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Artículo

FIRST RECORD OF *Lonchophylla bokermanni* (CHIROPTERA, PHYLLOSTOMIDAE) FOR THE CAATINGA BIOME

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ABSTRACT. *Lonchophylla bokermanni* is known from three localities in the southern portion of the Serra do Espinhaço, all located in the Cerrado of Minas Gerais. Based on recent material from two localities in the Caatinga of Bahia, northeastern Brazil, we report the species occurrence in the northern portion of Serra do Espinhaço. These new records extend the species distribution by more than 840 km and represent the first records of *L. bokermanni* in the Caatinga biome. The localities we report here are under severe anthropic pressure, and this distribution extension should not inhibit conservation efforts for the species.

RESUMO. **Primeiro registro de *Lonchophylla bokermanni* (Chiroptera, Phyllostomidae) para o bioma Caatinga.** *Lonchophylla bokermanni* é conhecida para três localidades na porção sul da cadeia de montanhas da Serra do Espinhaço, com todos os registros no Cerrado de Minas Gerais. Com base em registros recentes provenientes de duas localidades na Caatinga da Bahia, nordeste do Brasil, registramos a espécie na porção norte da Serra do Espinhaço. Os novos registros ampliam a distribuição da espécie em mais de 840 km, representando o primeiro registro de *L. bokermanni* para a Caatinga. As novas localidades reportadas estão sob grande pressão antrópica. Assim, a ampliação da distribuição não deve inibir estratégias de conservação para a espécie.

Key words: Cerrado. Conservation. Geographic distribution. Lonchophyllinae. Northeastern Brazil.

Palavras-chave: Cerrado. Conservação. Distribuição geográfica. Lonchophyllinae. Nordeste do Brasil.

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INTRODUCTION

Lonchophylla Thomas, 1903 (Chiroptera, Phyllostomidae, Lonchophyllinae) comprises 13 species of nectar-feeding bats restricted to the Neotropics (Moratelli & Dias 2015). Bat species in this genus are characterized by having unreduced molar cusps, an elongated muzzle bearing short vibrissae, wings attached to the ankle, and a long tongue with a deep lateral fissure, bordered with short papillae (Griffiths & Gardner 2008; Parlos et al. 2014). Five species occur in Brazil: *Lonchophylla mordax* Thomas 1903 recorded in the Cerrado, Caatinga, Atlantic Forest, Amazon, Pampa and Chaco biomes; *L. bokermanni* Sazima, Vizotto & Taddei 1978 recorded in the Cerrado biome; *L. dekeyseri* Taddei, Vizotto & Sazima 1983 recorded in the Cerrado and Caatinga biomes; *L. peracchii* Dias, Esbérard & Moratelli 2013 recorded in the Atlantic Forest biome; and *L. inexpectata* Moratelli & Dias 2015 recorded in the Caatinga biome (Paglia et al. 2012; Nogueira et al. 2014b; Moratelli & Dias 2015; Carmignotto & Astúa 2018). All of these species but *L. dekeyseri* are endemic to Brazil (Griffiths & Gardner 2008; Dias et al. 2013; Moratelli & Dias 2015).

Lonchophylla bokermanni was described with material collected from Serra do Cipó, Jaboticatubas municipality, Minas Gerais state, in the Cerrado biome (Sazima et al. 1978). Shortly after the species description, its distribution was extended to the Atlantic Forest biome occurring on continental islands and in mainland localities in Rio de Janeiro state (Taddei et al. 1988; Dias et al. 2013), and recently in mainland in Espírito Santo state (Pimenta et al. 2010). Atlantic Forest populations were reassigned to a new species, *L. peracchii* (see Dias et al. 2013) and after this taxonomic rearrangement, a few additional specimens have been taken near the type locality in the Cerrado of Minas Gerais (Almeida et al. 2016). Against this background, *L. bokermanni* appears to have the most restricted distribution among Brazilian Lonchophyllinae. Its occurrence records are in the Cerrado of Minas Gerais, in the municipalities of Jaboticatubas, Itambé do Mato Dentro and Diamantina, covering an area of 1506 km^2, in the southern portion of Serra do Espinhaço mountain chain (Teixeira et al. 2014). *Lonchophylla bokermanni* is classified as endangered on the IUCN Red List of Threatened Species (Aguiar 2016) but is absent from the latest Brazilian Red List because the listing effort preceded the taxonomic revision of the genus (ICMBIO 2016). In this report, we document the occurrence of *L. bokermanni* for the Caatinga biome in two localities of Bahia state, in the northern portion of Serra do Espinhaço.

MATERIALS AND METHODS

Specimens were captured in Caetité (14°16′ S, 42°30′ W) and Ourolândia (11°5′ S, 41°18′ W) municipalities that are located in Bahia state and the Caatinga biome, northeastern Brazil. One adult male and one adult female were collected as vouchers and deposited in the Coleção de Mamíferos Alexandre Rodrigues Ferreria, Universidade Estadual de Santa Cruz, Bahia (CMARF 0990, 0991). Two adult females of *L. bokermanni* and one adult male of *L. inexpectata* were collected as vouchers and are deposited in the mammal collection of Instituto de Ciências Biológicas e da Saúde, Universidade Federal Rural do Rio de Janeiro (*L. bokermanni*: ALP 11033, 11035; *L. inexpectata*: ALP 11034). Permits for specimen capture and collection in Caetité were provided by the Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA; N° 055/2012). Permits for capture and collection in Ourolândia were provided by the Instituto do Meio Ambiente e Recursos Hídricos (INEMA; Portaria INEMA N° 12.839).

The following biometric and biological information were recorded for all individuals captured in both localities: reproductive stage, age, body mass (BM, in grams) and external measurements (in millimeters), including body length (BL), tail length (TAL), hindfoot length (HL), ear length (EL), forearm length (FL). Moreover, *L. bokermanni* individuals were previously identified in field according to Dias et al. (2013). Vouchers were fixed with 10% buffered formalin and preserved in 70º GL alcohol. Skulls were removed, cleaned, and measured using a digital caliper accurate to 0.01 mm. In order to confirm the species identification made in field, vouchers were re-identified with the measurements used by Dias et al. (2013) and Moratelli & Dias (2015): greatest length of skull, including incisors (GLS), condyle-incisive length (CIL), basal length (BAL), postorbital breadth (PB), braincase breadth

(BB), mastoid breadth (MB), maxillary toothrow length (MTL), breadth across molars (BAM), breadth across canines (BAC), mandible length (MAL) and mandibular toothrow length (MAN). All external measurements but the forearm length were rounded off to units. Skull measurements and the forearm length were rounded off to tenths.

RESULTS

Natural history

Three adult males and six adult females were netted in Caetité on 9 July 2017. Individuals were captured in ground-level mist-nets set at the exit of a mine that is located in an area of shrub savanna with elevation of 840 m. Captures occurred when bats were leaving the roost, from 17:40 to 22:00. All males were with scrotal testes apparent; and all females were neither pregnant (by palpation) nor lactating. One *Carollia perspicillata* (Linnaeus, 1758) (Phyllostomidae, Carolliinae) and one *Glossophaga soricina* (Pallas, 1766) (Phyllostomidae, Glossophaginae) were also captured leaving the mine.

In Ourolândia bats were captured on 15 and 16 July 2017, and on 20 January 2018, also with mist-nets placed at ground-level but in an area of forested savanna with elevation of 940 m, the nets remained open from 18:00 to 00:00. Two females captured in July were neither pregnant (by palpation) nor lactating and one female captured on January was visibly pregnant. In addition to the three individuals of *L. bokermanni* caught in the field, on 15 July 2017, 23:30, one adult male of *L. inexpectata* was also captured in syntopy.

Identification

We captured 12 individuals of *L. bokermanni*, four of which were collected and presented dark brown membranes; tragus and noseleaf coloring ranged from medium to dark brown. The tragus was pointed at the tip, and the noseleaf was narrow with a central rib at the base. The dorsal surface of the forearm was covered with fur. The dorsal fur was markedly darker than the ventral fur. In the dorsal pelage, the bases of the fur were light brown and hair tips were medium brown. In the ventral pelage, the bases of the fur were brown and tips varied from pale greyish brown to whitish (**Fig. 1**). The lower lip had a deep groove surrounded by small warts and thin lobulated papillae; the interfemoral membrane was well developed, reaching the distal third of the tibia; tail was short and extended to the first third of the interfemoral membrane; and the calcar was short but distinct (ca. 7 mm).

In the skull, the rostrum was long and narrow but shorter than the braincase; the posteromedial edge of the palate was positioned posteriorly to the posterior border of the optic foramen; the posterior border of the infraorbital foramen was above the ante-

Fig. 1. Adult male of *Lonchophylla bokermanni* from the Caatinga of Caetité, Bahia state, Northeastern Brazil (CMARF 0991) (Credit: Vinícius C. Cláudio).

rior root of M1; the basisphenoid pits were shallow, with intervening septum moderately broad; the dentary was long and slender; the coronoid process was low, with rounded tip slightly above the line of the articular condyle. Additionally, the upper canines were long and distinctly grooved along the anterior surface, the upper premolars were triangular in lateral view, the inner lobe of the last upper premolar (P4) was absent or small, with lingual root displaced posteriorly; and parastyle, mesostyle, and metastyle cusps of the 1st and 2nd upper molars (M1 and M2) were moderately to well developed (**Fig. 2**), except in ALP 11035 due to teeth worn, apparently. External and skull measurements are in **Table 1**.

The four specimens from Caatinga have FA (36.1-39.8 mm; **Table 1**) below the range of variation described for *L. bokermanni* (FA 39.4-41.1 mm; Dias et al. 2013), overlapping partially with *L. peracchii* (FA 34.5-36.9 mm; Dias et al. 2013). Cranial measurements were also smaller than the range reported for *L. bokermanni*, with most of the measurements overlapping with *L. peracchii* (see Dias et al. 2013). Such differences suggest clinal variation, with size increasing from north to south. The same trend has been reported for *L. peracchii* by Dias et al. (2016). Despite this geographic variation in size and overlap with measurements of *L. peracchii*, the ratios of GLS/FL (0.61-0.64) and CIL/FL (0.57-0.61) obtained for the material from Caatinga are within the ranges reported by Dias et al. (2013) for *L. bokermanni* (GLS/FL: 0.62-0.64 in *bokermanni*, 0.65-0.73 in *peracchii*; CIL/FL: 0.59-0.61 in *bokermanni*, 0.64-0.70 in *peracchii*).

Lonchophylla bokermanni is readily distinguished from *L. dekeyseri*, *L. inexpectata* and *L. mordax* by the fur on the dorsal surface of the forearm; the anterior surface of the upper canines grooved; P4 narrow in occlusal view, with inner lobe absent or reduced, and lingual

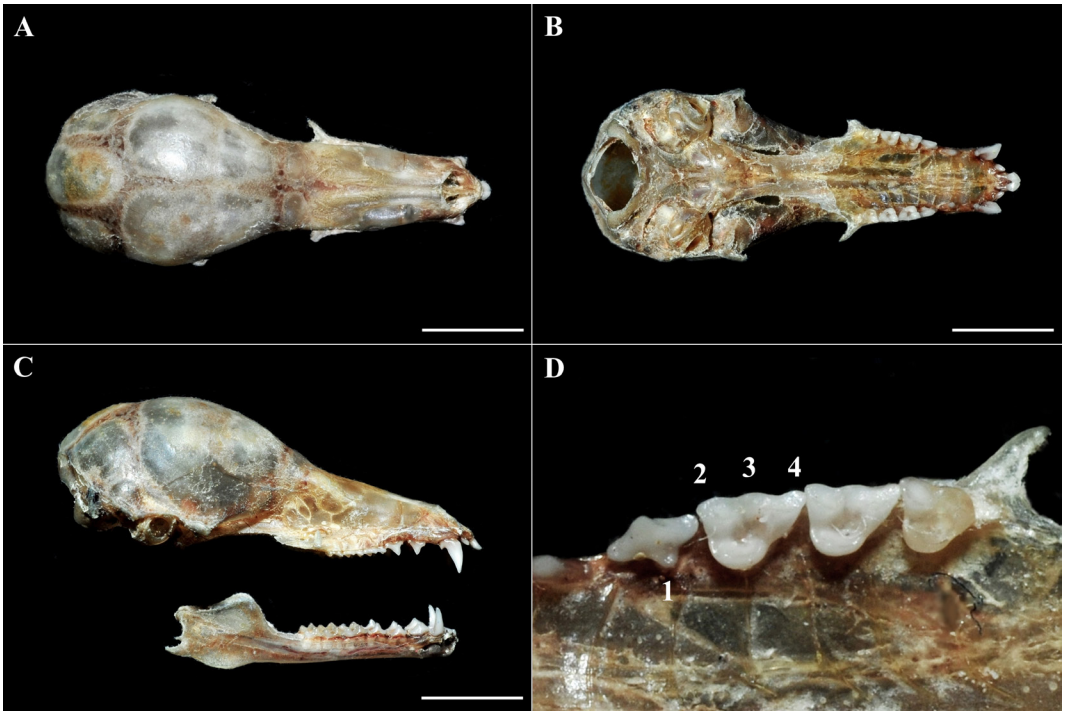

Fig. 2. Dorsal, ventral, and lateral views of the skull and lateral view of the mandible of *Lonchophylla bokermanni* from Caetité, Bahia state, Northeastern Brazil (A–C; CMARF 0990). Oblique occlusal view of the upper second premolar (P4) and molars (D; CMARF 0990). Note the P4 with a small and posteriorly displaced inner lobe (1); and the well-developed parastyle (2), mesostyle (3) and metastyle (4) cusps of M1 and M2. Scale bar = 5mm (Credit: Vinícius C. Cláudio).

Table 1

Selected measurements (mm) and body mass (g) for specimens of *Lonchophylla bokermanni* from the Cerrado of Minas Gerais state (Dias et al. 2013), and from Caetité (CMARF 0990, 0991) and Ourolândia (ALP 11033, 11035), Bahia state, Caatinga of northeastern Brazil. See the text for description of measurements.

Characters	Minas Gerais	CMARF 0991, ♂	CMARF 0990, ♀	ALP 11033, ♀	ALP 11035, ♀
BM	-	11	10	11	10
BL	-	53	55	55	57
TAL	-	10	11	12	11
HL	-	10	10	10	10
EL	-	15	17	12	13
FL	39.4-41.1	36.2	39.9	37.6	38.3
GLS	29.4-25.6	23.5	24.6	23.7	24.9
CIL	23.8-24.4	22.4	23.1	22.7	23.5
BAL	21.9-22.4	20.6	20.9	20.6	21.7
MTL	7.8-8.6	7.6	7.8	7.4	7.8
BAC	3.8-4.1	3.9	3.8	3.9	3.8
BAM	5.1-5.7	5.5	5.4	5.2	5.2
PB	4.8-5.2	4.7	4.7	4.7	4.8
BB	9.0-9.6	9.3	9.2	9.1	9.3
MB	9.4-9.7	9.4	9.3	9.3	9.3
MAL	17.3-17.6	16.4	16.8	16.3	17.1
MAN	8.2-9.0	7.8	8.1	7.8	8.1

root posteriorly displaced; and coronoid process low, with rounded tip only slightly above the articular condyle (Dias et al. 2013; Moratelli & Dias 2015). In comparison with *L. peracchii*, which is restricted to Brazilian Atlantic Forest (Dias et al. 2013; Teixeira et al. 2013; Dias et al. 2016), *L. bokermanni* can be distinguished by qualitative characters (Dias et al. 2013), such as ventral fur pale-grayish contrasting strongly with the dorsum (pale-brownish ventral fur contrasting slightly with the dorsum in *L. peracchii*), ventral hairs markedly bicolored with dark-brown bases and white or pale gray tips (weak contrast between brown bases and tips in *L. peracchii*), parastyle, mesostyle and metastyle cusps in M1 and M2 well developed (usually absent or poorly developed in *L. peracchii*). Based on the diagnostic traits reported above, the four voucher specimens (CMARF 0990, 0991, ALP 11033, 11035) fitted the description of *L. bokermanni*. Thus, we assume that the seven other individuals tentatively identified as *L. bokermanni*, which were released during fieldwork in Caetité, were conspecific.

Distribution

Specimens reported here represent the first record of *L. bokermanni* for the Caatinga biome and for the state of Bahia, extending the species distribution in more than 840 km northward along the Serra do Espinhaço (**Fig. 3**) and the Extent of Occurrence (EOO) to 17 534 km^2 (**Fig. 4**).

DISCUSSION

Information about *L. bokermanni*'s natural history is scarce and limited to notes on its diet (Reis et al. 2017). Our record of a pregnant female on January provides some information about the species reproduction. This data dif-

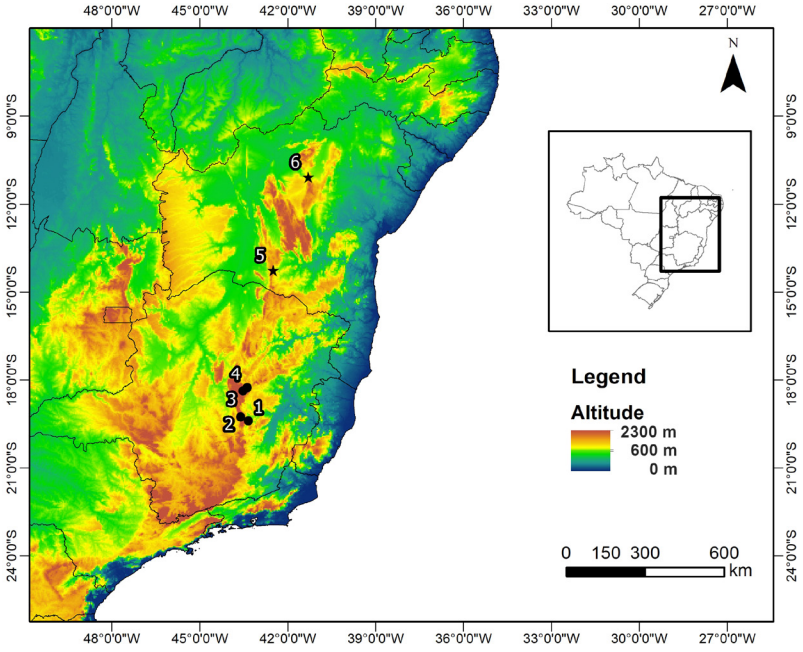

Fig. 3. Occurrence records for *Lonchophylla bokermanni* with altitudes ranging from 720 to 1129 m. Black circles represent previous records from Minas Gerais state, Cerrado of Southeastern Brazil. Black stars represent new records in the Bahia state, Caatinga of Northeastern Brazil. Numbers correspond to the following localities: Itambé do Mato Dentro (1), Jaboticatubas (2), Diamantina (3 and 4), Caetité (5), and Ourolândia (6). See **Table 2** for coordinates, altitudes and references.

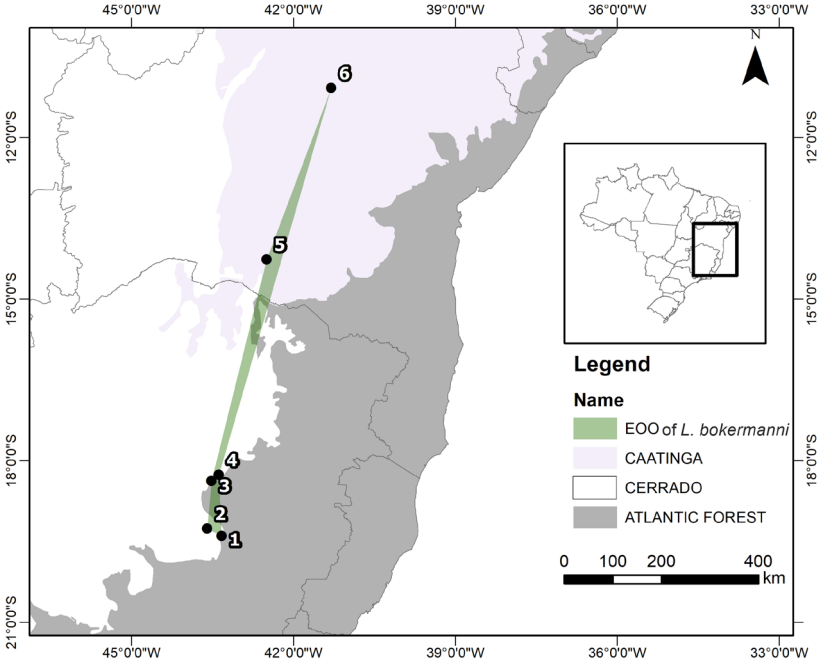

Fig. 4. The green area shows the Extent of Occurrence (EOO) of *L. bokermanni*, with an area of 17 534 km². The EOO encompasses the four known records on the Cerrado of Minas Gerais state, at Itambé do Mato Dentro (1), Jaboticatubas (2) and Diamantina (3 and 4); and the two known records at the Caatinga of Bahia state, at Caetité (5) and Ourolândia (6).

Table 2
Localities for all known occurrence records available for *Lonchophylla bokermanni*. The number (first column) corresponds to the localities in the map (**Fig. 3**).

Number	Municipality, State, elevation	Coordinates	Reference
1	Itambé do Mato Dentro, Minas Gerais, 720 m	19°24′S, 43°20′W	Nascimento et al. 2013
2	Jaboticatubas, Minas Gerais, 900 m	19°16′S, 43°36′W	Sazima et al. 1978
3	Diamantina, Minas Gerais, 1,015 m	18°23′S, 43°31′W	Dias et al. 2013
4	Diamantina, Minas Gerais, 1,129 m	18°23′S, 43°23′W	Almeida et al. 2016
5	Caetité, Bahia, 840 m	14°16′S, 42°30′W	Present study
6	Ourolândia, Bahia, 940 m	11°05′S, 41°18′W	Present study

fers from the available information for other congeners, where pregnant females are reported from March to June in *L. dekeyseri*, from July to November in *L. mordax* (see Nogueira et al. 2007) and in December in *L. peracchii* (see Taddei et al. 1988). Additional information is provided on shelter use. Species of the genus, such as *L. dekeyseri* and *L. mordax* are reported to use natural cavities as shelter, and *L. dekeyseri* is known to share those sites with other species of bats (Bredt et al. 1999; Nogueira et al. 2007; Reis et al. 2017). The use of a mine as shelter by *L. bokermanni* observed in Caetité supports the use of "natural cavities" for the species of the genus. The colony found in Caetité hosted at least nine individuals of *L. bokermanni*, which is superior to the number of two to five individuals per colony related by Aguiar (2016). The presence of individuals of *Carollia perspicillata* and *Glossophaga soricina* in the same shelter are in agreement with data available for other congeners (Bredt et al. 1999).

Lonchophylla bokermanni has been previously recorded for three localities in the Cerrado of Minas Gerais, with elevations above 720 m and predominance of rocky outcrops (campos rupestres; Sazima et al. 1978, Nascimento et al. 2013). These localities cover an area of 1506 km^2 (Teixeira et al. 2014), in the southern portion of Serra do Espinhaço mountain chain. The present records represent an extension in the species distribution, and may indicate that it is distributed along the Serra do Espinhaço mountain chain on elevated locations, as the altitudes of our new records ranged from 840 to 1129 m, and there are no recorded locations of the species at altitudes under 720 m. Considering the northward extension of the distribution of *L. bokermanni*, it is reasonable to expect that this species occurs in syntopy with *Xeronycteris vieirai* Gregorin & Ditchfield, 2005, which is distributed from the north of the state of Minas Gerais to the state of Paraíba (Nogueira et al. 2014a). According to Nogueira et al. (2014a), *L. bokermanni* is the species that most resembles *X. vieirai* in eastern Brazil, which can be differed from the first one by its shorter forearm, narrower braincase and longer mandible. Former registers of *L. bokermanni* on the state of Bahia were actually individuals of *X. vieirai* (see Nogueira et al. 2014a).

The records of *L. bokermanni* in the Caatinga increases to 10 the number of nectarivore species recorded for this biome. The number of species is higher than the one observed on the Atlantic forest (7 species; Muylaert et al. 2017) and similar to the one observed in the Amazon forest (10 species; Nogueira et al. 2014b; López-Baucells et al. 2016). Considering the species registered for the diagonal of Brazilian open areas, including the Cerrado and Caatinga biomes, the number of nectarivorous forms is even higher, reaching 12 species, of which five are endemic to those biomes (Paglia et al. 2012; Gutiérrez & Marinho-Filho 2017; Carmignotto & Astúa 2018).

Despite the distribution extension and the increase on the species EOO area, *L. bokermanni*

is still restricted to a small area if compared with most Brazilian species of bats (see Gardner 2008). This area still represents a gap in the knowledge of occurrence of bats in Brazil (Bernard et al. 2011), and more fieldwork is necessary to understand the distribution and biological requirements of this species. Finally, both localities in the Caatinga of Bahia are under severe anthropic pressure, including construction and operation of wind farms, mining fields, roads and a railroad. Thus, this distribution extension should not inhibit conservation efforts until more information is available.

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