B) *Tha. cerradensis* (male CRB 2919) with 2*n* = 36 and FNa = 34, (C) *Oligoryzomys fornesi* (male MN 62638) with 2*n* = 62 and FNa = 64, (D) *Wiedomys cerradensis* (male MN 61657) with 2*n* = 60 and FNa = 88, (E) *Calomys tener* (male CRB 2927) with 2*n* = 66 and FNa = 66, (F) the *Oecomys bicolor* group (male CRB 2930) with 2*n* = 80 and FNa = 118, (G) *Rhipidomys* aff. *macrurus* (female CRB 1881) with 2*n* = 44 and FNa = 50, (H) *Cerradomys scotti* (male MN 61672) with 2*n* = 58 and FNa = 70, (I) *Cer. marinhus* (male MN 63826) with 2*n* = 56 and FNa = 54, (J) *Necromys lasiurus* (male CRB 1823) and 2*n* = 34 and FNa = 34, (K) *Oxymycterus delator* (female CRB 2935) with 2*n* = 54 and FNa = 62.

males were juveniles. In the rainy season, 2 of 5 females were pregnant, both with 2 embryos. This species was also recovered in regurgitated Barn Owl pellets collected in the region (Bonvicino and Bezerra 2003). This endemic Cerrado species occurs in Goiás State, southwestern Bahia State, and eastern Mato Grosso do Sul State. It differs from the sympatric *Cer. scotti*, by its larger body size, proportionally smaller ears, darker dorsal coloration, absence of an alisphenoid strut, more-robust skull, and very developed supraorbital crests (Bonvicino 2003).

Cerradomys scotti (Langguth and Bonvicino, 2002) has a karyotype of 2*n* = 58, FNa = 70 (Fig. 3H). This karyotype was first described in 1999 (Bonvicino et al. 1999); however, this species was only described 3 yr later, when the karyotype was attributed to topotypes (Langguth and Bonvicino 2002). Nine specimens were captured. Six specimens were captured in the SD and P in the late dry season, when open vegetation formations were dry, while 4 specimens were captured in the CE, CC, and VE in the early dry season, when open vegetation formations were still green (Table 1). Two females were pregnant with 3 and 6 embryos in the late dry season. This widespread species of the Cerrado and Pantanal differs from other *Cerradomys* species by its proportionally larger ears, lighter-colored pelage, and the presence of an alisphenoid strut in the skull (Bonvicino 2003). It is characterized by a long incisive foramen and poorly defined limits between the ventral and dorsal coloration.

Necromys lasiurus (Lund, 1841) has a karyotype of 2*n* = 34, FNa = 34 (Fig. 3J). Five specimens were captured in the SD, VE, CU, and CM (Table 1). No captured females were pregnant or lactating. Our data suggest that this species occurs in vegetation with both grass cover (CU, VE, and CM) and without (or low) grass cover (SD), being commoner in the former. Late dry-season fires had scorched much of the area where we captured *N. lasiurus*. This widespread species is found in the Caatinga, Cerrado, Pantanal, western Atlantic Forest, and southern Amazonia domains. The species can be mistaken for *Akodon* Meyen, 1833, but has a ring of light hairs around the eyes, a furrier tail, a shorter rostrum, broader molars, and a different karyotype (Bonvicino et al. 2008).

Nectomys squamipes Brants, 1827 has a karyotype of 2*n* = 56, FNa = 56, with diploid and fundamental numbers variation due to the presence of up to 3 supernumerary chromosomes (Bonvicino et al. 1996). Although normally abundant, only 2 specimens were captured in the VE (Table 1), confirming that *Nec. squamipes* occurs in habitats near watercourses (Ernest and Mares 1986). This widespread species occurs in both the Cerrado and Atlantic forest. It differs from *Nec. rattus* (Pelzeln, 1883) (2*n* = 52) in (1) a reduction of the supraorbital ridges that do not reach frontal and parietal suture as they do in *Nec. rattus*, and (2) a longer palatal bone that projects behind the molar row by about the M^1 length; in *Nec. rattus*, the shorter palatal bone projects beyond the end of the molar row by about the M^2 length (Bonvicino 1994).

The *Oecomys bicolor* group (*sensu* Musser and Carleton 2005) has a karyotype of 2*n* = 80, FNa = 118 (Fig. 3F). Five specimens were captured in the GF. No captured females were pregnant or lactating. This species group is characterized by its karyotype and by the tail being longer than the body, with a tuft of hair at its end, short broad feet, a whitish venter, a brownish dorsum, very long vibrissae, and a small body size (see Patton et al. 2000).

Oligoryzomys fornesi (Massoia, 1973) has a karyotype of 2*n* = 62, FNa = 64 (Fig. 3C). This karyotype was first reported in a Paraguayan example of *Oli. fornesi* (Myers and Carleton 1981) and was variously associated in Brazil with *Oli.* aff. *eliurus* in Pernambuco State (Furtado 1981), and to *Oli. eliurus* in Distrito Federal (Svartman 1989) and Goiás State (Andrades-Miranda et al. 2001), but Bonvicino and Weksler (1998) showed that this karyotype belongs to *Oli. fornesi*. Seven specimens were captured in the VE, CM, and P (Table 1), but the species also occurs in campo sujo and Cerrado outcrops (Carmignotto and Aires 2011). The captured female was not pregnant or lactating. This widespread, but not abundant species occurs in the Cerrado and Caatinga domains (Bonvicino et al. 2002). It can be differentiated from other congeneric species of lowland Cerrado, i.e., *Oli. nigripes* (Olfers, 1818), *Oli. moojeni* Weksler and Bonvicino (2005), and *Oli. stramineus* Bonvicino and Weksler (1998), by its yellower-gray venter, the absence of a ventral orange patch of hair on the forearms (*Oli. nigripes* and *Oli. stramineus*), and by the karyotype (Bonvicino and Weksler 1998, Weksler and Bonvicino 2005).

Oxymycterus delator Thomas, 1903 has karyotypic data shared by all *Oxymycterus* species of 2*n* = 54, FNa = 62 (Fig. 3K) despite major morphological differences (Oliveira 1998), and it was exclusively captured in the VE (Table 1).

Regurgitated pellets showed that Barn Owls eat this species in the area (Bonvicino and Bezerra 2003). Forty-six specimens were captured in the VE and CU. In the early dry season, 2 females were pregnant with 3 embryos each; in the late dry season, 1 female had 5 and 2 had 3 embryos, 2 were nulliparous, and 7 were not pregnant. *Oxymycterus delator* is widespread in the Cerrado and Caatinga domains and easily identified by its powerful claws and the dark dorsum contrasting with a yellowish-orange underside (Oliveira 1998).

Rhipidomys aff. *macrurus* has a karyotype of 2*n* = 44, FNa = 50 (Fig. 3G). Twenty of the 22 recognized species of this genus have the same diploid number (2*n* = 44) and variable fundamental numbers, of 48-74 (Zanchin et al. 1992). The other 2 species, *R. nitela* Thomas, 1901 and *R*. cf. *nitela*, have karyotypes of 2*n* = 48 and 2*n* = 50, respectively (Tribe 1996). *Rhipidomys macrurus* is characterized by a 2*n* = 44, FNa = 48 karyotype, whereas specimens studied had an additional median-sized biarmed pair, probably a result of a pericentric inversion. Due to this difference, these specimens are referred to as *R.* aff. *macrurus*. Furthermore, phylogenetic analyses with cytochrome *b* sequences showed that these 2 lineages were not monophyletic and are likely independent lineages (Souza 2011). Six specimens were captured in the HU, SD, and GF (Table 1). No captured females were pregnant. This genus is identifiable by its completely white belly, the tuft of hair on the tail, and short feet with a characteristic dark patch of hair on the upper surface of the manus and pes (Bonvicino et al. 1998).

Thalpomys cerradensis Hershkovitz, 1990 has a karyotype of 2*n* = 36, FNa = 34 (Fig. 3B). This karyotype was described based on G and C bands for specimens from Federal District and Bahia State (Andrade et al. 2004). One individual we collected was dropped by a Burrowing Owl (*Athene cunicularia*) at the CU and VE ecotone in the early dry season, and another was captured by a Sherman trap in the CE (Table 1). Barn Owl pellets in the region also included specimens (Bonvicino and Bezerra 2003). The single specimen of *Tha. cerradensis* captured in traps in the course of 3 expeditions suggests low density, trap shyness, or specialized micro-habitat use. Although there are few samples in museums, this rare species can be locally abundant, as in Tocantins State, where it was found to be one of the 4 most abundant cricetid rodent species (Carmignotto and Aires 2011). This endemic Cerrado species occurs in Distrito Federal and in the states of Goiás, Tocantins (south), Bahia (west), and Mato Grosso (southeast) (Andrade et al. 2004, Carmignotto and Aires 2011). Sympatric with *Tha. lasiotis*, it differs in a larger size and darker dorsal coloration, and the karyotype (Andrade et al. 2004).

Thalpomys lasiotis Thomas, 1916 has a karyotype of 2*n* = 38, FNa = 38 (Fig. 3A). The karyotype was first described in 1983 for specimens identified as *Akodon reinhardti* Langguth 1995 (Armada et al. 1983), which was later considered a junior synonym of *Tha. lasiotis* (Musser and Carleton 2005). Subsequently, a polymorphism (2*n* = 37 or 38, FNa = 38) resulting from a centric fusion of 2 autosomal chromosomes was described for specimens from Brasília, and also *A. reinhardti* (Yonenaga-Yassuda et al. 1987). The 1st association between *Tha. lasiotis* and 2*n* = 38, FNa = 38 was based on specimens from Federal District and Bahia State (Andrade et al. 2004). Twelve specimens were found in the CM and CU in the late dry season (Table 1), and this species was common in regurgitated Barn Owl pellets collected in the same season in Cocos, Jaborandi, and Bahia States (Bonvicino and Bezerra 2003). One female was pregnant with 2 embryos. This Cerrado endemic species is widespread, and its western limitis in Vilhena, extreme southern Rondônia State. Sympatric with *Tha. cerradensis* Hershkovitz, 1990, it differs in a smaller size and pale-yellowish dorsal coloration. Similar in external morphology to *Cal. tener* (Winge, 1887), also found in the area, it differs in lacking the white hair tufts at the ear base (Bonvicino et al. 2008).

Wiedomys cerradensis Gonçalves, Almeida and Bonvicino, 2005 has a karyotype of 2*n* = 60, FNa = 88 (Fig. 3D). This karyotype was first described in *W. cerradensis* topotypes (Gonçalves et al. 2005). Three specimens were captured in the SD (Table 1), one of which was a juvenile. The captured female was not pregnant. This endemic Cerrado species is found in southwestern Bahia, northeastern Goiás, and southern Tocantins States (Gonçalves et al. 2005, AMR Bezerra unpubl. data). It differs from other sympatric rodent species in its reddish rostrum nose, ears, and flanks all contrasting with the overall grayish coloration of the body, and from *W. pyrrhorhinus* (Wied-Neuwied, 1821) in the presence of an alisphenoid strut (Gonçalves et al. 2005).

DISCUSSION

In the Cerrado domain, relationships of species diversity with abundance, habitat, and seasonality are dynamic and unique to each area (Carmignotto 2005). However, general patterns like a preference for forested or open vegetation habitat are stable (Bezerra et al. 2009, Rocha et al. 2011). Despite this constant association, species appear to be able to choose between different environmental variables. In this study, *Thalpomys* species showed restricted habitat use, occurring only in natural grasslands, as *Oxymycterus delator*, *Net. squamipes*, and *Cer. marinhus*, which were found only in the VE, CU, and CM habitats. Species with arboreal habits (e.g., *Rhipidomys* aff. *macrurus*, *Oecomys bicolor* group, and *G. agilis*) were collected only in forest vegetation and adjacent open vegetation immediately adjacent to forested areas.

Pinus plantations provide a mesic habitat for small mammals, and thus there was high trap success in the dry season. The data suggest that in dry months small mammals' use of open vegetation habitats like the CC decreases and use of wetland habitat like the VE increases. Thus the relation between faunal composition and vegetation type varies among different seasons. More-complex vegetation (SD and VE with pioneer formations) presented higher species richness in both seasons, although the richness in the wet season in the VE decreased probably due to a higher water table. Specimens were only captured in the P during the dry session and only in the 1st 2 d of collection. Open vegetation formations (CU, CM, and CC) showed low species richness values in both seasons.

It is suggested that gallery and dry forests, which occupy < 20% of the Cerrado, are critical for a large portion of regional biodiversity (Silva and Bates 2002). However, open vegetation formations, despite lower species richness, contain the majority of Cerrado endemic small-mammal species (Bezerra 2005, Carmignotto 2005, Carmignotto et al. 2012). In the sampled area, four of the 5 Cerrado endemics are mainly open vegetation inhabitants (*Tha. lasiotis*, *Tha. cerradensis*, *Cer. marinhus*, and *Thr. apereoides*), and only 1 species (*W. cerradensis*) appears to be a forest inhabitant. Werneck (2011) suggested that the importance of forest formations to diversity levels is not equally distributed among taxonomic groups, being more important, for example, for large than small mammals. The data of our study fortify Werneck's hypothesis and corroborate that open vegetation formations are very important for small endemic rodents.

Five (38%) of the 16 small rodent species endemic to the Cerrado domain (Marinho-Filho et al. 2002, Carmignotto 2005, Bonvicino et al. 2008) occurred in the study area, showing the importance of this region for conservation (Fig. 1), and four of them have restricted distributions: *W. cerradensis*, *Tha. cerradensis*, *Cer. marinhus*, and *Thr. apereoides* (*sensu* Braggio and Bonvicino 2004) (Fig. 1). *Wiedomys cerradensis* is known from southwestern Bahia State and southern Tocantins State (Gonçalves et al. 2005, AMR Bezerra unpubl. data), *Tha. cerradensis* from Distrito Federal, southwestern Bahia State, Goiás State, and southeastern Mato Grosso State (Andrade et al. 2004), *Cer. marinhus* from southwestern Bahia and Goiás States, and *Thr. apereoides* from Goiás and Minas Gerais States. *Thalpomys lasiotis*, also considered a Cerrado endemic species (Fig. 1) was found in the study area, and in the extreme northwest of the Cerrado, near the Amazonian region.

The Cerrado is recognized as an important center of South American endemism (Müller 1973, Rizzini 1979, Cracraft 1985, Haffer 1985), which was confirmed for small rodents (Carmignotto 2005). The eastern Cerrado domain together with the Federal District totally or partially encompasses the home ranges of all 16 small endemic Cerrado rodents. The sampled area contains five of these, indicating this region's importance to Cerrado biodiversity, principally because most of these endemic species have restricted distributions and are closely associated with the environment that they inhabit (Bonvicino et al. 2002). The Brazilian Federal District (Distrito Federal) and neighboring areas as well as the Lagoa Santa region in the state of Minas Gerais have been intensely inventoried. Their high comparative endemism (Fig. 1) may be a consequence of this intensive sampling, as shown by Nogueira et al. (2011) for squamate reptiles, identifying 10 endemism areas in the Cerrado domain based on extensive field sampling, data on museum specimens, and the taxonomic literature. We anticipate that the picture shown in figure 1 will change with the intensification of inventories in the Cerrado domain's less-studied areas.

Acknowledgments: We are grateful to AC de Paula, L.S. Maroja, P.M. Borodin, J.F. Vilela, J.W. Costa, F.P. Caramaschi, V. Penna-Firme, M.A.M.

Moreira, and P.S. D'Andrea for help with fieldwork, and to B. Patterson and an anonymous referee for important comments and suggestions that greatly improved this manuscript. Logistical support was received from São Francisco da Trijunção Ranch. Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio) granted licenses for specimen collecting. This project was supported by PAPES/FIOCRUZ, FAPERJ, and CNPq.

REFERENCES

Andrade Afb, Cr Bonvicino. 2003. A new karyologic variant of *Oecomys* (Rodentia: Sigmodontinae) and its phylogenetic relationship based on molecular data. Genome **46:** 195-203.

Andrade Afb, Cr Bonvicino, DC Briani, S Kasahara. 2004. Karyologic diversification and phylogenetic relationships of the genus *Thalpomys* (Rodentia, Sigmodontinae). Acta Theriol. **49:** 181-190.

Andrades-Miranda J, LFB Oliveira, CAV Lima-Rosa, AP Nunes, NIT Zanchin, MS Mattevi. 2001. Chromosome studies of seven species of *Oligoryzomys* (Rodentia: Sigmodontinae) from Brazil. J. Mammal. **82:** 1080-1091.

Armada JL, LA Pereira, PGS Filho, HN Seuánez. 1983. Chromosome number in *Akodon reinhardti* Langguth, 1975 (Rodentia, Cricetidae). Mammal. Chromos. Newslett. **24:** 176-182.

Bezerra AMR. 2005. Endemic mammals of the Cerrado. Ciên. Hoje Crianças **18:** 2-6. (in Portuguese)

Bezerra AMR. 2008. Taxonomic revision of the genus *Galea* Meyen, 1832 (Rodentia: Caviidae: Caviinae). Unpublished PhD dissertation PPG Animal Biology, Univ. de Brasília, Distrito Federal, Brazil. (in Portuguese with English summary)

Bezerra AMR, CR Bonvicino, AAN Menezes, JS Marinho-Filho. 2010. Endemic climbing cavy *Kerodon acrobata* (Rodentia: Caviidae: Hydrochoerinae) from dry forest patches in the Cerrado domain: new data on their distribution, natural history, and morphology. Zootaxa **2724:** 29-36.

Bezerra AMR, AP Carmignotto, FHG 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. Zool. Stud. **48:** 861-874.

Bonvicino CR. 1994. Speciation of the water-rat *Nectomys* (Rodentia, Cricetidae): karyologic, morphologic and geographic approach. PhD dissertation, Genetics Department, Univ. Federal do Rio de Janeiro, Brazil. (in Portuguese)

Bonvicino CR. 2003. A new species of *Oryzomys* (Rodentia, Sigmodontinae) of the *subflavus* group from the Cerrado of central Brazil. Mammalian Biology **68:** 78-90.

Bonvicino CR, FC Almeida. 2000. Karyotype, morphology and taxonomic stats of *Calomys expulsus* (Rodentia: Sigmodontinae). Mammalia **64:** 339-351.

Bonvicino CR, AMR Bezerra. 2003. Use of regurgitated pellets of barn owl (*Tyto alba*) for inventorying small mammals in the Cerrado of central Brazil. Stud. Neotrop. Fauna Environ. **38:** 1-6.

Bonvicino CR, PS D'Andrea, R Cerqueira, HN Seuánez. 1996. The chromosomes of *Nectomys* (Rodentia, Cricetidae) with 2n=52, 56, and interspecific hybrids (2n=54). Cytogen. Cell Genet. **73:** 190-193.

Bonvicino CR, B Lemos, M Weksler. 2005. Small mammals of Chapada dos Veadeiros National Park (Cerrado of central Brazil). Ecologic, karyologic and taxonomic considerations. Braz. J. Biol. **65:** 395-406.

Bonvicino CR, SM Lindbergh, L Maroja. 2002. Small non-flying mammals from conserved and altered areas of Atlantic forest and Cerrado: comments on their potential use for monitoring environment. Braz. J. Biol. **62:** 765-774.

Bonvicino CR, MAM Moreira. 2001. Molecular phylogeny of the genus *Oryzomys* (Rodentia: Sigmodontinae) based on cytochrome *b* sequence data. Mol. Phylogen. Evol. **18:** 282-292.

Bonvicino CR, JA Oliveira, PS D'Andrea. 2008. Guide of the rodents of Brazil with keys for genera, based on external characters. Rio de Janeiro: Centro Pan-Americano de Febre Aftosa- OPAS/OMS. (in Portuguese)

Bonvicino CR, IB Otazú, PM Borodin. 1999. Chromosome variation in *Oryzomys subflavus* species group (Sigmodontinae, Rodentia) and its taxonomic implication. Cytologia **64:** 327-332.

Bonvicino CR, M Weksler. 1998. A new species of *Oligoryzomys* (Rodentia, Sigmodontinae) from central Brazil. Z. Säugetierk **63:** 90-103.

Braggio E, CR Bonvicino. 2004. Molecular divergence in the genus *Thrichomys* (Rodentia, Echimyidae). J. Mammal. **85:** 7-11.

Cáceres NC, MR Bornschein, WH Lopes, AR Percequillo. 2007. Mammals of the Bodoquena Mountains, southwestern Brazil: an ecological and conservation analysis. Rev. Bras. Zool. **24:** 426-435.

Carmignotto AP. 2005. Non volant small mammals of the Cerrado biome: local and regional faunistic patterns. Unpublished PhD dissertation, PPG Zoology, Univ. de São Paulo, São Paulo, Brazil. (in Portuguese with English summary)

Carmignotto AP, CC Aires. 2011. Non-volant mammals (Mammalia) from Estação Ecológica Serra Geral do Tocantins. Biota Neotrop. **11:** 307-322. (in Portuguese with English summary)

Carmignotto AP, M de Vivo, A Langguth. 2012. Mammals of the Cerrado and Caatinga: distribution patterns of the tropical open biomes of Central America. Chapter 14. *In* BD Patterson, E Costa, eds. Bones clones and biomes. Chicago, IL: Univ. of Chicago Press, 368 pp.

Carmignotto AP, T Monfort. 2006. Taxonomy and distribution of the Brazilian species of *Thylamys* (Didelphimorphia: Didelphidae). Mammalia **70:** 126-144.

Cracraft J. 1985. Historical biogeography and patterns of differentiation within the South America avifauna: areas of endemism. Ornithol. Monogr. **36:** 49-84.

Eiten G. 1983. Vegetation classification of Brazil. Brasília, DF: Conselho Nacional de Pesquisa. (in Portuguese)

Eiten G. 1992. The Cerrado vegetation of Brazil. Bot. Rev. NY **38:** 201-341.

Ernest KA, MA Mares. 1986. Ecology of *Nectomys squamipes*, the Neotropical water rat, in central Brazil: home range, habitat selection, reproduction and behaviour. J. Zool. **210:** 599-612.

Furtado V. 1981. Chromosomic diversity in rodents of the families Cricetidae and Caviidae of Pernambuco state,

Brazil. Unpublished MSc thesis. Univ. Federal do Rio Grande do Sul, Porto Alegre, Brazil. (in Portuguese with English summary)

Gardner AL. 2008. Mammals of South America. Vol. 1. Marsupials, xenarthrans, shrews, and bats. Chicago, IL: Univ. of Chicago Press.

Gonçalves PR, FC Almeida, CR Bonvicino. 2005. A new species of *Wiedomys* (Rodentia: Sigmodontinae) from Brazilian Cerrado. Mammal. Biol. **70:** 46-60.

Haffer J. 1985. Avian zoogeography in the Neotropical lowlands. Ornithol. Monogr. **36:** 113-146.

IBGE. 2004. Map of biomes of Brazil. 2nd ed. Scale 1:5.000.000. Rio de Janeiro, RJ: Instituto Brasileiro de Geografia e Estatística. (in Portuguese)

Langguth AR, CR Bonvicino. 2002. The *Oryzomys subflavus* species group, with description of two new species (Rodentia, Muridae, Sigmodontinae). Arq. Mus. Nac. Rio de Janeiro **60:** 285-294.

Mares MA, KA Ernest. 1995. Population and community ecology of small mammals in a gallery forest of central Brazil. J. Mammal. **76:** 750-768.

Marinho-Filho J, FHG Rodrigues, KM Juarez. 2002. The Cerrado mammals: diversity, ecology and natural history. *In* PS Oliveira, RJ Marquis, eds. The Cerrados of Brazil. Columbia, NY: Columbia Univ. Press, pp. 266-284.

Müller P. 1973. The dispersal centers of terrestrial vertebrates in the Neotropical realm. Biogeographica **2:** 1-244.

Musser GM, MD Carleton. 2005. Family Muridae. *In* DE Wilson, DM Reeder, eds. Mammal species of the world. A taxonomic and geographic reference. Baltimore, MD: Johns Hopkins Univ. Press, pp. 894-1531.

Myers N, RA Mittermeier, CG Mittermeier, GAB Fonseca, J Kent. 2000. Biodiversity hotspots for conservation priorities. Nature **403:** 853-858.

Myers P, MD Carleton. 1981. The species of *Oryzomys* (*Oligoryzomys*) in Paraguay and the identity of Azara's "Rat sixième ou Rat à Tarse Noir". Misc. Publ. Mus. Zool. Univ. MI **161:** 1-41.

Nimer E. 1989. Climatology in Brazil, 2nd ed. Rio de Janeiro, RJ:, Instituto Brasileiro de Geografia e Estatística. (in Portuguese)

Nogueira C, S Ribeiro, GC Costa, GR Colli. 2011. Vicariance and endemism in a Neotropical savanna hotspot: distribution patterns of Cerrado squamate reptiles. J. Biogeogr. **38:** 1907-1922.

Oliveira JA de. 1998. Morphometric assessment of species groups in the South American rodent genus *Oxymycterus* (Sigmodontinae), with taxonomic notes base on the analysis of type material. PhD dissertation, Texas Tech Univ., Lubbock, TX.

Patton JL, MNF da Silva, JR Malcolm. 2000. Mammals of the rio Juruá and the evolution and ecological diversification of Amazônia. Bull. Am. Mus. Nat. Hist. **244:** 1-306.

Pessôa LM, MMO Corrêa, JA Oliveira, GMO Lopes. 2004. Karyological and morphometric variation in *Thrichomys* (Rodentia, Echimyidae). Mammal. Biol. **80:** 385-395.

Pereira LG, L Geise. 2009. Non-flying mammals of Chapada Diamantina (Bahia, Brazil). Biota Neotrop. **9:** 185-196.

Ribeiro R, J Marinho-Filho. 2005. Community structure of small mammals (Mammalia, Rodentia) from Estação Ecológica de Águas Emendadas, Planaltina, Distrito Federal, Brazil. Rev. Bras. Zool. **22:** 898-907. (in Portuguese with English summary)

Rizzini CT. 1979. Phytogeographic treaty of Brazil. Vol. 2. Ecological aspects. São Paulo, SP: Hucitec, Ed. Univ. de São Paulo. (in Portuguese)

Rocha CR, R Ribeiro, FSC Takahashi, J Marinho-Filho. 2011. Microhabitat use by rodent species in a central Brazilian cerrado. Mammal. Biol. **76:** 651-653.

Silva JMC, JM Bates. 2002. Biogeographic patterns and conservation in the South American Cerrado: a tropical savanna hotspot. Bioscience **52:** 225-233.

Souza A. 2011. Morphological variability, cytogenetics and molecular of selected species of sigmodontine and hystricognath rodents occurring in Brazil. Unpublished PhD dissertation, PPG Biological Sciences (Zoology), Museu Nacional, Univ. Federal do Rio de Janeiro, Rio de Janeiro, Brazil. (in Portuguese with English summary)

Svartman M. 1989. Karyotypical survey of rodent species from Distrito Federal, Brazil. Unpublished MSc thesis, Univ. de São Paulo, São Paulo, Brazil. (in Portuguese with English summary)

Tribe CJ. 1996. The Neotropical rodent genus *Rhipidomys* (Cricetidae: Sigmodontinae) - a taxonomic revision. PhD dissertation, Univ. College, London.

Voss RS, DP Lunde, SA Jansa. 2005. On the contents of *Gracilinanus* Gardner and Creighton, 1989, with the description of a previously unrecognized clade of small didelphid marsupials. Am. Mus. Novitates **3482:** 1-34.

Weksler M, CR Bonvicino. 2005. Taxonomy of pigmy rice rats (genus *Oligoryzomys*, Rodentia: Sigmodontidae) of the Brazilian Cerrado, with the description of two new species. Arq. Mus. Nac. Rio de Janeiro **63:** 113-130.

Weksler M, AR Percequillo, RS Voss. 2006. Ten new genera of oryzomyine rodents (Cricetidae: Sigmodontinae). Am. Mus. Novitates **3537:** 1-29.

Werneck FP. 2011. The diversification of eastern South American open vegetation biomes: historical biogeography and perspectives. Q. Sci. Rev. **30:** 1630-1648.

Wilson DE, DM Reeder. 2005. Mammal species of the world - a taxonomic and geographic reference. 2nd ed. 2 Vols. Washington DC: Smithsonian Institute Press.

Yonenaga Y. 1975. Karyotype and chromosome polymorphism in Brazilian rodents. Caryologia **28:** 269-286.

Yonenaga-Yassuda Y, LA Pereira, JL Armada, M L'abbate. 1987. Chromosomal polymorphism in *Akodon reinhardti* Langguth, 1975 (Rodentia, Cricetidae). Rev. Bras. Gen. **10:** 199-208.

Zanchin N, A Langguth, MS Mattevi. 1992. Karyotypes of Brazilian species of *Rhipidomys* (Rodentia, Cricetidae). J.Mammal. **73:** 120-122.

Appendix 1. List of captured specimens. MN, mammal collection, Museu Nacional, UFRJ, Rio de Janeiro, Brazil; CRB, field number of Cibele R. Bonvicino

DIDELPHIMORPHIA
Cryptonanus agricolai: CRB1658.
Didelphis albiventris: MN66015, CRB11666, CRB1849, CRB1870.
Gracilinanus agilis: MN61651, MN66009-14, CRB1648, CRB1850, CRB2925, CRB2932, CRB2955, CRB2956-8, CRB2965, CRB2969-CRB2971, CRB2924, CRB2972.
Thylamys karimii: CRB2967.
RODENTIA, Caviinae, *Galea spixii*: MN66028-35, MN61660.
RODENTIA, Eumysopinae, *Thrichomys apereoides* MN61659, MN66017-27, CRB1871, CRB1875, CRB1886, CRB1887, CRB2918, CRB2923, CRB2937, CRB2938, CRB2946, CRB2968.
RODENTIA, Sigmodontinae
Calomys expulsus: MN61658, MN61606, CRB2966.
Calomys tener: MN61649, MN62641-6, CRB2927, CRB2953.
Cerradomys marinhus: MN63810-7, MN63819-35, MN63837-9, MN64836, CRB1577, CRB1585, CRB1601, CRB1645, CRB1673, CRB1835, CRB1872, CRB1883.
Cerradomys scotti: MN61667, MN61668-72, CRB2920, CRB2940, CRB2933.
Necromys lasiurus: MN61607, MN61654, CRB1610, CRB1669, CRB1825.
Nectomys squamipes: MN63818, CRB1882.
Oecomys gr. *bicolor*: CRB2930, CRB2943, CRB2944, CRB2945, CRB2954.
Oligoryzomys fornesi: MN 62637, MN62638, MN61605, CRB1665, MN62640, CRB1649, CRB1879.
Oxymycterus delator: MN66036-51, CRB1556, CRB1581, CRB1582, CRB1597, CRB1615-7, CRB1642, CRB1832, CRB2921, CRB2922, CRB2928, CRB2929, CRB2934-6, CRB2939, CRB2941, CRB2942, CRB2948-52, CRB2959, CRB2960-4.
Rhipidomys aff. *macrurus*: MN62177, MN61650, CRB1881, CRB1884, CRB2931, CRB2947.
Thalpomys cerradensis: MN59503.
Thalpomys lasiotis: MN61652, MN62651-9, MN66008, CRB1674.
Wiedomys cerradensis: MN67023, MN61657, MN67022.