

New records of bats for the state of Piauí, northeastern Brazil (Mammalia: Chiroptera)

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ABSTRACT: We provide four news records of bats—*Micronycteris hirsuta* (Peters, 1869), *Dermanura gnoma* (Handley, 1987), *Myotis riparius* Handley, 1960, and *Myotis lavalii* Moratelli, Peracchi, Dias and Oliveira, 2011 to the Piauí State, northestern Brazil. We also provide measurements and taxonomic comments about the species recorded. With these new records, 59 bat species are now recognized for the Piauí.

Brazil has one of the highest mammal diversities in the world (Costa *et al.* 2005). Currently, about 701 native species of 12 orders are known for the country (Paglia *et al.* 2012). Chiroptera is the second most diverse order in the country with 177 species of 68 genera and nine families, which correspond to approximately 25% of the Brazilian mammal fauna (Gregorin *et al.* 2011a; Paglia *et al.* 2012; Nogueira *et al.* 2012; Castro *et al.* 2012). Despite these impressive numbers and the considerable increase in the number of recorded bat species in the last 15 years, there are large gaps of knowledge on the occurrence, biology and distribution of Brazilian bats since less than 10% of the Brazilian territory may be considered minimally sampled for Chiroptera (Bernard *et al.* 2011). Recent data point out that more than half of the original areas of Caatinga and Cerrado have been severely modified by human activities, in particular agriculture, with high risk of desertification and loss of endemic species (Casteletti *et al.* 2003; Costa *et al.* 2005). Although there are important survey works on bat faunas from several localities within the limits of these biomes (Mares *et al.* 1985; Willig 1985; 1986; Willig and Mares 1989; Gonçalves and Gregorin 2004; Esbérard *et al.* 2005; Zortéa and Alho 2008; Gregorin *et al.* 2011b), they are considered the least known since only 7% of the Caatinga and 6% of the Cerrado may be considered partially inventoried for bats (Bernard *et al.* 2011).

The state of Piauí comprises several types of vegetation (CEPRO 1990; Castro 2007). The main predominant phytophysionomies are xerophytic vegetation, associated with the semi-arid climate characteristic of the Caatinga biome in the eastern region of the state, and the shrubby non-deciduous arboreous vegetation of the Cerrado, associated with the sub-humid climate of the southwestern region of the state. There are also the mixed sub-deciduous seasonal forests or babaçu forest, the dry forests, the vine

forests, the complexes of the coastal zone (mangroves, dunes, and restingas) and transitional areas between ecosystems, in particular the Cerrado/Caatinga ecotone, which covers the southern axis of the state (Castro 2007).

Southwestern Piauí is one of the most poorly sampled regions for bats in Brazil and as a consequence it is considered a priority area for bat inventories (Bernard *et al.* 2011). Although a large part of this region is part of the Cerrado biome, it also harbors a complex ecotone resulting from the transition to the Caatinga, in which different plant communities may occur, such as semi-deciduous Cerrado with caatinga elements (Prado 2003). Currently, there are 55 species pertaining to nine families known for the state of Piauí (Reis *et al.* 2007; Gregorin *et al.* 2008; Tavares *et al.* 2008; Peracchi *et al.* 2011).

In the present study, we report four news records of bats for the state of Piauí: *Micronycteris hirsuta*, *Dermanura gnoma*, *Myotis riparius*, and *Myotis lavalii*, obtained from bat inventories carried out in two municipalities in the Cerrado and the Cerrado/Caatinga ecotone, in the southwestern region of the state.

Bats were captured from 13th July to 10th August 2010, in four sampling areas in the southwestern region of Piauí. We distributed the sampling areas within the municipalities of Ribeiro Gonçalves, where cerrado grasslands (campos cerrados) and cerrado forests (cerradões) predominate; and Colônia de Gurguéia, where cerrado grasslands, cerrado forests, and arboreous caatingas occur (Figure 1—CEPRO 1990; Castro 2007). For capturing bats we used 10 mist nets (9 m x 2.5 m), which remained open for six hours from sunset on, during five nights in each sampling area. On each night, we set up the nets at ground level, along trails or in gaps, at different sites. We checked the nets every 20 min. The total sampling effort in each area was 6,750 m².h (following Straube and Bianconi 2002).

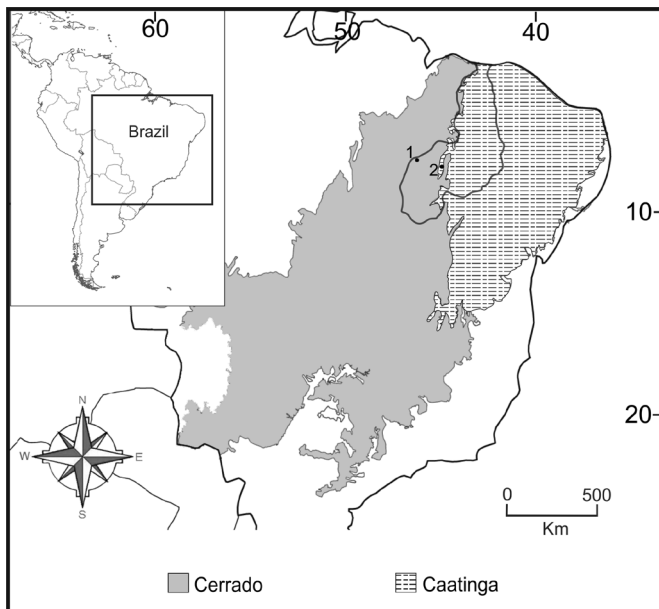


FIGURE 1. Map of the state of Piauí, showing the sampling sites. 1 - Ribeiro Gonçalves, 2 - Colônia de Gurguéia.

In this region the Cerrado predominates and is composed mainly of shrubby and non-deciduous arboreal vegetations (CEPRO 1990; Castro 2007). The climate is hot sub-humid tropical, the average annual temperatures varies from 26.3 to 27.0°C, the annual rainfall varies from 1,207 to 1,790 mm, and the water deficit varies from 365 to 560 mm; the rains are unevenly distributed, but slightly concentrated from December to April (Castro 2007). Transitional areas between Cerrado and Caatinga are also represented in southwestern Piauí; there is Cerrado associated with xerophytic formations, such as arboreal and shrubby Caatinga (Castro 2007). The climate in the region is hot semi-arid tropical, with an average rainfall of 825.7 mm, and a dry season lasting on average six months (CEPRO 1990). Specimens were collected under ICMBio/SISBIO license 02001.001111/2008-14.

Voucher specimens were preserved in alcohol 70° and are currently deposited in the Collection of Mammals at the Museu Nacional (MN), Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil.

Following the protocol proposed by Taddei *et al.* (1998), and using digital calipers accurate to 0.02 mm, we recorded 12 measurements (in mm) for the specimens collected (Tables 1): forearm length (FA), greatest length of skull (GLS), condylo-incisive length (CIL), maxillary tooth-row length (MTL), breadth across the upper molars (BAM), breadth across the cingula of the upper canines (BAC), postorbital breadth (POB), braincase breadth (BCB), zygomatic breadth (ZB), mastoid breadth (MB), mandibular length (ML), and mandibular tooth-row length (MDTL).

We report below the new records to the Piauí State. For each species we comment identifications and distributions.

***Micronycteris hirsuta* (Peters, 1869)**

We collected one adult female *Micronycteris hirsuta* (MN 75011) (Figure 2A) and identified it following Sanborn (1949), Genoways and Williams (1986), Simmons (1996), Simmons *et al.* (2002) and Williams and Genoways (2008). *Micronycteris hirsuta* is the largest species of the

genus and the measurements of the specimen collected (Table 1) fit the range recorded for specimens from other localities (*e.g.*, Genoways and Williams 1986; Simmons 1996; Simmons and Voss 1998; Simmons *et al.* 2002). The dorsal fur is long, silky, dense, and dark grayish-brown. The venter is pale-brown. The ears are connected across the crown of the head by a low interauricular skin band, without notch. The lower incisors are markedly hypsodont, with long and narrow crowns and a bilobate cutting edge (Simmons *et al.* 2002).

In Brazil, *M. hirsuta* has been recorded only in the Amazon and Atlantic Forest (Paglia *et al.* 2012), in the states of Acre, Amazonas, Bahia, Espírito Santo, Pará, Rio de Janeiro, and Roraima (Mok *et al.* 1982; Peracchi and Albuquerque, 1985; Nogueira *et al.* 1999; Simmons *et al.* 2002; Esbérard 2004; Bernard and Fenton 2007; Faria *et al.* 2006). Our specimen was collected from a secondary riparian forest, in a Cerrado area in the municipality of Ribeiro Gonçalves (07°40'57" S; 45°09'30" W), approximately 15 km away from the Parnaíba River. In the Cerrado, riparian or gallery forests are humid mesophytic formations that occur along watercourses (Eiten 1990). Although our record may be considered the first for the Brazilian cerrado, it is important to highlight that this species seems to prefer humid environments in primary and secondary forests (Genoways and Williams 1986; Peracchi and Albuquerque 1993; Bernard and Fenton 2002; Esbérard 2004) and inside forest fragments (Faria 2006).

***Dermanura gnoma* (Handley, 1987)**

The *Dermanura gnoma* specimen (MN 73548) was identified according to previous descriptions and measurements reported for this species (Handley 1987; Simmons and Voss 1998; Gonçalves and Gregorin 2004; Lim *et al.* 2008). Our specimen has pale-brown dorsal fur, and the ventral fur is even paler than the dorsal; it has distinct white and prominent facial stripes above and below the eyes, bright yellow color on the tragus, noseleaf and edge of the ears, and yellowish warts on the chin (Figure 2B). The specimen has also a small third lower molar, short rostrum with a concavity on the dorsal surface, inflated anterorbital region, posteriorly constricted mesopterygoid pit and maxillary tooth-row length below 6.20 mm (Table 1). *Dermanura cinerea* Gervais, 1856, recorded for the state of Piauí (Peracchi *et al.* 2010; 2011), is on average larger than *D. gnoma* and differs from it by having a dark noseleaf and pale cream tragus and edge of the ears, brown warts on the chin, absence of a third lower molar, long rostrum, not inflated anterorbital region, mesopterygoid pit not constricted posteriorly and maxillary tooth-row length over 6.20 mm (Handley 1987; Simmons and Voss 1998; Gonçalves and Gregorin 2004; Lim *et al.* 2008).

In Brazil, *D. gnoma* is distributed in the Amazon, Atlantic Forest, and Cerrado (Paglia *et al.* 2012), in the states of Amazonas, Amapá, Bahia, Espírito Santo, Mato Grosso, Pará, and Rondônia (Peracchi *et al.* 2011). The examined specimen was collected in a disturbed area in a buriti forest associated with a watercourse (07°36'43" S; 45°06'7" W), in the municipality of Ribeiro Gonçalves. This species has been found in primary and secondary forests, riparian forests, and secondary forest, in dry and

open areas such as Cerrado, as well as in disturbed areas, such as orchards and plantations (Handley 1987; Aguiar *et al.* 1995; Bernard and Fenton 2002; Marques-Aguiar *et al.* 2002; Gonçalves and Gregorin 2004).



FIGURE 2. Bats collected in a cerrado area in the municipality of Ribeiro Gonçalves, state of Piauí, Brazil: A) *Micronycteris hirsuta* and B) *Dermanura gnoma*. Photos by André Pol.

***Myotis riparius* Handley, 1960**

We collected one adult female of *M. riparius* (MN 75016) that fits diagnostic traits and dimensions provided by LaVal (1973), Bárquez *et al.* (1999), and López-González *et al.* (2001). The plagiopatagium is attached at the level of the toes by a broad band of membrane (López-González *et al.* 2001; figure 1, p. 141), and the fringe of hairs along the trailing edge of the uropatagium is absent. Our specimen has woolly and short fur, and short and narrow ears. The dorsal fur is bicolor with dark-brown base and light-brown burned tip, which contrast slightly. The ventral fur is markedly bicolor with dark-brown base and pale tip. A low sagittal crest is present and the ratio between the postorbital constriction and the breadth across the canines

is over 1.00, as generally reported for this species (LaVal 1973; López-González *et al.* 2001). The second upper premolar (P3) is shorter than one-fourth of the height of P4 in labial view, and is aligned in the tooth-row. Variation in position and displacement of P3 exist in specimens of *M. riparius* and *M. nigricans* (Schinz, 1821) in some localities, P3 is not always crowded to the lingual side in *M. riparius* and may be crowded in some *M. nigricans* (see LaVal 1973; Simmons and Voss 1998; López-González *et al.* 2001; Dias and Peracchi 2007; 2008). Nonetheless, *M. nigricans* is on average smaller than *M. riparius*, and it usually has long and silky dorsal fur; the ratio between the postorbital constriction and the breadth across the canines is below 1.00 and the sagittal crest is usually absent (LaVal 1973; Lopez-González *et al.* 2001).

Myotis riparius has been recorded in Brazil in the states of Acre, Amazonas, Amapá, Bahia, Espírito Santo, Minas Gerais, Mato Grosso, Pará, Paraná, Rio de Janeiro, Rio Grande do Sul, Santa Catarina, and São Paulo (Gonçalves and Gregorin 2004; Peracchi *et al.* 2011). This species occurs in the Amazon, Atlantic Forest, Cerrado, and Caatinga (Paglia *et al.* 2012). In the Cerrado, a *M. riparius* specimen was collected in a gallery forest (Gonçalves and Gregorin 2004) and others specimens collected in humid forest/humid grassland ecotone and cerrado *strictu sensu*/gallery forest ecotone (Gregorin *et al.* 2011b). Our specimen examined was collected in a gallery forest, in the municipality of Ribeiro Gonçalves (07°41'49" S; 45°08'14" W), within the Cerrado biome. This record corroborated previous observations of a possible preference of this species for forest areas and humid environments, in particular close to rivers and watercourses, where it is frequently found foraging over water (*e.g.* Dias and Peracchi 2007; Simmons and Voss 1998; Wilson 2008).

***Myotis lavalii* Moratelli, Peracchi, Dias, and Oliveira, 2011**

We collected one adult male (MN 75034) and two adult females (MN 73549, MN 75035) of *Myotis lavalii*. This species presents long and silky fur and its plagiopatagium is attached to the toes by a broad band of membrane. The dorsal fur is markedly bicolor with brown hair bases (2/3 of total length) and light-brown tips. The ventral fur is also bicolor with dark-brown bases and yellowish tips. The fringe of hairs of hairs along the trailing edge of uropatagium is absent, golden hairs are present on its proximal dorsal surface and on the femur. The postorbital constriction is narrow, the breadth across the canines/postorbital breadth ratio is over 1.00, the forehead is steeply sloping with regards to the skull, with a round supraoccipital region, and low sagittal crest present. This combination of characters distinguishes *M. lavalii* from all other Brazilian species of *Myotis* Kaup, 1829 (Moratelli *et al.* 2011). In two specimens, the second upper premolar (P3) is aligned to the toothrow and in one specimen the P3 is displaced to the lingual side. Variations in position and displacement of P3 have been found among specimens of *M. lavalii* (Moratelli *et al.* 2011).

We collected *M. lavalii* specimens in a shrubby caatinga (08°10'54" S; 43°42'22" W), in the municipality of Colônia de Gurguéia, located in the Cerrado/Caatinga ecotone. Before the present record, *M. lavalii* was only known

through the type series from Exu, state of Pernambuco, and from specimens collected in the states of Ceará and Bahia, within the limits of the Caatinga. Most of these specimens were collected in sub-humid and deciduous forests, between elevations from 390 to 900 m with relatively cold and wet climatic conditions compared to the dry adjacent localities in lower altitudes within the limits of Caatinga biome (Moratelli *et al.* 2011).

The bat fauna of Piauí is still poorly known, but with these new records (*M. hirsuta*, *D. gnoma*, *M. lavalii*, and *M. riparius*), 59 species are now recognized (Tavares *et al.*

2008; Gregorin *et al.* 2008; Peracchi *et al.* 2011; present study). We expect a higher diversity due to the mosaic of vegetations found in Piauí (CEPRO 1990; Castro 2007), since it affects species occurrence and distribution, and it is possible to find taxonomic assemblages that are characteristic of different adjacent formations. Hence, the intensification of sampling efforts in localities that harbor all physiognomies could strongly contribute to a better knowledge of bat diversity in Piauí and, in a broader context, it could contribute to clarify bat ecology and distribution.

TABLE 1. Selected measurements of four bat species recorded for the first time in the state of Piauí, northeastern Brazil. M = male; F = female.

	<i>Micronycteris hirsuta</i>	<i>Dermanura gnoma</i>	<i>Myotis lavalii</i>		<i>Myotis riparius</i>
	MN 75011	MN 73548	MN 75034	MN 73549, 75035	MN 75016
	F	M	M	F	F
FA	45.54	37.50	33.34	32.44 – 33.00	34.76
GLS	23.16	18.90	13.76	13.40 – 13.48	14.00
CIL	20.52	17.02	13.02	12.60 – 12.88	13.34
MTL	9.22	5.96	5.20	5.00 – 5.30	5.42
BAM	7.24	7.96	5.34	5.32 – 5.34	5.54
BAC	4.22	5.12	3.34	3.38 – 3.42	3.52
POB	4.80	4.92	3.34	3.26 – 3.36	3.44
BCB	8.74	8.70	6.26	6.34 – 6.36	6.44
ZB	11.20	10.56	8.00	8.00 – 8.10	7.78
MB	10.00	10.00	6.82	6.78 – 6.84	6.92
ML	15.50	11.52	9.72	9.46 – 9.72	9.82
MDTL	10.04	6.48	5.54	5.26 – 5.54	5.70

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