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Artículo

BATS (MAMMALIA: CHIROPTERA) FROM THE CAATINGA SCRUBLANDS OF THE CRATEUS REGION, NORTHEASTERN BRAZIL, WITH NEW RECORDS FOR THE STATE OF CEARÁ

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*In Memoriam

ABSTRACT. Whereas surveys of the bat fauna are available for some localities in the Brazilian Northeast, studies in the caatinga scrublands are still limited. The aim of this study was to survey the bat fauna in an area of caatinga scrublands in the Private Natural Heritage Reserve (RPPN Serra das Almas), which is located on the Ibiapaba Plateau, State of Ceará. The bat assemblage of the reserve was surveyed in July 2012 (rainy season), and January 2013 (dry season), with a total of 19 sampling nights. We captured 347 individuals of 23 species representing six families. The bat fauna was characterized by the predominance of a few abundant species, in particular phyllostomid frugivores, and many rare species, which is frequent in studies based on mist nets at ground level. The first records of *Tonatia saurophila* and *Chiroderma vizottoi* (recently described and known only from its type locality) are reported for the State of Ceará, where 66 bat species are now known to occur.

RESUMO. Morcegos de uma área de Caatinga arbustiva na região de Crateús, nordeste do Brasil (Mammalia: Chiroptera), com novos registros para o estado do Ceará. Embora inventários da quiropterofauna estejam disponíveis para algumas localidades do Nordeste brasileiro, os estudos em área de caatinga arbustiva ainda são escassos. O objetivo deste estudo foi realizar um levantamento e atualização da quiropterofauna em uma área de caatinga arbustiva na Reserva Particular do Patrimônio Natural (RPPN Serra das Almas), localizada no Planalto da Ibiapaba, estado do Ceará. A assembleia de morcegos da Reserva foi inventariada em julho de 2012 (período chuvoso) e janeiro de 2013 (período seco), totalizando 19 noites de amostragem. Um total de 347 indivíduos de 23 espécies e seis famílias foi capturado. A quiropterofauna é caracterizada por uma dominância de poucas espécies mais abundantes, particularmente filostomídeos frugívoros, e várias outras menos abundantes,

o que é freqüente em inventários com redes armadas ao nível do solo. *Tonatia saurophila* e *Chiroderma vizottoi*, essa última recentemente descrita e conhecida apenas da localidade tipo, são registradas pela primeira vez no Ceará, onde 66 espécies de morcegos estão agora registradas.

Key words: Caatinga. Neotropical bats. New records. Semiarid region.

Palavras chave: Caatinga. Morcegos neotropicais. Novos registros. Região semiárida.

INTRODUCTION

Brazil has the second richest bat fauna of any South American country, with a total of 179 species recorded to date (Nogueira et al., 2014; Moratelli and Dias, 2015). While a large body of data on the occurrence, biology, and distribution of Brazilian bats has been accumulated over the past few decades, many lacunae persist, and many areas lack basic inventories (Bernard et al., 2011). A recent study estimated that less than 10% of Brazil has been surveyed in a minimally adequate way and that no Brazilian biome can be considered to have been satisfactorily surveyed at the present time (Bernard et al., 2011).

While surveys of the bat fauna are available for some localities in the Brazilian Northeast (e.g. Mares et al., 1985; Willig, 1985, 1986; Willig and Mares, 1989; Silva et al., 2001; Gregorin et al., 2008; Feijó et al., 2010; Sá-Neto and Marinho-Filho, 2013; Maas et al., 2013; Novaes et al., 2015), studies in the Caatinga scrublands are still limited, and Bernard et al. (2011) found that less than 7% of this biome has been surveyed. In fact, most of the data available on the vertebrates of the Caatinga are derived from a small number of sites, with less than the adequate sampling effort (Albuquerque et al., 2012).

The Brazilian state of Ceará is inserted within the Caatinga biome (sensu Ab'Saber, 1971) in the Brazilian Northeast. The Ibiapaba Plateau, also known locally as Serra Grande, is placed in the border between Ceará and Piauí states. The term "Caatinga" refers to the typical xeromorphic vegetation of the semiarid Brazilian Northeast, which also includes areas of semi-deciduous and cloud forests, covering a total area of 770 442 km² (Coimbra-Filho

and Câmara, 1996; Marinho-Filho and Sazima, 1998). According to IBGE (2012) the Caatinga is the most representative area of the "Brazilian semi-arid region", and it is described by MMA (2011) as the most populated semiarid region in the world.

The occurrence of at least 92 bat species has been confirmed for the Caatinga (Garcia et al., 2014; Moratelli and Dias, 2015). Of these, 64 species are found in the Brazilian state of Ceará (Garcia et al., 2014; Novaes and Laurindo, 2014).

The high temperatures and the strong seasonality in the rainfall in dry forests affect patterns of plant reproduction and consequently the resource availability to various groups of animals, including bats (Bullock, 1995; Stoner, 2005; Pezzini et al., 2008; Avilla Cabadilla et al., 2009). In general, a larger number of individuals are expected in the rainy season due to increased availability of food resources (Marinho-Filho, 1991; Mello 2009). However, bats, especially frugivores and nectarivores, can move to adjacent areas with different types of habitat that provide more resources than dry habitats (Stoner and Timm, 2011).

The aim of this study was to survey the bat fauna in an area of Caatinga scrublands and to investigate possible seasonal variations in the bat abundance in the RPPN Serra das Almas and update the bat checklist for the Ceará State.

MATERIAL AND METHODS

Study area

The Chapada da Ibiapaba is characterized by distinct morphoclimatic features, which transform it into an island of humidity placed within the typical semiarid landscape of the surrounding region. The Chapada da Ibiapaba's altitude—up to 950 m a.s.l.—determines

higher precipitation rates in comparison with the neighboring lowland areas (Uvo and Berndtsson, 1996).

The eastern part of the Ibiapaba Plateau has a hot and moist climate, while in the western portion it is hot and semiarid, with mean annual precipitation of over 1100 mm. The rainy season comprises the months between December and July. Along the length of the coast, which is characterized by a gentle slope to the west and a steep slope to the east, the climate varies from tropical to hot and semiarid, with the rainy season lasting from October to April, and mean annual precipitation of 725 to 959 mm (Velloso et al., 2002; Claudino-Sales and Lira, 2011; Peixoto and Sales, 2012).

The RPPN Serra das Almas is located mainly within the municipality of Cratêus, Ceará, with a small portion in Buriti dos Montes, Piauí (05°05'–5°15' S, 40°50'–41°00' W). It has a total area of 61.46 km², and is part of the Sertão dos Inhamuns, in the northeastern portion of the Ibiapaba-Araripe complex (Fig. 1). The reserve includes part of the plateau, the steep frontslope of the cuesta and the lowland plains (Araújo et al., 2011), with three distinct vegetation types: 1) seasonal semi-deciduous forest, covering a total area of 27.93 km², or 47.64% of the reserve, 2) low “carrasco” scrub, covering 11.79 km² (20.12%), and 3) caatinga scrub, covering 17.10 km² (29.19%) of the reserve. The deciduous forest occurs in the moist areas along rivers, above an altitude of 750 m. The “carrasco” is a diverse xerophytic vegetation restricted to the plateau at 600 m on areas of sandy soil. The caatinga scrub occurs in the semi-arid lowlands and slope bottoms, where annual precipitation does not exceed 750 mm (Araújo et al., 2011).

Capture, collection and identification of specimens

Ten sites, at elevations between 560 and 650 m in the seasonal semi-deciduous forest and caatinga scrub, were selected for the present survey. Nine and ten sampling nights were conducted in July 2012 (dry season) and January 2013 (rainy season), respectively, with a total of 19 nights of fieldwork. We used eight mist nets (9.0 x 2.5 m) during each night opened before sunset and closed after six hours. The mist nets were set up in natural clearings, adjacent to or crossing bodies of water, forest edges, trails, and near plants with flowers or fruits (Fig. 2).

The specimens were checked for sex determination and preliminary identification in the field following Reis et al. (2013). Standard external measurements

(in millimeters) of the head-body length, tail length, hindfoot length, ear length and forearm length and body mass (in grams) were taken for all individuals captured, following Vizotto and Taddei (1973).

The capture and collection of specimens was authorized by the Chico Mendes Institute for the Conservation of Biodiversity (ICMBio) of the Brazilian government. The animals that were returned to the wild were marked using perforations in the patagium (Wilson et al., 1996), and then released at the capture site following their identification in the field. Voucher specimens were preserved in 70° ethanol or as filled skins and deposited in the Adriano Lucio Peracchi (ALP) Collection at the Universidade Federal Rural do Rio de Janeiro (UFRRJ) in Rio de Janeiro, Brazil.

Voucher specimens were examined with literature (identification keys, taxonomic reviews and descriptions) in order to confirm field identifications. Forearm length and eleven cranial measurements of the voucher of selected species were taken with a digital caliper (0.02 mm precision), following Vizotto and Taddei (1973).

Data analyses

The calculation of sampling effort followed Straube and Bianconi (2002). The paired Wilcoxon test was used to analyze seasonal variations in species abundance. The test was performed using the PAST program version 2.17 (Hammer et al., 2001).

RESULTS AND DISCUSSION

List of species, new records and taxonomic comments

We captured 347 individuals of 23 species representing six families (Table 1). A total of 168 vouchers were incorporated into the ALP collection at UFRRJ. Two species, *Chiroderma vizottoi* Taddei & Lim, 2010 and *Tonatia saurophila* Koopman & Williams, 1951, were recorded for the first time in the state of Ceará (Tables 2 and 3, Fig. 3).

The voucher specimens of *C. vizottoi*, three males and four females, presented measurements (Table 2) within the range of values recorded for *C. vizottoi*, presenting no overlap with *C. doriae* Thomas, 1891. The collected specimens present a number of qualitative characters that support their identification as *C. vizottoi*, according to Taddei and Lim

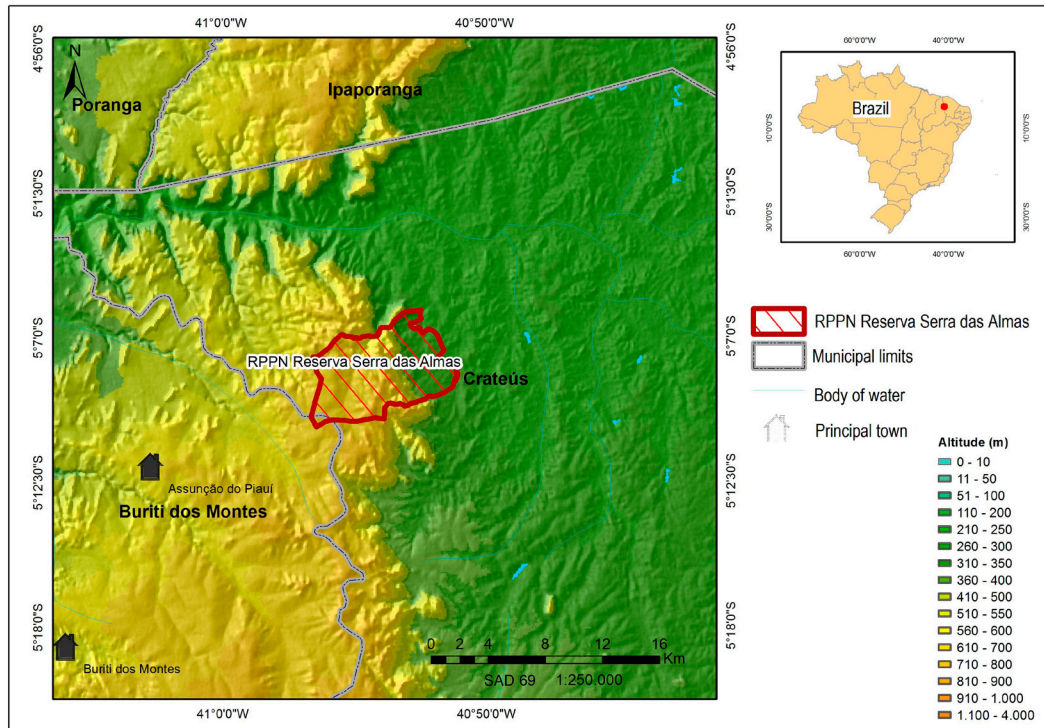


Fig. 1. Location of RPPN Serra das Almas in Crateus, Ceará (Brazil) (Software ArcGis 10.1- Esri Maps).

(2010). However, the length of the mandible is greater in our specimens than that recorded in the original description of *C. vizottoi*. This species is morphologically similar to *C. doriae* but presents smaller external and cranial dimensions (Taddei and Lim, 2010).

Chiroderma vizottoi was recently described from one specimen collected in Caatinga habitats in Teresina, in the state of Piauí, Brazil (Taddei and Lim, 2010), one specimen collected by Gregorin et al. (2008) at Serra das Confusões and other collected by Wilson Uieda at Sete Cidades, being both cities located in the Caatinga of Piauí. The species is currently known only from these localities and little is known about its natural history. The specimens collected at RPPN Serra das Almas, which is 236.78 km east of the type locality, constitute the first record of the species in Ceará state. While one of *C. vizottoi* paratypes was collected in a mist net in low caatinga scrub (Gregorin et al., 2008), our specimens were captured in

nets set adjacent to fruiting trees (Moraceae) in an area of deciduous forest, which also constitutes a new habitat occupied by the species. One individual was collected during the dry season, and the other six during the rainy season. A pregnant and lactating female and a male with scrotal testes were captured and released in January, during the rainy season.

Fourteen specimens of *T. saurophila* were collected during the study. The voucher specimens, three males, exhibit the set of characters that distinguish *T. saurophila* from *T. bidens* (Williams et al., 1995; Williams and Genoways, 2008). There was some variation in the white stripe on the top of the head among the voucher specimens, which was only present in ALP 10162, although all the released individuals following capture had this white stripe.

In Brazil, *T. saurophila* occurs in the Amazon and Atlantic Forest, Cerrado, as well as the Caatinga (Paglia et al., 2012). The species has been recorded in the Caatinga in the Brazilian



Fig. 2. Sampling sites located in deciduous forest (A,B,C,D) and caatinga scrub (E,F) within the RPPN Serra das Almas, Crateús, Ceará (Brazil) (Photographs: Alexandre P. da Cruz).

states of Pernambuco (Astúa and Guerra, 2008), Paraíba (Feijó and Langguth, 2011), Piauí and Alagoas (Neto, 2003; Reis et al., 2013), and this study provides the first record for the Ceará state. Eleven individuals were captured in the rainy season, including three males and eight females, one of which was pregnant. During the dry season, only three animals (two males and one female) were collected, none of which presented any signs of reproductive activity.

All the individuals were collected in deciduous forest in the vicinity of bodies of water. In the Espírito Santo state, in southeastern Brazil, Peracchi et al. (2011) collected the species in the vicinity of a lake, and Luz et al. (2009) observed it in a restinga ecosystem. These records indicate that *T. saurophila* may be able to use diversified types of habitats.

Other four species, *Micronycteris sanborni* Simmons, 1996, *Natalus macrourus* (Gervais,

Table 1

Number of bat specimens captured (N) and relative abundance (%) of each species during the rainy and dry seasons at the RPPN Serra das Almas in Crateús, Ceará, Brazil.

Taxa	Season				N (%)
	Dry		Rainy		
	Male	Female	Male	Female	
PHYLLOSTOMIDAE					
<i>Anoura geoffroyi</i> Gray,1838	3	–	–	–	3 (0.9%)
<i>Artibeus lituratus</i> (Olfers,1818)	7	1	17	8	33 (9.5%)
<i>Artibeus planirostris</i> Spix,1823	–	1	32	21	54 (15.6%)
<i>Carollia perspicillata</i> (Linnaeus,1758)	21	7	32	6	66 (19.0%)
<i>Chiroderma vizottoi</i> Taddei & Lim, 2010	–	1	4	4	9 (2.6%)
<i>Dermanura cinerea</i> (Gervais, 1856)	–	–	1	2	3(0.9%)
<i>Glossophaga soricina</i> (Pallas,1766)	13	1	3	–	17 (4.9%)
<i>Lonchophylla mordax</i> Thomas, 1903	1	1	–	–	2 (0.6%)
<i>Lophostoma brasiliense</i> Peters, 1867	2	3	5	2	12 (3.5%)
<i>Micronycteris sanborni</i> Simmons, 1996	3	–	3	1	7 (2.0%)
<i>Phyllostomus discolor</i> Wagner,1843	2	–	2	–	4 (1.2%)
<i>Platyrrhinus lineatus</i> (E. Geoffroy,1810)	1	–	–	12	13 (3.7%)
<i>Sturnira lilium</i> (E. Geoffroy,1810)	1	3	1	1	6 (1.7%)
<i>Tonatia bidens</i> (Spix, 1823)	1	1	1	1	4 (1.2%)
<i>Tonatia saurophila</i> Koopman & Williams, 1951	2	1	3	8	14 (4.0%)
<i>Trachops cirrhosus</i> (Spix,1823)	5	3	7	3	18 (5.2%)
MORMOOPIDAE					
<i>Pteronotus parnelli</i> (Gray,1843)	3	1	30	9	43 (12.4%)
<i>Pteronotus gymnonotus</i> Natterer, 1843	2	–	1	10	13 (3.7%)
NOCTILIONIDAE					
<i>Noctilio leporinus</i> (Linnaeus, 1758)	–	–	1	1	2 (0.6%)
NATALIDAE					
<i>Natalus macrourus</i> (Gervais, 1856)	2	–	–	–	2 (0.6%)
MOLOSSIDAE					
<i>Molossus molossus</i> (Pallas, 1767)	7	2	–	–	9 (2.6%)
VESPERTILIONIDAE					
<i>Eptesicus furinalis</i> (d'Orbigny & Gervais, 1847)	–	1	2	3	6 (1.7%)
<i>Myotis lavalii</i> Moratelli et al.(2011)	4	–	2	1	7 (2.0%)
Abundance	80	27	147	93	347 (100%)
Richness	21		19		23

Table 2

Selected measurements (in millimeters) of the specimens of the two bat species recorded for the first time in Ceará, northeastern Brazil, M= male; F= female. Measurements, following Vizotto and Taddei (1973): forearm length (FA); greatest length of skull, including incisors (GLS); condylobasal length (CBL); maxillary tooththrow length (MTL); breadth across canines (BAC); postorbital breadth (POB); breadth across molars (BAM); braincase breadth (BCB); zygomatic breadth (ZB); mastoid breadth (MAB); mandibular length (MAL); mandibular tooththrow length (MAN).

Species	<i>Chiroderma vizottoi</i>		<i>Tonatia saurophila</i>
Sex (Number of specimens)	M (3)	F (4)	M (3)
FA	44.80 - 46.80	46.40 - 49.10	44.80 - 46.80
GLS	25.66 - 26.36	25.88 - 27.02	25.66 - 26.36
CBL	23.64 - 23.88	23.36 - 24.84	23.64 - 23.88
MTL	9.42 - 9.80	9.42 - 9.98	9.42 - 9.80
BAC	5.84 - 6.00	5.80 - 5.98	5.84 - 6.00
POB	5.84 - 6.20	5.78 - 6.36	5.84 - 6.20
BAM	11.52 - 12.00	11.38 - 11.90	11.52 - 12.00
BCB	11.34 - 11.48	11.06 - 11.88	11.34 - 11.48
ZB	16.20 - 16.58	16.10 - 16.98	16.20 - 16.58
MAB	12.66 - 12.84	12.84 - 13.38	12.66 - 12.84
MAL	17.46 - 18.00	17.84 - 18.34	17.46 - 18.00
MAN	10.26 - 10.36	10.34 - 10.82	10.26 - 10.36

Table 3

Selected measurements (in millimeters) of the specimens of the four bat species recorded in the Caatinga of Ceará (northeastern Brazil) for the first time, M= male; F= female. Measurements, following Vizotto and Taddei (1973): forearm length (FA); greatest length of skull, including incisors (GLS); condylobasal length (CBL); maxillary tooththrow length (MTL); breadth across canines (BAC); postorbital breadth (POB); breadth across molars (BAM); braincase breadth (BCB); zygomatic breadth (ZB); mastoid breadth (MAB); mandibular length (MAL); mandibular tooththrow length (MAN).

Species	<i>Micronycteris sanborni</i>	<i>Natalus macrourus</i>		<i>Eptesicus furinalis</i>		<i>Myotis lavalii</i>	
Sex (Number of specimens)	M (3)	M (1)	F (1)	M (2)	F (3)	M (6)	F (1)
FA	30.80 - 33.30	38.04	37.44	38.82 - 39.00	39.20 - 41.48	31.50 - 33.42	34.26
GLS	16.94 - 17.46	16.64	16.28	15.30 - 16.06	15.62 - 16.60	13.48 - 14.00	13.78
CBL	14.82 - 15.10	15.16	14.50	14.68 - 14.80	15.00 - 15.34	12.46 - 12.96	13.14
MTL	5.76 - 6.00	6.90	6.66	5.70 - 5.80	5.76 - 5.98	5.16 - 5.38	5.28
BAC	2.68 - 2.74	3.94	3.60	4.94 - 5.12	4.86 - 5.00	3.40 - 3.60	3.56
POB	3.96 - 4.04	3.26	3.40	3.66 - 3.70	3.74 - 3.78	3.26 - 3.38	3.28
BAM	4.40 - 4.74	5.60	5.40	6.60 - 6.64	6.52 - 6.84	5.20 - 5.38	5.24
BCB	7.16 - 7.30	8.40	8.20	7.20 - 7.50	6.84 - 7.40	6.14 - 6.66	6.48
ZB	7.70 - 7.96	8.78	8.40	10.96 - 10.94	10.44 - 11.00	8.10 - 8.50	8.62
MAB	8.20 - 8.38	7.60	7.58	8.20 - 8.52	8.32 - 8.48	6.74 - 7.26	7.00
MAL	10.14 - 10.26	12.28	11.70	10.72 - 11.44	11.38 - 11.82	9.52 - 9.90	10.26
MAN	6.06 - 6.28	7.34	6.96	6.20 - 6.22	6.22 - 6.36	5.32 - 5.68	5.64

1856), *Eptesicus furinalis* (d'Orbigny & Gervais, 1847), and *Myotis lavalii* Moratelli, Peracchi, Dias & Oliveira, 2011, were recorded in the Caatinga scrublands within Ceará for the first time (Fig. 4).

Seven specimens of *M. sanborni* were collected during the study and present the set of diagnostic traits described for *M. sanborni* by Simmons (1996). Three males were captured in the dry season (July), one of which had well-developed testes. Three males and one female were captured in the rainy season (January), and were released following the collection of measurements (Table 3).

The geographic distribution of *M. sanborni* had previously been restricted to the Caatinga and Cerrado biomes, typically in open habitats (Simmons, 1996; Brooks et al., 2002; Gregorin et al., 2008; Nogueira et al., 2008; Cunha et al., 2009; Feijó et al., 2010; Gregorin et al., 2011). More recently, Lopez-Baucells et al. (2013) recorded *M. sanborni* in the Amazon forest, in the Brazilian state of Amazonas, which suggests that the species may not be restricted to dry habitats. In the Ceará, *M. sanborni* had previ-

ously only been recorded in the Cerrado of the Araripe Plateau in the region of Crato, in the southeast of the state near the border with Pernambuco (Simmons, 1996). The specimens collected in this study extend the distribution of the species in Ceará in 267.69 km northward, and into the Caatinga biome. Few data are available on the geographic distribution, conservation status and threats or ecological data of *M. sanborni* (Tavares and Aguirre, 2008), reinforcing the need for further studies on the occurrence and natural history of this species.

Only two specimens of *N. macrourus*, a male and a female, were collected and have the morphological traits described for the identification of *N. macrourus* (Tejedor, 2011). The male specimen is larger than the female (Table 3), which is typical of the species (Tejedor, 2011). *Natalus macrourus* is commonly found in dry and semi-deciduous forests and humid secondary habitats, and occurs from sea level up to mean elevations of approximately 1000 m a.s.l. (Reid, 1997; Tejedor, 2011). In Ceará, the species has been recorded on the Araripe Plateau in Crato, in the Cerrado (Mares et al., 1981). In this study, the specimens were captured in mist nets set over bodies of water in an area of deciduous Caatinga forest in July (dry season). This record extends the known distribution of the species in the state 267.69 km to the north. Due to the vulnerability of the species' habitat (caves), it is listed as near-threatened by the IUCN (Dávalos and Tejedor, 2008). Following Garbino and Tejedor (2013), *N. macrourus* was accepted here as the valid name for the only natalid species that occurs in Brazil, based on its taxonomic priority over *Myotis espiritosantensis* Ruschi, 1951 (= *Natalus espiritosantensis*).

Five voucher specimens of *Eptesicus Rafinesque*, 1820 (two males and three females) were collected, all of which have the diagnostic traits and measurements within the range of values of *E. furinalis* (Simmons and Voss, 1998; Davis and Gardner, 2008). The species occurs in Mexico and Central America, Colombia Venezuela, the Guianas, Brazil, Bolivia, Paraguay, Uruguay and northern Argentina (Davis and Gardner, 2008). It is widely distributed in Brazil, but in the northeastern region it has only been recorded in the states of Bahia, Ceará,



Fig. 3. (a) *C. vizottoi* and (b) *T. saurophylla*



Fig. 4. (a) *Micronycteris sanborni*, (b) *Natalus macrourus*, (c) *Eptesicus furinalis*, (d) *Myotis lavalii* captured in RPPN Serra das Almas, Crateús, Ceará (Brazil) (Photographs: Alexandre P. da Cruz).

and Pernambuco, found in forests, woodland and buildings (Reis et al., 2013). Mares et al. (1981) did not record the species in the Caatinga of the Araripe Plateau in Crato, Ceará. The specimens and two individuals captured and released including a pregnant female in the rainy season, were collected in an area of dry semi-deciduous forest. This record extends the distribution of the species in the state of Ceará 267.69 km to the north.

One female and six males of *M. lavalii* were collected in an area of semi-deciduous forest at an altitude of 680 m a.s.l. Some of the specimens were collected when they emerged from the roof of a building, in which they had roosted. All the specimens present the diagnostic characteristics of *M. lavalii* and measurements (Table 3) within the range of values recorded for this species by Moratelli et al. (2011). *Myotis lavalii* is found throughout the corridor of semiarid vegetation that links the Caatinga of northeastern Brazil to the Alto Chaco of Paraguay, with some records in marginal areas of the Atlantic Forest in northeastern Brazil, and in Paraguay (Moratelli and Wilson, 2013). In Brazil, this species has been

recorded only in the northeastern region, in the states of Bahia, Ceará, Pernambuco, and Piauí (Maas et al., 2013; Moratelli and Wilson, 2013). In Ceará, the species has been recorded in Caatinga areas in the municipalities of Crato and Russo, in open xeromorphic vegetation, as well as sub-humid and deciduous formations at between 15 and 900 m a.s.l. (Moratelli et al., 2011). The specimens collected here extend the known distribution of the species within Ceará by 267.69 km northwest, in relation to Crato.

Species richness and abundance

Based on a total sampling effort of 36.315 m².h over the two field surveys, 347 individuals of 23 species and six families were captured (Table 1). Of the total number of bats captured, 179 were marked and released. Six of these individuals, five *Lophostoma brasiliense* Peters, 1867 and one *Trachops cirrhosus* (Spix, 1823), were recaptured.

Phyllostomidae was the most diverse family in this study (16 species; 76%), followed by Mormoopidae (2; 17%), Vespertilionidae (2; 4%), Molossidae (1; 3%), Natalidae (1; 0.6%), and Noctilionidae (1; 0.6%). The predominance

of phyllostomids is typical of bat inventories in the Neotropics (Simmons and Voss, 1998), as well as in Brazil, and in the Caatinga in particular (e.g., Willig, 1983; Silva et al., 2004; Gregorin et al., 2008).

In Brazil, surveys on bat communities tend to be characterized by a marked predominance of few most abundant species, in particular phyllostomid frugivores, while most species are rare (e.g., Bernard and Fenton, 2002; Gonçalves and Gregorin, 2004; Gregorin et al., 2008; 2011). A similar pattern was recorded at the RPPN Serra das Almas, where a few common species, such as *Carollia perspicillata* (Linnaeus, 1758) (N=66, 19%) and *Artibeus planirostris* Spix, 1823 (N=54, 15.6%), were recorded alongside a number of other, much less abundant taxa. In other studies in Caatinga, these species were also some of the most abundant (Silva et al., 2004; Gregorin et al., 2008; Sá-Neto and Marinho-Filho, 2013; Novaes and Laurindo, 2014; Novaes et al., 2015).

Our inventory recorded species richness within the expected range, given that other inventories in the Caatinga have reported between 14 and 31 species (Silva et al., 2001, 2004; Gregorin et al., 2008; Sá-Neto and Marinho-Filho, 2013; Novaes and Laurindo, 2014; Novaes et al., 2015), evidencing that our study did not diverge from what is commonly observed. Among these studies, Sá-Neto and Marinho-Filho (2013), employing 118 sampling nights and a total effort of 259.2 m².h of mist-netting, collected 651 individuals of 31 bat species. Previously, Mares et al. (1981) and Willig (1983) sampled over 6000 individuals of 38 species during inventories conducted over a six-year period in areas of Caatinga in Crato (Ceará state) and Exu (Pernambuco state). Although some of these studies do not report sampling effort clearly, making comparisons difficult, it can be stated that long-term studies employing large capture effort (more nights, more mist nets and longer hours of field work) as well as sampling several sites and using different capture techniques, results in the sampling of more species.

Bat abundance did not vary significantly between the dry and rainy season (W = 171.5; p = 0.05). Seasonal variation in the abundance of

bats is expected, since semiarid regions usually present climatic seasonality (Prado, 2003). The marked seasonality of Caatinga strongly influences patterns of plant reproduction (Bullock, 1995; Pezzini et al., 2008) and the highest abundance in the rainy season may be due to fluctuations in resource availability (Stoner, 2005). The small difference found in seasonal abundance may be, however, influenced by climatic factors, that must be accompanied by further studies on the region.

The bat fauna of the RPPN Serra das Almas was characterized by a predominance of frugivorous/nectarivorous species (N = 11), which is typical of studies based on mist-netting at ground level (MacNab, 1971; Willig, 1986), and insectivorous (N = 11), which mist nets over water bodies proved to be essential for sampling.

During a previous survey of the RPPN Serra das Almas, Silva et al. (2004) recorded 16 species, of which four were not captured during this study, probably due to anthropogenic interference and the suppression of tracts of forest that were once present in the study area. These species were *Artibeus fimbriatus* Gray, 1838, *Desmodus rotundus* (É. Geoffroy, 1810), *Phyllostomus hastatus* (Pallas, 1767), and *Myotis riparius* Handley, 1960. The combined results of the two studies indicate a total of 27 bat species for RPPN Serra das Almas. The results shown here further reinforce the need for new inventories of the bat fauna of the Brazilian Northeast, as recommended by Bernard et al. (2011). While 66 bat species have now been recorded in the Ceará state, its chiropteran fauna remains poorly documented. This lack of data, together with the ongoing impacts affecting this biome, such as deforestation for the establishment of pastures and plantations, and an accelerated process of desertification (Castelleti et al., 2003), reinforce the need for new surveys and taxonomic reviews of the museum specimens representing the different vegetation types of the Caatinga for a better understanding of the diversity of Chiroptera in the northeastern Brazil.

The total of species recorded for RPPN Serra das Almas, comprising approximately 35% of the species occurring for the Caatinga, indicates

the importance of this region for the conservation of bat fauna in this biome.

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APPENDIX

List of the bat specimens (and their catalog numbers) collected during the present study and deposited in the Collection Adriano Lucio Peracchi (ALP) in the Laboratório de Mastozoologia, Instituto de Biologia, Universidade Federal Rural do Rio de Janeiro.

Anoura geoffroyi (3): ALP 10167, ALP 10177, ALP 10184.

Artibeus planirostris (15): ALP 10391, ALP 10399, ALP 10400, ALP 10401, ALP 10404, ALP 10405, ALP 10406, ALP 10412, ALP 10417, ALP 10426, ALP 10430, ALP 10431, ALP 10441, ALP 10456, ALP 10473.

Artibeus lituratus (3): ALP 10166, ALP 10380, ALP 10455.

Carollia perspicillata (38): ALP 10131, ALP 10132, ALP 10134, ALP 10147, ALP 10152, ALP 10165, ALP 10178, ALP 10181, ALP 10185, ALP 10379, ALP 10392, ALP 10396, ALP 10398, ALP 10407, ALP 10413, ALP 10414, ALP 10420, ALP 10424, ALP 10427, ALP 10433, ALP 10434, ALP 10435, ALP 10436, ALP 10438, ALP 10439, ALP 10446, ALP 10448, ALP 10449, ALP 10450, ALP 10452, ALP 10453, ALP 10458, ALP 10461, ALP 10465, ALP 10470, ALP 10475, ALP 10478, ALP 10479.

Chiroderma vizottoi (7): ALP 10196, ALP 10418, ALP 10421, ALP 10423, ALP 10440, ALP 10451, ALP 10464.

Dermanura cinerea (2): ALP 10429, ALP 10432.

Eptesicus furinalis (5): ALP 10186, ALP 10378, ALP 10410, ALP 10463, ALP 10472.

Glossophaga soricina (17): ALP 10138, ALP 10141, ALP 10151, ALP 10154, ALP 10158, ALP 10159, ALP 10161, ALP 10163, ALP 10169, ALP 10170, ALP 10172, ALP 10175, ALP 10179, ALP 10182, ALP 10466, ALP 10476, ALP 10477.

Lonchophylla mordax (2): ALP 10176, ALP 10180.

Lophostoma brasiliense (11): ALP 10135, ALP 10142, ALP 10153, ALP 10164, ALP 10393, ALP 10395, ALP 10408, ALP 10409, ALP 10411, ALP 10416, ALP 10457.

Micronycteris sanborni (7): ALP 10148, ALP 10155, ALP 10160, ALP 10385, ALP 10437, ALP 10442, ALP 10459.

Molossus molossus (4): ALP 10143, ALP 10144, ALP 10145, ALP 10146.

Myotis lavalii (7): ALP 10140, ALP 10171, ALP 10187, ALP 10191, ALP 10468, ALP 10469, ALP 10471.

Natalus macrourus (2): ALP 10136, ALP 10173.

Noctilio leporinus (1): ALP 10447.

Phyllostomus discolor (4): ALP 10190, ALP 10195, ALP 10454, ALP 10467.

Platyrrhinus lineatus (6): ALP 10174, ALP 10397, ALP 10403, ALP 10425, ALP 10428, ALP 10444.

Pteronotus gymnotus (6): ALP 10192, ALP 10194, ALP 10386, ALP 10389, ALP 10390, ALP 10422.

Pteronotus parnellii (10): ALP 10183, ALP 10188, ALP 10381, ALP 10382, ALP 10383, ALP 10387, ALP 10415, ALP 10443, ALP 10462, ALP 10474.

Sturnira lilium (6): ALP 10133, ALP 10149, ALP 10150, ALP 10189, ALP 10394, ALP 10445.

Tonatia bidens (4): ALP 10157, ALP 10193, ALP 10384, ALP10460.

Tonatia saurophila (3): ALP 10162, ALP 10388, ALP 10402.

Trachops cirrhosus (5): ALP 10137, ALP 10139, ALP 10156, ALP 10168, ALP 10419.