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Bats (Mammalia, Chiroptera) from an area of Caatinga in southwestern Bahia, Brazil

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Morcegos (Mammalia, Chiroptera) de uma área de Caatinga do sudoeste da Bahia, Brasil

Resumo: O presente estudo fornece um inventário das espécies de morcegos capturados no município de Caetité, no sudoeste da Bahia, Brasil. No total, foram capturados 68 indivíduos de morcegos, pertencentes a nove espécies e três famílias. A riqueza de espécies estimada para a área através do estimador Jackknife 1, foi 9.9. Os morcegos filostomidaeos foram os mais abundantes, e a espécie *Carollia perspicillata* (Linnaeus, 1758) foi a dominante. Nossos resultados são consistentes com estudos anteriores realizados na Bahia e no bioma Caatinga, fornecendo dados sobre a estrutura local da comunidade de morcegos. Além disso, destaca a importância de inventários rápidos para compreender a diversidade e distribuição da fauna de morcegos.

Palavras chave: Assembléia de morcegos, Caatinga, Caetité, inventário rápido.

Abstract: The present study provides an inventory of the bat species recorded in the municipality of Caetité, in southwestern Bahia, Brazil. Sixty-eight individuals were captured, belonging to nine species and three families. The Jackknife 1 procedure estimated a species richness of 9.9. The phyllostomid bats were the most abundant, and *Carollia perspicillata* (Linnaeus, 1758) was captured most frequently. Our results are consistent with previous studies conducted in Bahia and the Caatinga, providing data on the local bat community structure. It also highlights the importance of rapid inventories for the understanding of the diversity and distribution of the bat fauna.

Key words: Bat assemblage, Caatinga, Caetité, rapid inventories.

Introduction

The Brazilian Caatinga biome is formed predominantly by a seasonal, dense arboreal scrub composed of small trees and shrubs, without a continuous canopy, dominated by spiny, small-leaved plants and succulents (Cardoso & Queiroz 2007). The Caatinga extends over a total

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area of 735.000 km², including part of nine Brazilian states (Leal *et al.* 2005). The climate of the Caatinga is characterized by long dry seasons and irregular rains (Andrade-Lima 1981).

A total of 153 species of mammal are known to occur in the Caatinga, of which approximately half (82) are bats (Paglia *et al.* 2012; Moratelli & Dias 2015; Feijó *et al.* 2015a,b; Rocha *et al.* 2015, 2018). Chiroptera is the second largest mammalian order, with 182 species known to occur in Brazil, representing nine families (Nogueira *et al.* 2014; Feijó *et al.* 2015a; Moratelli & Dias 2015; Rocha *et al.* 2015, 2018; Gregorin *et al.* 2016). In addition to their high taxonomic diversity (Simmons 2005), bats have an exceptionally wide range of diets and ecological niches (Kalko 1998), and play a vital role in the ecosystem and the maintenance of natural environments (Peracchi *et al.* 2011).

A number of studies have focused on the bat fauna of the Brazilian state of Bahia (Falcão *et al.* 2005; Faria 2006; Faria *et al.* 2006; Faria & Baumgarten 2007; Rios *et al.* 2008; Sá-Neto & Marinho-Filho 2013), including both Atlantic Forest and Caatinga biomes. To date, 78 species have been identified, representing 50 genera and eight families (Faria *et al.* 2006). Bahia includes some areas, in particular in the south of the state, that Bernard *et al.* (2011) consider to be relatively well-sampled, but with a total area of 565.000 km², much of which is poorly accessible, there are considerable gaps, especially in the Caatinga biome. The present study provides a new inventory from a poorly-studied region of Caatinga scrubland in southwestern Bahia.

Material and Methods

Study site

Bats were surveyed in the Fazenda do Engenho Cachoeira (13°50'34.07" S, 42°15'22" W), a ranch in the municipality of Caetité, in southwestern Bahia (**Figure 1**). The property is owned by Indústrias Nucleares do Brasil (INB), and contains 172 hectares of seasonal Caatinga. The region's climate is semi-arid, with a rainy season typically between November and April, mean annual precipitation of 600 mm and mean annual temperature of 26ºC (INMET 2014).

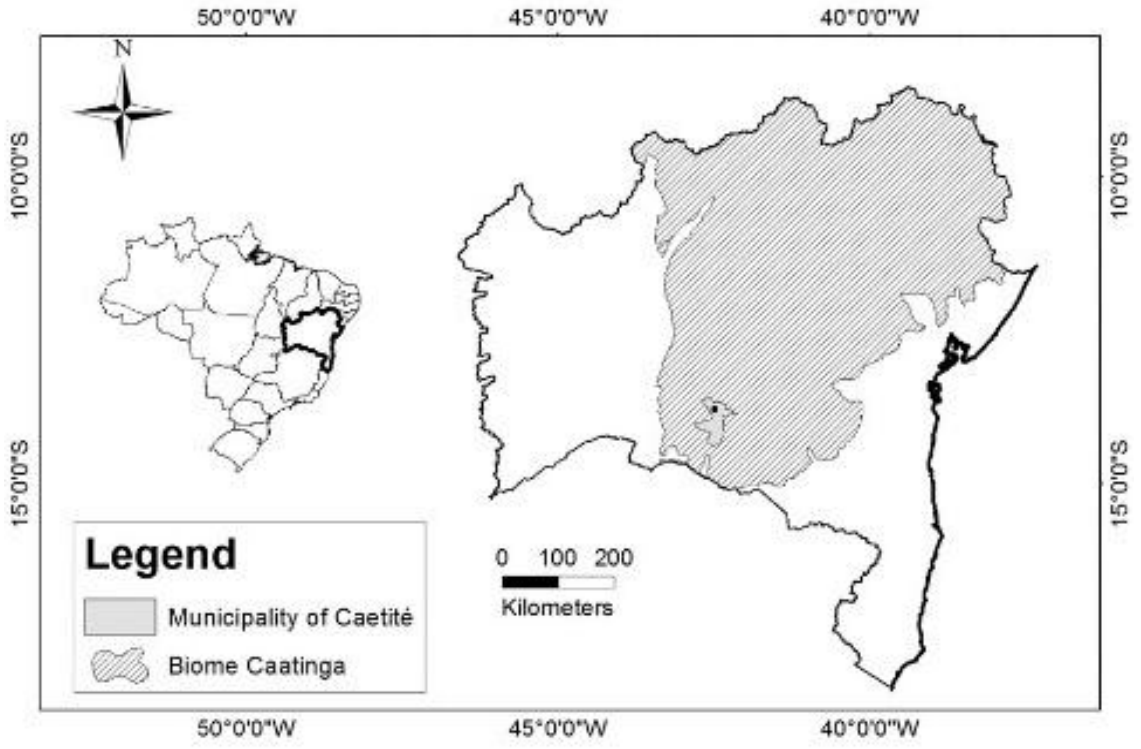

Figure 1. Location of the Fazenda do Engenho Cachoeira in the municipality of Caetité, southwestern Bahia, Brazil.

The forest at the study site (**Figure 2**) has a continuous canopy of approximately 20 m or more in some places, with varying levels of anthropogenic disturbance. Domestic stock (cattle and sheep) were observed in some areas. Other large tracts of mature Caatinga can be found in the surrounding area, including a private natural heritage reserve (RPPN), also owned by the INB. The principal plant families found in the study area are the Anacardiaceae, Bignoniaceae, Cactaceae, Fabaceae, Moraceae, Myrtaceae and Rhamnaceae.

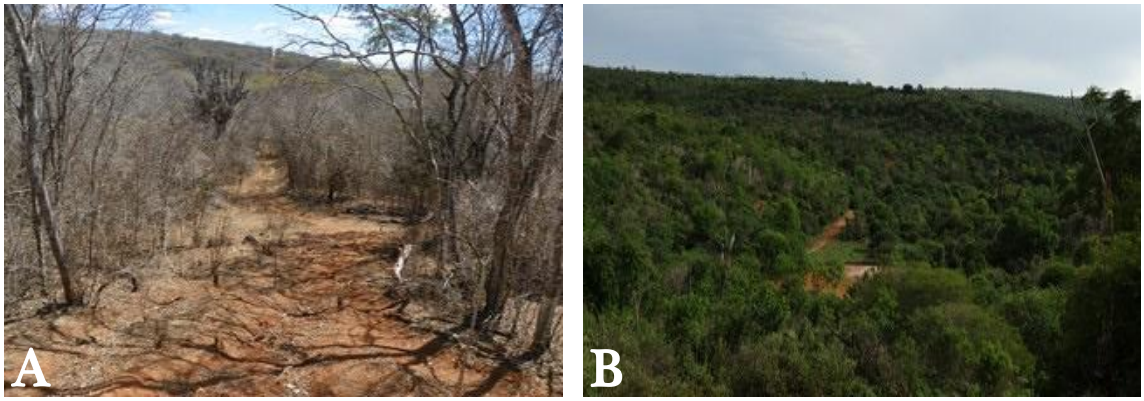

Figure 2. Area of Caatinga sampled in the municipality of Caetité during the dry (**A**) and rainy (**B**) seasons.

Data collection

Two field campaigns were conducted in 2014, one in the dry season, in August, and the other in the rainy season, in December, each lasting 10 days (total sample of 20 days). Five points were sampled within and around the Fazenda do Engenho Cachoeira, each point sampled during two days in each campaign. The mist-nets were set along pre-existing trails, and adjacent to reservoirs and mango orchards.

Bats were captured using 10 mist-nets (12 x 3 m) set at ground level, continuously between 18:00 p.m. and 00:00 h. Active searches for bats were also conducted at specific sites (tree hollows, abandoned houses, storm drains, and termite nests) in the surrounding area, as well as households in the village of Maniaçu, approximately 28 km from Caetité.

Captured bats were placed in cotton bags for identification, the confirmation of the reproductive condition of the specimen (males: active or inactive; females: pregnant, lactating or post-lactation), and the collection of biometric data.

The species were identified based on Simmons & Voss (1998), Gregorin & Taddei (2002) and Gardner (2007), and nomenclature followed Simmons (2005). The voucher specimens were deposited in the Mammalian Zoology Collection of the Natural History Museum at the Federal University of Alagoas (**Appendix 1**).

Data analysis

The data from the active searches were not included in the analyses. The relative abundance of each species was calculated by the percentage of individuals captured in comparison with the total number of specimens. Sampling effort was determined using the index of Straube & Bianconi (2002). Species richness was estimated in the software EstimateS, with 1000 randomizations.

Results

A total sampling effort of 43.200 m^2.h (mist-nets) together with the active searches in roosts resulted in the capture of 68 individuals representing nine species in three families (**Table 1**). The family Molossidae, represented by *Molossus molossus* (Pallas, 1766), was captured only in roosts. The Jackknife 1 procedure estimated species richness of 9.9 (**Figure 3**), which indicates that 91% of the species expected for the area were collected during the present study.

Table 1. List of the bat species captured at Fazenda do Engenho Cachoeira, Caetité (Bahia). Guilds: FR – frugivorous, NE – nectarivorous, HE – hematophagous, IN – insectivorous.

Taxa	Number of specimens collected in:		Guild
	Mist-nets	Roosts	
Phyllostomidae			
Desmodontinae			
Desmodus rotundus (E. Geoffroy, 1810)	05	-	HE
Glossophaginae			
Anoura geoffroyi Gray, 1838	01	-	NE
Glossophaga soricina (Pallas, 1766)	04	-	NE
Carolliinae			
Carollia perspicillata (Linnaeus, 1758)	18	-	FR
Stenodermatinae			
Artibeus planirostris Spix, 1823	02	-	FR
Platyrrhinus lineatus (E. Geoffroy, 1810)	03	01	FR
Sturnira lilium (E. Geoffroy, 1810)	04	-	FR
Molossidae			
Molossus molossus (Pallas, 1766)	-	17	IN
Vespertilionidae			
Myotis lavali Moratelli, Peracchi, Dias & Oliveira, 2011	12	01	IN
Total	49	19	

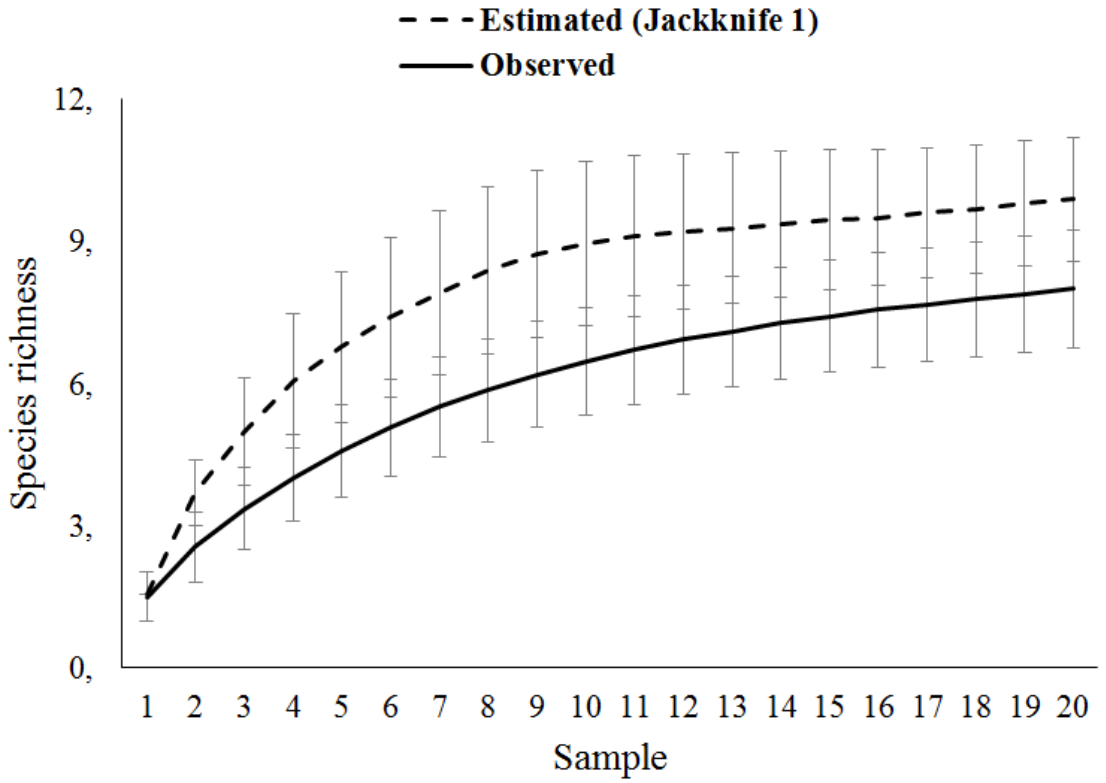

Figure 3. Cumulative bat species richness and the species richness estimated by Jackknife 1, based on the standardized samples collected at Fazenda do Engenho Cachoeira, Caetité (Bahia).

The family Phyllostomidae (N = 37) dominated the sample, with 77.5% of the specimens captured. *Carollia perspicillata* was the most abundant species (N = 18) (**Figure 4D**), followed by *Myotis lavali* Moratelli, Peracchi, Dias & de Oliveira, 2011 (N = 12) (**Figure 4I**). Only *C. perspicillata* was classified as common, with all the other species being classified as rare. The frugivorous guild was the most common (N = 28), followed by the insectivorous guild (N = 12), whereas nectarivorous and hematophagous bats were collected only during the rainy season (**Table 2**).

Table 2. List of the bat species captured in mist-nets at Fazenda do Engenho Cachoeira, Caetité (Bahia) during the dry and rainy seasons.

Species	Number of individuals collected during the:		Total
	Dry season	Rainy season	
Anoura geoffroyi	-	01	01
Artibeus planirostris	-	02	02
Carollia perspicillata	06	12	18
Desmodus rotundus	-	05	05
Glossophaga soricina	-	04	04
Platyrrhinus lineatus	-	03	03
Sturnira lilium	-	04	04
Myotis lavali	01	11	12
Total	**07**	**42**	**68**

Bats were observed in a reproductive condition only during the rainy season. Two pregnant females of *Carollia perspicillata* and one of *Platyrrhinus lineatus* (E. Geoffroy, 1810) and *Myotis lavali* were captured. Lactating and post-lactating females of *Desmodus rotundus* (E. Geoffroy, 1810), *Artibeus planirostris* Spix, 1823, *C. perspicillata*, *Sturnira lilium* (E. Geoffroy, 1810) and *Glossophaga soricina* (Pallas, 1766) were also captured (**Figure 4**).

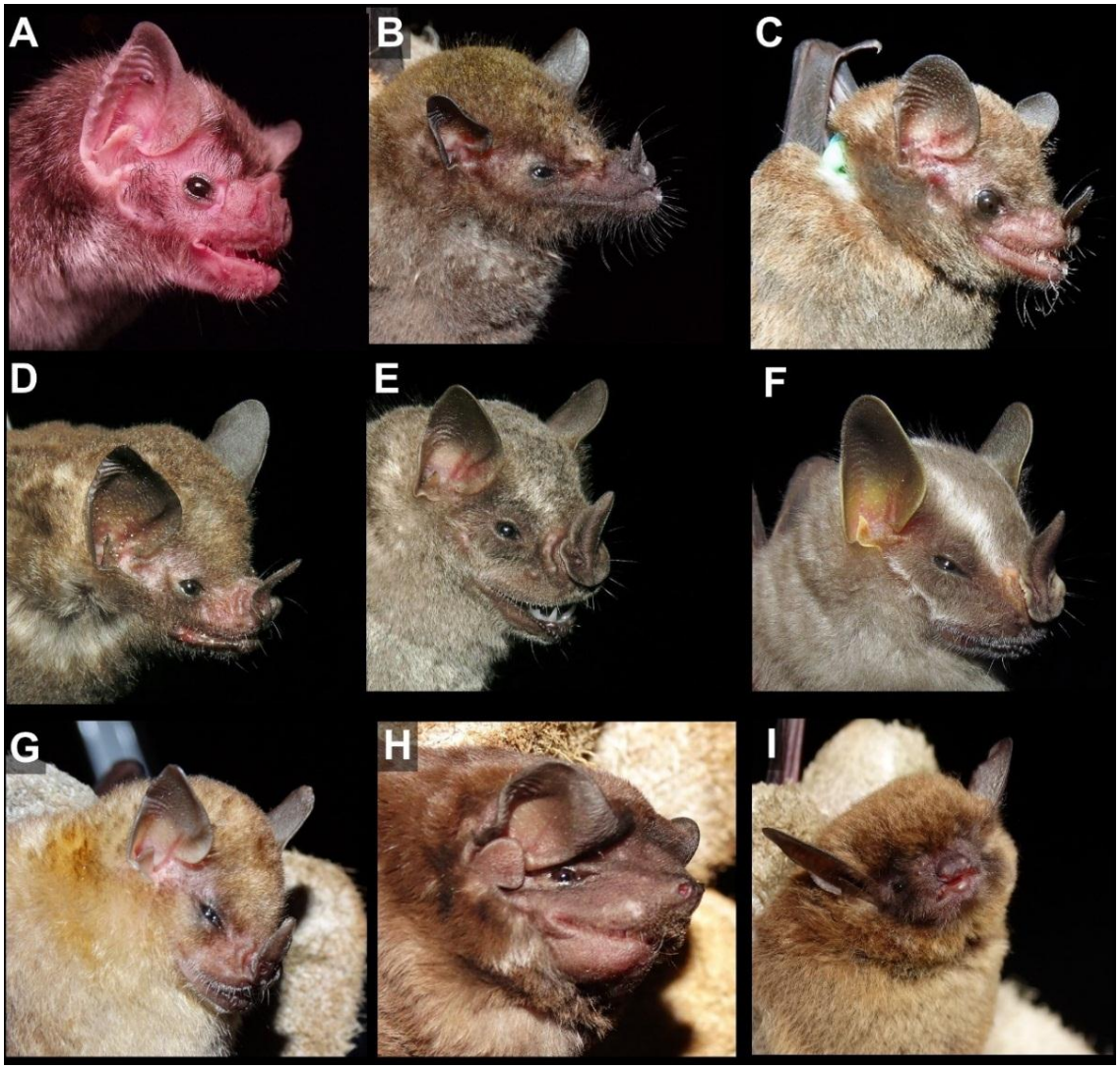

Figure 4. Bat species captured at Fazenda do Engenho Cachoeira, Caetité (Bahia): **A**. *Desmodus rotundus*, **B**. *Anoura geoffroyi*, **C**. *Glossophaga soricina*, **D**. *Carollia perspicillata*, **E**. *Artibeus planirostris*, **F**. *Platyrrhinus lineatus*, **G**. *Sturnira lilium*, **H**. *Molossus molossus*, **I**. *Myotis lavali*.

Discussion

All the species recorded in the present study (**Figure 4**) had been recorded previously in the Brazilian state of Bahia. The species composition and abundance patterns are consistent with the results of Falcão *et al.* (2005), and the predominance of phyllostomids is typical of the Neotropical region in general (Humphrey & Bonaccorso 1979; Fenton *et al.* 1992; Kalko 1998), and of the Caatinga biome, in particular, where more than half the species are members of this family (Silva & Nascimento 2008; Carvalho-Neto *et al.* 2016).

It is important to remember, however, that the mist-netting technique adopted in the present study strongly favors the capture of phyllostomids over other families (Findley 1993), given that they tend to fly low down in the forest (Sampaio *et al.* 2003). Consequently, they are typically the most abundant group captured in studies of this type. To obtain a more reliable inventory of bats in areas of Caatinga, complementary techniques should be employed (Silva & Bernard 2017). In particular, acoustic monitoring can increase the inventory of species not captured by mist nets, especially insectivorous bats, which typically fly above the canopy (MacSwiney *et al.* 2008; Silva & Bernard 2017). Nearly half of the Caatinga bat species are insectivores that forage in open spaces, flying high above nets, or species able to detect and avoid the nets (Paglia *et al.* 2012; Nogueira *et al.* 2014).

Carollia perspicillata, the species most captured in the present study, is generally the dominant species at Caatinga sites (Mares *et al.* 1981; Gregorin *et al.* 2008; Novaes & Laurindo 2014). This species is widely distributed in Brazil, occurring in all its biomes (Peracchi *et al.* 2011). The predominance of one or a few common species is typical of Brazilian bat communities (Pedro & Taddei 2007).

A predominance of insectivorous bats in the Caatinga has been observed in the states of Piauí (Gregorin *et al.* 2008; Novaes *et al.* 2015), Ceará (Willig & Mares 1989; Novaes & Laurindo 2014) and Paraíba (Zeppelini *et al.* 2017). In the present study, the insectivorous guild was abundant in the diurnal roosts, although no *Molossus molossus* were captured in the mist nets. The vespertilionid *Myotis lavali* was captured mainly in the nets set at the margins of small bodies of water, an ideal location for the capture of insectivorous bats (Lourenço *et al.* 2010; Costa *et al.* 2012; Novaes *et al.* 2015).

While observed bat species richness was close to that expected by the Jackknife 1 estimator, a relatively small number of species was recorded overall. The cumulative species curve did not reach the asymptote, indicating that additional species should be found. A number of species recorded commonly in the Caatinga were not encountered during the present study, including *Artibeus lituratus* (Olfers 1818), *Dermanura cinerea* Gervais, 1856, *Lonchophylla mordax* Thomas, 1903, and *Phyllostomus discolor* Wagner, 1843) (e.g., Mares *et al.* 1981; Willig 1983; Silva 2007; Novaes & Laurindo 2014; Rocha *et al.* 2015, 2017). Therefore, more systematic sampling with a greater capture effort may be necessary to obtain more reliable inventories of the bat fauna.

The number of species and the capture rates recorded at Caetité were much lower than those observed at other Caatinga sites. Even so, a reduced abundance of bats appears to be typical of the Caatinga biome (Silva *et al.* 2004; Gregorin *et al.* 2008; Novaes & Laurindo 2014; Beltrão *et al.* 2015; Novaes *et al.* 2015; Rocha *et al.* 2017; Zeppelini *et al.* 2017), where richness may typically be between 15 and 25 species (Novaes & Laurindo 2014). Surveys conducted at other sites in Bahia have also resulted in the capture of small numbers of bats. In Contendas do Sincorá, approximately 200 km from the present study area, for example, Rios *et al.* (2008) captured 14 bats belonging to seven species, while in Vitória da Conquista, 240 km from the present study, Falcão *et al.* (2005) recorded 13 bat species.

During the rainy season we recorded a greater abundance and species richness of bats at Fazenda do Engenho Cachoeira. In addition, actively reproductive bats were only observed during the rainy season. In the Caatinga, the highest abundance and diversity of bats is recorded during the rainy season (Rocha *et al.* 2017), a period is characterized by a greater abundance of resources such as insects (Vasconcellos *et al.* 2010) and fruit (Amorim *et al.* 2009). Rapid surveys

are important for the understanding of the diversity and distribution of the bat fauna, given the potential structure of local communities. In addition to providing primary data, they access the diversity of a given location directly, and provide important insights for the managers of protected areas and other public agents (Silveira *et al.* 2010). The understanding of local diversity is fundamental to the development of effective conservation measures (Brooks & Helgen 2010). In the specific case of the present study, the occurrence of additional, rare species may be confirmed through the collection of complementary data, through bio-acoustic studies, for example. The results of the present study nevertheless constitute an important contribution to the understanding of the bat diversity of the seasonal Caatinga of the Brazilian state of Bahia.

Appendix

Vouchers deposited in the Museu de História Natural da Universidade Federal de Alagoas (MHNUFAL): *Carollia perspicillata* ♂ MHNUFAL 106, *Platyrrhinus lineatus* ♂ MHNUFAL 107, *Sturnira lilium* ♀ MHNUFAL 141, *Myotis lavali* ♂ MHNUFAL 142, *Artibeus planirostris* ♀ MHNUFAL 143, *Desmodus rotundus* ♂ MHNUFAL 144, *Anoura geoffroyi* ♀ MHNUFAL 145, *Glossophaga soricina* ♂ MHNUFAL 146, *Molossus molossus* ♂ MHNUFAL 147.

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References

Amorim I.L., Sampaio E.V.S.B. & Araújo E.L. (2009) Fenologia de espécies lenhosas da caatinga do Seridó, RN. *Revista Árvore*, 33: 491–499. doi: 10.1590/S0100-67622009000300011

Andrade-Lima D. (1981) The caatingas dominium. *Revista Brasileira de Botânica*, 4: 149–153.

Beltrão M.G., Zeppelini C.G., Fracasso M.P.A. & Lopez L.C.S. (2015) Bat inventory in a Caatinga area in Paraíba State, Northeastern Brazil, with a new occurrence for the state. *Neotropical Biology and Conservation*, 10: 15–20. doi: 10.4013/nbc.2015.101.03

Bernard E., Aguiar L.M.S. & Machado R.B. (2011) Discovering the Brazilian bat fauna: a task for two centuries? *Mammal Review*, 41: 23–39. doi: 10.1111/j.1365-2907.2010.00164.x

Brooks T.M. & Helgen K.M. (2010) Biodiversity: a standard for species. *Nature*, 467: 540–541. doi: 10.1038/467540a

Cardoso D.B.O.S. & Queiroz L.P. (2007) Diversidade de Fabaceae nas Caatingas de Tucano, Bahia: implicações para a fitogeografia do semiárido do nordeste do Brasil. *Rodriguesia*, 58(2): 379–391.

Carvalho-Neto F.G., Silva J.R., Santos N., Rhode C., Garcia A.C.L. & Montes M.A. (2016) The heterogeneity of Caatinga biome: an overview of the bat fauna. *Mammalia*, 81(3): 1–8. doi: 10.1515/mammalia-2015-0046

Costa L.M., Luz J.L. & Esberard C.E.L. (2012) Riqueza de morcegos insetívoros em lagoas no Estado do Rio de Janeiro, Brasil. *Papéis Avulsos de Zoologia*, 52: 7–19.

Falcão F.C., Santos-Soares B. & Drummond S. (2005) Espécies de morcegos do Planalto da Conquista, Bahia, Brasil. *Chiroptera Neotropical*, 11(2): 220–223.

Faria D. (2006) Phyllostomid bats of a fragmented landscape in the north-eastern Atlantic forest, Brazil. *Journal of Tropical Ecology*, 22(5): 531–542. doi: 10.1017/S0266467406003385

Faria D. & Baumgarten J. (2007) Shade cacao plantations (*Theobroma cacao*) and bat conservation in southern Bahia, Brazil. *Biodiversity and Conservation*, 16(2): 291–312. doi: 10.1007/s10531-005-8346-5

Faria D., Laps R., Baumgarten J. & Cetra M. (2006) Bat and bird assemblages from forests and shade cacao plantations in two contrating landscapes in the Atlantic forest of southern Bahia, Brazil. *Biodiversity and Conservation*, 15: 587–612. doi: 10.1590/S1676-06032006000200022

Feijó J.A., Rocha P.A. & Althoff S.L. (2015a) New species of *Histiotus* (Chiroptera: Vespertilionidae) from northeastern Brazil. *Zootaxa*, 4048(3): 412–427. doi: 10.11646/zootaxa.4048.3.4

Feijó J.A., Rocha P.A., Mikalauskas J.S. & Ferrari S.F. (2015b) *Macrophyllum macrophyllum* (Schinz, 1821) in the brazilian Caatinga scrublands: river basins as potential routes of dispersal in xeric ecosystems. *Mastozoologia Neotropical*, 22(1): 1–7.

Fenton M.B., Acharya L., Audet D., Hickey M.B.C., Merriman C., Obrist M.K. & Syme D.M. (1992) Phyllostomid bats (Chiroptera: Phyllostomidae) as indicators of habitat disruption in the Neotropics. *Biotropica*, 24(3): 440–446. doi: 10.2307/2388615

Findley J.S. (1993) Bats: a Community Perspective. New York: Cambridge University Press. 179 p.

Gardner A.L. (2007) Mammals of South America, Volume 1: Marsupials, Xenarthrans, Shrews, and Bats. Chicago: University of Chicago Press. 669 p. [Dated 2007; published 31 March 2008]

Gregorin R. & Taddei V.A. (2002) Chave artificial para a identificação de Molossídeos brasileiros (Mammalia, Chiroptera). *Mastozoología Neotropical*, 9(1): 13–32.

Gregorin R., Carmignotto A.P. & Percequillo A.R. (2008) Quirópteros do Parque Nacional da Serra das Confusões, nordeste do Brasil. *Chiroptera Neotropical*, 14(1): 366–383.

Gregorin R., Moras L.M., Acosta L.H., Vasconcellos K.L., Poma J.L., Santos F.R. & Paca R.C. (2016) A new species of *Eumops* (Chiroptera: Molossidae) from southeastern Brazil and Bolivia. *Mammalian Biology-Zeitschrift für Säugetierkunde*, 81(3): 235–246. doi: 10.1016/j.mam bio.20 16.01.002

Humphrey S.R. & Bonaccorso F.J. (1979) Population and community ecology (p. 409–441). *In*: Baker R.J., Jones-Jr. J.K. & Carter D.C. (Eds). Biology of the bats of the New World family Phyllostomatidae, Part III. *Special Publications the Museum Texas Tech University*, (16): 1–441.

INMET (2014) Instituto Nacional de Meteorologia. Clima. Electronic Database. Available at: athttp://www.inmet.gov.br/portal/ (Accessed on 10/10/2017).

Kalko E.K.V. (1998) Organization and diversity of tropical bat communities through space and time. *Zoology*, 101: 281–297.

Leal I.R., Silva J.M.C., Tabarelli M. & Lacher Jr. T.E. (2005) Mudando o Curso da Conservação da Biodiversidade da Caatinga do Nordeste do Brasil. *Megadiversidade*, 1(1): 139–146.

Lourenço E.C., Costa L.M., Silva R.M. & Esbérard C.E.L. (2010) Bat diversity of Ilha da Marambaia, Southern Rio de Janeiro State, Brazil (Chiroptera, Mammalia). *Brazilian Journal of Biology*, 70(3): 511–519. doi: 10.1590/S1519-69842010000300007

MacSwiney M.G., Clarke F.M. & Racey P.A. (2008) What you see is not what you get: the role of ultrasonic detectors in increasing inventory completeness in Neotropical bat assemblages. *Journal of Applied Ecology*, 45(5): 1364–1371. doi: 10.1111/j.1365-2664.2008.01531.x

Mares M.A., Willig M.R., Strailein K.E. & Lacher Jr. T.E. (1981) The mammals of northeastern Brazil: a preliminary assessment. *Annals of Carnegie Museum*, 50: 81–137.

Moratelli R. & Dias D. (2015) A new species of nectar-feeding bat, genus *Lonchophylla*, from the Caatinga of Brazil (Chiroptera, Phyllostomidae). *ZooKeys*, 514: 73–91. doi: 10.3897/zookeys.514.10013

Nogueira M.R., Lima I.P., Moratelli R., Tavares V.C., Gregorin R. & Peracchi A.L. (2014) Checklist of Brazilian bats, with comments on original records. *Check List*, 10(4): 808–821. doi: 10.15560/10.4.808

Novaes R.L.M. & Laurindo R.S. (2014) Morcegos da Chapada do Araripe, nordeste do Brasil. *Papéis Avulsos de Zoologia*, 54: 315–328. doi: 10.1590/0031-1049.2014.54.22

Novaes R.L.M., Laurindo R.S. & Souza R.F. (2015) Structure and natural history of an assemblage of bats from a xerophytic area in the Caatinga of northeastern Brazil. *Studies on Neotropical Fauna and Environment*, 50(2): 40–51. doi: 10.1080/01650521.2015.1006478

Paglia A.P., Fonseca G.A.B., Rylands A.B., Herrmann G., Aguiar L.M.S., Chiarello A.G., Leite Y.L.R., Costa L.P., Siciliano S. & Kierulff M.C.M. (2012) Lista anotada dos mamíferos do Brasil. 2° edição. *Occasional Paper of Conservation Biology*, 6: 1–76.

Pedro W.A. & Taddei V.A. (1997) Taxonomic assemblage of bats from Panga Reserve, southeastern Brazil: abundance patterns and trophic relations in the Phyllostomidae (Chiroptera). *Boletim do Museu de Biologia Mello Leitão*, 6: 3–21. doi: 10.1590/S0101-81752002000300033

Pedro W.A. & Taddei V.A. (1997) Taxonomic assemblage of bats from Panga Reserve, southeastern Brazil: abundance patterns and trophic relations in the Phyllostomidae (Chiroptera). *Boletim do Museu de Biologia Mello Leitão*, 6: 3–21. doi: 10.1590/S0101-81752002000300033

Peracchi A.L., Lima I.P., Nogueira M.R. & Ortêncio-Filho H. (2011) Ordem Chiroptera (p. 155–234). *In*: Reis N.R., Peracchi A.L., Pedro W.A. & Lima I.P. (Eds). Mamíferos do Brasil. 2° edition. Londrina: Nelio R. dos Reis. 437 p.

Prado D. (2003) As caatingas da América do Sul (p. 3–73). *In*: Leal I.R., Tabarelli M. & Silva J.M.C (Eds). Ecologia e conservação da Caatinga. Recife: Editora Universitária, Universidade Federal de Pernambucoe. 822 p.

Rios G.F.P., Sá-Neto R.J. & Graciolli G. (2008) Fauna de dípteros parasitas de morcegos em uma área de Caatinga do nordeste do Brasil. *Chiroptera Neotropical*, 14(1): 339–345.

Rocha P.A., Feijo J.A., Pedroso M.A. & Ferrari S.F. (2015) First record of the big free-tailed bat, *Nyctinomops macrotis* (Chiroptera, Molossidae), for the semi-arid Caatinga scrublands of northeastern Brazil. *Mastozoología Neotropical*, 22(1): 195–200.

Rocha P.A., Pedroso M.A. & Velazco P.M. (2018) First record of *Platyrrhinus fusciventris* (Chiroptera, Phyllostomidae) for the Caatinga biome. *Mammalia*, 82(2): 178–182. doi: 10.1515/mammalia-2016-0170

Rocha P.A., Ruiz-Esparza J. & Ferrari S.F. (2017) Differences in the structure of the bat community between a cloud forest refuge and a surrounding semi-arid Caatinga scrubland in the northeastern Brazil. *Journal of Arid Environment*, 151: 41–48. doi: 10.1016/j.jaridenv.2017.11.005

Sampaio E.M., Kalko E.K.V., Bernard E., Rodríguez-Herrera B. & Handley Jr. C.O. (2003) A biodiversity assessment of bats (Chiroptera) in a tropical lowland rainforest of central Amazonia, including methodological and conservation considerations. *Studies on Neotropical Fauna and Environment*, 38(1): 17–31. doi: 10.1076/snfe.38.1.17.14035

Sá-Neto R.J. & Marinho-Filho J. (2013) Bats in fragments of xeric woodland caatinga in Brazilian semiarid. *Journal of Arid Environments*, 90: 88–94. doi: 10.1016/j.jaridenv.2012.10.007

Silva L.A.M. (2007) Comunidades de morcegos na Caatinga e brejo de altitude no agreste de Pernambuco. Tese de Doutorado, Biologia Animal. Universidade de Brasília, Distrito Federal, Brasília. 161 p.

Silva C.R. & Bernard E. (2017) Bioacoustics as an Important Complementary Tool in Bat Inventories in the Caatinga Drylands of Brazil. *Acta Chiropterologica*, 19(2): 409–418.

Silva L.A.M. & Nascimento J.L. (2008) Morcegos da Caatinga: História Natural, Riqueza e Conservação (p. 101–114). *In*: Pacheco S.M., Marques R.V. & Esbérard C.E.L. (Eds). Morcegos no Brasil: Biologia, Sistemática, Ecologia e Conservação. Porto Alegre: Armazém Digital Comunicação Ltda. 575 p.

Silva S.S.P., Guedes P.G., Camardella A.R. & Peracchi A.L. (2004) Survey of bats (Mammalia, Chiroptera), with comments on reproduction status, in Serra das Almas Private Heritage Reserve, in the state of Ceará, Northwestern of Brazil. *Chiroptera Neotropical*, 10: 191–195.

Silveira L.F., Beisiegel B.M., Curcio F.F., Valdujo P.H., Dixo M., Verdade V.K., Mattox G.M.T. & Cunningham P.T.M. (2010) Para que servem os inventários de fauna? *Estudos Avançados*, 24: 173–207. doi: 10.1590/S0103-40142010000100015

Simmons N.B. (2005) Order Chiroptera (p. 312–529). *In*: Wilson D.E. & Reeder D.M. (Eds). Mammal species of the world: A Taxonomic and Geographic Reference. 3° edition. Baltimore: The Johns Hopkins Press. 2000 p.

Simmons N.B. & Voss J.L. (1998) The mammals of Paracou, French Guiana, a Neotropical lowland rainforest fauna, Part 1. Bats. *Bulletin of the American Museum of Natural History*, 237: 1–219.

Straube F.C. & Bianconi G. (2002) Sobre a grandeza e a unidade utilizada para estimar o esforço de captura com utilização de redes-de-neblina. *Chiroptera Neotropical*, 8(1–2): 150–152.

Vasconcellos A., Andreazze R., Almeida A.M., Araujo F.F.P., Oliveira E.S. & Oliveira U. (2010) Seasonality of insects in the semi-arid Caatinga of northeastern Brazil. *Revista Brasileira de Entomologia*, 54(3): 471–476.

Willig M.R. (1983) Composition, microgeographic variation, and sexual dimorphism in Caatingas and Cerrado bat communities from Northeastern Brazil. *Bulletin of the American Museum of Natural History*, 23: 1–131.

Willig M.R. & Mares M.A. (1989) Mammals from the Caatinga: an update list and summary of recent research. *Revista Brasileira de Biologia*, 49(2): 361–367.

Zeppelini C.G., Beltrão M.G., Feijo J.A., Fracasso M.P.A. & Lopez L.C.S. (2017) Bats of Alagoa Grande, a semi-arid area of Northeastern Brazil. *Neotropical Biology and Conservation*, 12: 185–190. doi: 10.4013/nbc.2017.123.04