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SHORT COMMUNICATION

Update of the distribution of *Lonchorhina aurita* (Chiroptera), a vulnerable cave-dwelling bat in Brazil[1]

Atualização da distribuição de *Lonchorhina aurita* (Chiroptera), um morcego habitante de caverna vulnerável no Brasil

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Abstract

Lonchorhina aurita is an insectivorous cave-dwelling bat, which roosts primarily in caves, and has been reported from three (Cave Pedra Branca, Cave Janela, and Cave Raposa) of the 94 natural caves registered in Sergipe by the National Register of Speleological Information/National Center for Cave Research and Conservation.The subfamily Lonchorhininae encompasses bats that can be distinguished from other phyllostomids by the presence of an extremely well-developed nasal leaf, which is as long as the ears. This study provides an update on the distribution of this species and reports its first record in the Caatinga for the state of Sergipe, northeastern Brazil. An adult female and an adult male with no evidence of reproductive activity were captured by mist nets in the surroundings of the Xingó Hydroelectric Reservoir, a region dominated by shrubby hyper xerophilous Caatinga vegetation, at the height of the dry season. The morphometric and morphological data were consistent with those recorded for the species in other South American countries. It is important to prioritize the investigation of these sites in order to better understand the abundance and distribution of the species in Sergipe, which is classified as threatened in Brazil.

Keywords: bats, caves, distribution, Lonchorhininae, Tomes's sword-nosed bat, threatened species.

Resumo

Lonchorhina aurita é um morcego insetívoro cavernícola conhecido por se abrigar primariamente em cavernas, o qual foi registrado em três (Caverna Pedra Branca, Gruta da Janela e Gruta da Raposa) das 94 cavidades naturais registradas em Sergipe pelo Cadastro Nacional de Informações Espeleológicas/Centro Nacional de Pesquisa e Conservação de Cavernas. A subfamília Lonchorhininae compreende morcegos que podem ser distinguidos de outros filostomídeos pela presença de uma folha nasal extremamente bem desenvolvida, a qual é mais longa que as orelhas. Este estudo fornece uma atualização sobre a distribuição da espécie e reporta seu primeiro registro para a Caatinga no estado de Sergipe, Nordeste do Brasil. Uma fêmea e um macho adultos sem evidências de atividade reprodutiva foram capturados com redes de neblina no entorno do Reservatório Hidroelétrico de Xingó, uma região dominada por vegetação hiperxerófila de Caatinga, no alto da estação seca. Os dados morfométricos e morfológicos foram consistentes com aqueles registrados para a espécie em outros países sul-americanos. É importante priorizar as investigações dessas localidades

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para melhor entender a abundância e a distribuição da espécie em Sergipe, a qual é classificada como ameaçada de extinção no Brasil.

Palavras-chave: cavernas, distribuição, espécie ameaçada, *Lonchorhininae*, morcego nariz-de-espada de Tomes.

The genus *Lonchorhina* Tomes 1863, subfamily Lonchorhininae (Nogueira *et al.*, 2014), includes primarily insectivorous bats that often roost inside caves and tunnels (Goodwin and Greenhall, 1961; Gardner, 2008). The cranium of the lonchorhinines is differentiated from those of other species by the presence of a concavity near the base of the rostrum in the interorbital region (Gardner, 2008).

The bats lonchorhinines can be distinguished from other phyllostomids by the presence of an extremely well-developed nasal leaf, which is as long as the ears (Reis *et al.*, 2007). The tragus is also well developed, the calcaneum is longer than the hind foot and the tail extends beyond the posterior margin of the long interfemoral membrane (Gardner, 2008; Nogueira *et al.*, 2007).

Lonchorhina includes five medium-sized species of bats aerial and gleaning insectivores: *Lonchorhina fernandezi* Ochoa and Ibañes 1982; *L. marinkellei* Hernández-Camacho and Cadena 1978; *L. orinocensis* Linares and Ojasti 1971; *L. inusitata* Handley and Ochoa 1997 and *L. aurita* Tomes 1863. Only the latter two species occur in Brazil (Simmons, 2005; Gardner, 2008; Peracchi *et al.*, 2011; Nogueira *et al.*, 2014), with *L. inusitata* occurring in the Amazonic region, with record, inside Brazil, just in the northern state of Rondônia, in Porto Velho (Bernard and Sampaio, 2008; Mantilla-Meluk and Montenegro, 2016). The craniodental characteristics provide useful diagnostic criteria for the differentiation of *L. aurita* and *L. inusitata*, which are relatively similar in body size (Freeman, 1988).

Uncommon and broadly distributed, *L. aurita* has records in several localities of 16 countries throughout North America, Central America and South America. Its type locality is Trinidad and Tobago (Muñoz-Arango, 2001). The species was registered accidentally in the Bahamas, where is known only from a single specimen collected on the island of Nassau Harbor (Lassieur and Wilson, 1989). Although it is also housed in tunnels and mines this species may be geographically limited to areas with caves or rocks (Emmons and Feer, 1997) and can be locally abundant near caves (Lassieur and Wilson, 1989). These bats usually form colonies of 12 to 25, and sometimes more than 500 individuals (Goodwin and Greenhall, 1961; Lassieur and Wilson, 1989; Reid, 1997; Eisenberg and Redford, 1999).

Occurring in lowlands, not been found above 1,500 m asl (Reid, 1997), *L. aurita* is strongly associated with moist habitats (Eisenberg and Redford, 1999). In Brazil, the species is found in the Amazonian, Atlantic Forest, Cerrado, Caatinga, and Pantanal biomes (Paglia *et al.*, 2012), besides in urban areas (Bredt and Uieda, 1996).

Data on the distribution of wild populations are fundamentally important for the assessment of the conservation status of a species (IUCN, 2001) and one of the primarily problems for this issue in Brazil is the lack of data at both local and regional levels. In this context, we provide the first confirmed record, based on voucher specimens, of the occurrence of *L. aurita* in the Caatinga scrublands of the Brazilian state of Sergipe extending its known range and highlighting factors that may influence the conservation of bats in Brazil (Bernard *et al.*, 2012).

The specimens of *L. aurita* were captured during a survey of the mammalian fauna in surroundings of the Xingó Hydroelectric Reservoir, specifically in the Fazenda Miramar (9º33'30" S, 37º49'21" W), a farm located in the Southern Backlands Depression of northeastern Brazil, a region dominated by shrubby hyperxerophilous Caatinga vegetation (Velloso *et al.*, 2002). The climate is hot and semi-arid, corresponding to the *Bsh* type in the Köppen classification, with temperatures ranging from 21ºC to 27ºC and a rainy season typically occurring between October and April (Velloso *et al.*, 2002).

During the surveys, which were conducted between 2007 and 2008, bats were captured in mist-nets set at a standard height of 1 m above the ground. Specimens of *L. aurita* were found in the vicinity of an intermittent water course which crosses a garbage tip on the access road to the Fazenda Miramar (9º33'S, 37º49'W), located on the right margin of the São Francisco River.

The specimens were taxidermized following the procedure described by Monteiro (1993), and the cranium was removed. External and craniodental measurements (Díaz *et al.*, 2016) were taken (in millimeters) using a calliper with a precision of 0.001 mm, while body mass was determined using a spring balance with a scale of 1 g. The specimens were deposited in the Mammal Collection of the Federal University of Pernambuco (UFPE) in Recife and their morphology was compared with published data (Polaco *et al.,* 1992; Aguirre *et al.,* 2010; Lessieur and Wilson, 1989). Eight external and sixteen cranial measurements were taken and compared with data available in the literature for the study specie (Table 1).

To expand the known geographic distribution of *L. aurita*, the existing records were compiled from the literature, such as published papers, books, theses and dissertations, available in the main Brazilian libraries and international databases, as well as *SpeciesLink* and Ministério do Meio Ambiente (Biodiversidade/ICMBio/MMA). The localities were plotted on a map generated in ArcGis, version 10.3,

and whenever necessary, the coordinates were converted into decimal values.

Two specimens were collected in Sergipe, being an adult female (UFPE 2519) and an adult male (UFPE 2523) with no evidence of reproductive activity in any case. These specimens were collected on February 12th 2007, at the height of the dry season, at 19h37min and 21h16min, respectively.

The specimens were identified as *L. aurita* based on the diagnostic morphological traits described by Gardner (2008) and Handley and Ochoa (1997) for the differentiation of the species of the genus *Lonchorhina*. These traits include narrow, elongated ears almost as long as the head, tragus larger than half the length of the ear, with an indented base, reduced second lower premolar, trilobate lower incisors, broad palate, proportionally smaller than the tympanic bulla, short, narrow and low face, hind foot shorter than the calcaneum, and the presence of hairs of approximately 9 mm in length on the ventral surface of the ear and forearm, as well as the proximal portion of the nasal leaf. The morphometric data were compared with those available in Lassieur and Wilson (1989), Polaco *et al.* (1992) and Aguirre *et al.* (2010) (Table 1).

In the case of the craniodental data, both the specimens showed smaller total length of the cranium, condylobasal length, width of the postorbital constriction and breadth of the cranium than the specimens from Mexico, while the lower tooth row was longer (Polaco *et al.*, 1992). The zygomatic breadth was greater than the value recorded by Lassieur and Wilson (1989), while the braincase was narrower. All other craniodental parameters were within the range of published data (Table 1).

The forearm of the specimen ♀ UFPE 2519 collected in the present study was shorter than that described by Polaco *et al.* (1992) for specimens of *L. aurita* from Mexico. By contrast, the specimen ♂ UFPE 2523 had a longer tail than that described by Polaco *et al.* (1992) and a longer foot than that recorded by Aguirre *et al.* (2010).

The present record of *L. aurita* from the Caatinga represents the first formal evidence of occurrence of the species in the state of Sergipe, based on the collection, identification, and deposit of voucher specimens in scientific collections. In addition to increasing the number of localities *L. aurita* is known from, the record presented here represents the first confirmed one of the species in the Caatinga biome of Sergipe (Table 2).

In Sergipe, Donato *et al.* (2012) recorded the predation of *L. aurita* by a rainbow boa *Epicrates cenchria* (Linnaeus 1758), in the Pedra Branca Cave (10º46'11" S, 37º47'19" W), located in the village of Pedra Branca, municipality of Laranjeiras. Although no voucher specimens of *L. aurita* from this cave have been deposited in any scientific collection. This cave, registered by the Brazilian Speleology Society as SE-06, is located near a channel of the Sergipe River, in an area of mangrove forest within the intertidal zone with the Atlantic Forest biome (Almeida *et al.*, 2006).

Lonchorhina aurita is classified as "Least Concern" by the IUCN due to its wide distribution and low population decline (Solari, 2015) and it is currently not included in the Brazilian Red List (Machado *et al.*, 2008). Nevertheless, it was included in the seven most endangered bat species defined by the Official National List of Endangered Fauna of Brazil published by the Brazilian Environment Ministry (MMA) through federal ordinance number 444 on December 17th, 2014. The record of the species reported here thus increases the number of endangered bat species found in Sergipe to three (Leal *et al.*, 2013; Machado *et al.*, 2008; Ordinance number 444/2014 – MMA).

Based on a revision of zoological collection data bases, specialized literature and scientific papers we founded records of *L. aurita* in more than 150 localities of 16 countries (Figure 1; Table 2). However, this species is relatively rarely in inventories and is poorly represented in scientific collections due to the inherent bias of sampling with mist-nets set at ground level (Farias *et al.*, 2006; Farias, 2012). Insectivorous bats are more capable of detecting the nets by echolocation, given the higher frequencies they use to detect their prey (Fleming *et al.*, 1972).

In the specific case of *L. aurita*, Nelson (1965) found that the bat is not only able to detect mist-nets using its sonar, but may even perch on the net before returning to its roost, which may account for the few records of the species when using the mist-nets method. Solari (2015) mentions that this bat is an extremely agile flier and may stop and hover in front of a mist net or escape through small gaps.

Esbérard *et al.* (1997) suggested that setting mist-nets in the proximity of bodies of water increases the probability of capturing *L. aurita*, although this cannot be confirmed here, given that no other trapping methods were employed in the present study in Canindé do São Francisco, impeding any systematic comparison of methods. Among the currently available options that may contribute to the increase of distribution area of *L. aurita*, given its difficult of capture in fieldworks that use mist-nets (Solari, 2015), the use of ultrasonic detectors to identification and monitoring of echolocation signals has been reported as the most efficient. The use of this method has allowed for records of several insectivorous bat species traditionally considered rare and of restricted distribution (Kalko and Aguirre, 2006).

In general, the data on the occurrence of bat species in Sergipe are still incipient (Leal *et al.*, 2013) and the bat fauna associated with cave environments is especially poorly known (Guimarães and Ferreira, 2014). Out of a total of 94 caves are known to exist in Sergipe (CANIE/CECAV, 2018), which can provide potential roosts for *L. aurita*, species known to be primarily cave-dwelling (Goodwin

Table 1. Selected measurements (mm) of the *Lonchorhina aurita* specimens from Caatinga of Northeastern Brazil and other localities in North America and South America.

	Measurements	Present study		Lassieur and Wilson (1989)	Polaco *et al.* (1992)	Aguirre *et al.* (2010)
		♀UFPE 2519	♂UFPE 2523			
External Measurements (mm)	Body mass (g)	8.0	10.0	-	-	-
	Body length	54.0	60.4	53.0-67.0	-	53.0-67.0
	Ear length	30.0	30.0	19.2-35.0	29.0-34.0	19.0-35.0
	Forearm length	47.0	49.0	46.7-56.7	48.9-49.7	45.0-54.0
	Tail length	49.0	53.0	42.0-65.0	49.0-51.0	42.0-65.0
	Hind foot length	12.0	11.6	10.0-17.0	13.0-15.0	13.0-15.0
	Length of the 3rd metacarpal	45.0	46.8	-	-	-
	Length of the 1st phalange	14.0	14.6	-	-	-
	Length of the 2nd phalange	24.8	25.9	-	-	-
	Length of the 3rd phalange	10.0	11.0	-	-	-
Craniodental Measurements (mm)	Greatest length of skull	20.20	20.07	19.5-22.7	20.5-21.1	-
	Condylobasal length	18.29	18.24	17.8-20.8	18.5-19.1	-
	Condyle-canine length	17.55	17.50	-	-	-
	Basal length of the skull	16.24	15.33	-	-	-
	Palate length	8.98	9.45	-	-	-
	Maxillary toothrow length	6.43	6.64	6.2-7.6	-	-
	Lower toothrow length	6.94	7.68	-	6.6-6.8	-
	Breadth across upper canines	4.32	4.41	-	-	-
	Mandible length	12.64	12.68	12.4-13.8	-	-
	Postorbital constriction	4.56	4.52	-	5.0-5.1	-
	Zygomatic breadth	10.98	10.28	4.3-7.5	10.2-10.9	-
	Breadth of braincase	8.87	9.03	9.5-11.5	-	-
	Mastoidal breadth	10.19	10.40	-	-	-
	Width of the palate	3.15	3.15	-	-	-
	Height of the braincase	7.60	7.05	-	-	-
	Height of the occipital	7.23	7.05	-	-	-

and Greenhall, 1961; Gardner, 2008; Donato *et al.*, 2012), just three caves home the only know colony in the state of *L. aurita*. Therefore, actions for the conservation of these cavities are a priority, since they harbor colonies of a species considered vulnerable in the Official National List of Endangered Fauna of Brazil (MMA, 2014).

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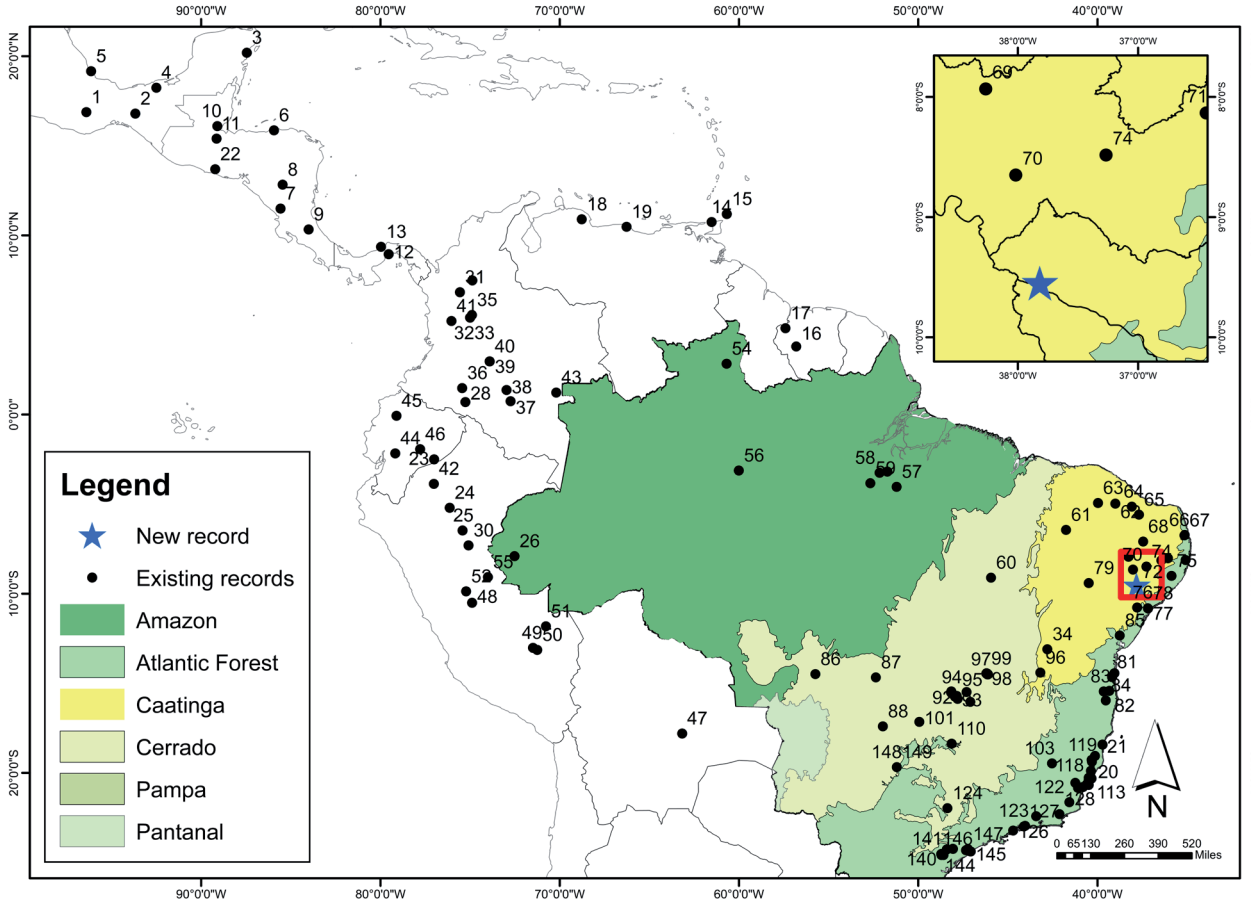

Figure 1. Geographic distribution of Lonchorhina aurita throughout North America, Central America and South America. Star: new record from the Sergipe, Northeast Brazil. Black circles: previous records. The numbers correspond to the records as indicated in the Table 2.

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Table 2. Localities with records of *Lonchorhina aurita* throughout North America, Central America and South America. The numbers refer to the points shown in Figure 1.

Country	Coordinates			
Code	Lat y	Long x	Locality	Reference or Acronym of the Collection/Source
MEXICO				
1	-96.400000	16.883333	Oaxaca	Hayssen *et al.* (1993)
2	-93.666667	16.800000	Chis, Tonala, Rio Ocuil	Azevedo (2013)
3	-87.450000	20.200000	Quintana Roo, Tulum	Azevedo (2013)
4	-92.493711	18.245335	Tabasco	Lassieur and Wilson (1989)
5	-96.134689	19.168224	Sala Seca Cave, Veracruz	Polaco *et al.* (1992); Solari (2015)
HONDURAS				
6	-85.933333	15.866667	Colon, Trujillo, National Park Capiro and Calentura	Azevedo (2013); Mantilla-Meluk and Montenegro (2016)
NICARAGUA				
7	-85.566667	11.500000	Ometepe Island, Lake Nicarágua	Jordan *et al.* (2014)
8	-85.450000	12.833333	Matiguás Municipality, Matagalpa Departament	Medina *et al.* (2007)
COSTA RICA				
9	-84.000000	10.333333	La Selva Biological Reserve, Braulio Carrillo National Park, Provincia of Heredia,	Timm *et al.* (1989)
BELIZE				
10	-89.089989	16.102729	Toledo, Bladen Nature Reserve, Teakettel Camp, on Bladen Branch	Mantilla-Meluk and Montenegro (2016)
GUATEMALA				
11	-89.136249	15.404209	Izabal, Quebrados	Mantilla-Meluk and Montenegro (2016)
PANAMA				
12	-79.538746	8.953935	Canal zone, Mine Shaft, Coco Plantation, Gamboa	Mantilla-Meluk and Montenegro (2016)
13	-79.959224	9.363473	Canal zone, Fort Sherman	Mantilla-Meluk and Montenegro (2016)
TRINIDAD AND TOBAGO				
14	-61.516667	10.750000	Trinidad, Saut d'Eau Cave	Goodwin and Greenhall (1961)
15	-60.672627	11.196288	Saint George	Mantilla-Meluk and Montenegro (2016)
SURINAME				
16	-56.800000	3.800000	Rudi Kappelvliegveld, District Sipaliwini,	Azevedo (2013)
17	-57.399375	4.822444	Avanavero, District Nickerie	Genoways *et al.* (1981)
VENEZUELA				
18	-68.766667	10.900000	Riecito, 30 km S of Mirimire, 300 m, Fálcon State	Handley (1976)
19	-66.266667	10.483333	Birongo, 60m, Miranda State	Handley (1976)
20	-67,21666667	6,583333333	El Pesquero Río Cinaruco, Pedro Camejo, Apure State	FPR-Colombia (SpeciesLink, 2018)
21	-67,795	5,243888889	Samariapo Orinoco River, Atures, Federal Territory, Amazonas State	FPR-Colombia (SpeciesLink, 2018)
EL SALVADOR				
22	-89.211605	13.695312	Unidentified locality	Owen *et al.* (1981); Owen and Girón (2012)
COLOMBIA				
23	-77.000000	-2.500000	Tambito Natural Reserve, Cauca Departament	Dávalos and Guerrero (1999)

Table 2. Continuation.

Country	Coordinates			
Code	Lat y	Long x	Locality	Reference or Acronym of the Collection/Source
24	-76.133333	-5.200000	Pueblorrico, 1.560m, Risaralda Departament	Handley and Ochoa (1997)
25	-75.416667	-6.466667	San Francisco, ca. 2,500 m, Antioquia Departament	Muñoz-Arango (2001)
26	-72.516667	-7.900000	Cúcuta, 215m, North of Santander Departament	Sanborn (1949)
27	-72,43333333	0,08333333333	Raudal El Tubo Río Cuñaré, Solano, Intendência del Caquetá	FPR-Colombia (SpeciesLink, 2018)
28	-75.254948	0.699069	Tepuy Puerto Abeja River Mesay, Solano, Intendência del Caquetá	FPR-Colombia (SpeciesLink, 2018)
29	-74.867553	7.487518	Zaragoza 26 km W Aljibes, Departament of Antioquia	Mantilla-Meluk and Montenegro (2016)
30	-75.083333	-7.300000	26 km S, 22 km W of Zaragoza (Aljibes), Antioquia Departament	Mantilla-Meluk and Montenegro (2016)
31	-75.560344	6.828942	Zaragoza 25 km W La Tirana, Antioquia Departament	Mantilla-Meluk and Montenegro (2016)
32	-74.990504	5.412185	Samana, Norcasia, Professional Camp I, Project La Miel I, Caldas Departament	Mantilla-Meluk and Montenegro (2016)
33	-74.994284	5.414061	Samana, Vereda La Miel, near the Campamento Tasajos	Mantilla-Meluk and Montenegro (2016)
34	-42.792690	13.094898	Samana, Corregimiento Norcaia, surroundings Camp CHEC	Mantilla-Meluk and Montenegro (2016)
35	-74.890736	5.560988	Samana, Norcasia Corregimiento, Prairie Path, CHEC Camp, Caldas Hydroelectric Corporation, La Miel I	Mantilla-Meluk and Montenegro (2016)
36	-75.437089	1.478750	Municipio Montañitas; Vereda Santuario, Finca Ceilán, Intendencia del Caquetá,	Mantilla-Meluk and Montenegro (2016)
37	-72.738708	0.745915	Rio Cuñare, Raudal El Tubo, and Serrania de Chiribiquete, National Park Natural (PNN) Chiribiqueté	Mantilla-Meluk and Montenegro (2016)
38	-72.960147	1.373160	River Mesay, Puerto Abeja, SE Serranía de Chiribiquete	Mantilla-Meluk and Montenegro (2016)
39	-73.897692	2.968846	San Juan de Arama, Northern portion Serrania La Macarena, Caño Guamalito, Department of Meta	Mantilla-Meluk and Montenegro (2016)
40	-73.904613	2.967833	San Juan de Arama, Northern portion Serranía La Macarena, Caño La Curia, Meta Departament	Mantilla-Meluk and Montenegro (2016)
41	-76.032445	5.221775	Pueblo Rico, road to the Bocatoma, Risaralda Departament	Mantilla-Meluk and Montenegro (2016)
42	-77.016667	-3.866667	29 km SE Buenaventura, Valle del Cauca Departament	Mantilla-Meluk and Montenegro (2016)
43	-70.188501	1.227120	Vulpés Departament	Muñoz-Arango (2001)
ECUADOR				
44	-79.166667	-2.166667	Puente de Chimbo, 370m, Guayas Province	Gardner (2008)
45	-79.100000	-0.066667	Chontillal, Manabí Province	Solmsen (1985)
46	-77.783333	-1.933333	Cueva de los Tayos on the Pastaza River, Província de Morona San Tiago	Azevedo (2013)
BOLIVIA				
47	-63.166667	-17.800000	Cave The Curicha, San Matías, Santa Cruz Departament	Sanborn (1932); Aguirre *et al.* (2010)
PERU				
48	-74.883333	-10.500000	San Juan, Pasco Departament	Tuttle (1970)
49	-71.483333	-13.016667	Paucartambo, Cusco Departament	Azevedo (2013)

Table 2. Continuation.

Country	Coordinates			
Code	Lat y	Long x	Locality	Reference or Acronym of the Collection/Source
50	-71.250000	-13.133333	Paucartambo; Consuelo, 15.9 km SW Pilcopata, Cusco Departament	Mantilla-Meluk and Montenegro (2016)
51	-70.766133	-11.815291	Maskoitania, 13.4 km NNW Atalaya, left bank Rio Alto Madre de Dios, Madre de Dios Departament	Mantilla-Meluk and Montenegro (2016)
52	-75.216925	-9.865694	Oxmpa, San Juan, Pasco Departament	Mantilla-Meluk and Montenegro (2016)
BRAZIL				
53	-51.716667	-3.183333	Maracá Village, Mazagão municipality, Amapá State	Azevedo (2013)
54	-60.681871	2.839584	Roraima State	Bernard and Sampaio (2008)
55	-74.000000	-9.066667	Serra do Divisor Nacional Park, Cruzeiro do Sul municipality, Acre State	ZEE_MAM (SpeciesLink, 2018)
56	-60.000965	-3.123472	Amazonas State	Bernard and Sampaio (2008)
57	-51.200000	-4.033333	Amazonia's National Park, municipality of Itaituba, Pará State	George *et al.* (1988)
58	-52.150000	-3.250000	Valdeci Cave, 9 km by road SE of Altamira, Pará State	Handley and Ochoa (1997); Mantilla-Meluk and Montenegro (2016)
59	-52.666667	-3.833333	85 km SW Iriri River eastern bank, Altamira municipality, Pará State	Mantilla-Meluk and Montenegro (2016)
60	-45.933333	-9.100000	Upper Parnaíba (=region along upper Parnaíba river- MA	Sanborn (1932); Mantilla-Meluk and Montenegro (2016)
61	-41.750000	-6.433333	Olho d'Água Farm, 2 km North of Valença do Piauí municipality, Piauí State	Mares *et al.* (1981)
62	-39.000000	-4.966667	Cedro weir, Quixadá municipality, Ceará State	Miretzki (2005)
63	-39.966667	-4.933333	Santo Antônio grange, Russas municipality, Ceará State	Miretzki (2005)
64	-38.083333	-5.133333	Várzea do Cobre grange, Limoeiro do Norte municipality, Ceará State	Miretzki (2005)
65	-37.683333	-5.583333	Três Lagos Grotto, municipality of Felipe Guerra, Rio Grande do Norte State	Ferreira *et al.* (2010); Mena (2016)
66	-35.133333	-6.716667	Guaribas Biological Reserve, Mamanguape municipality, Paraíba State	Lopez and Ditchfield (2009); Azevedo (2013); Zeppellini *et al.* (2016)
67	-35.146631	-6.738371	Cabeça-de-Boi Forest, Guaribas Biological Reserve, Ibama, municipality of Mamanguape, Paraíba State	MZV_BR (SpeciesLink, 2018)
68	-37.450000	-7.083333	Panajó River and Serra do Tamanduá weir, Santa Terezinha municipality, Paraíba State	Feijó and Langguth (2011)
69	-38.266667	-7.933333	Saco Farm, 6.6 km NNE of the municipality of Serra Talhada, Pernambuco State	Carvalho-Neto (2010)
70	-38.016667	-8.650000	Serra Negra Biological Reserve, Floresta municipality, Pernambuco State	Sousa *et al.* (2004)
71	-36.433333	-8.133333	Arara Farm, Brejo da Madre de Deus municipality, Pernambuco State	Silva (2007)

Table 2. Continuation.

Country	Coordinates			
Code	Lat y	Long x	Locality	Reference or Acronym of the Collection/Source
72	-36.066667	-8.016667	Pedra dos Pontais, Matumbo Farm, Toritama municipality, Pernambuco State	Mares *et al.* (1981), Handley and Ochoa (1997); Astúa and Guerra (2008); Mantilla-Meluk and Montenegro (2016); ZUEC-MAM (SpeciesLink, 2018); SISBIO-DIBIO/ICMBio 342002 (PortaBio, 2016)
73	-35.083333	-8.116667	Carnijó Private Natural Heritage Reserve, Moreno municipality, Pernambuco State	Soares (2008); Soares *et al.* (2017)
74	-37.266667	-8.483333	Catimbau National Park, Meu Rei Cave, Tupanatinga municipality, Pernambuco State	Azevêdo and Bernard (2015)
75	-35.866667	-9.000000	São José da Laje/Ibateguara Municipalities, Usina Serra Grande, Alagoas State	Sá-Neto (2003)
76	-37.783333	-10.766667	Pedra Branca Cave (SE-06*), municipality of Laranjeiras, Sergipe State	Donato *et al.* (2012) (observation)
77	-37.177554	-10.818860	Gruta da Janela, municipality of Laranjeiras, Sergipe State	SISBIO-DIBIO/ICMBio 131727 (observation) (PortaBio, 2016)
78	-37.187554	-10.810730	Gruta da Raposa, municipality of Laranjeiras, Sergipe State	SISBIO-DIBIO/ICMBio 131727 (observation) (PortaBio, 2016)
79	-37.816667	-9.550000	Miramar Farm, municipality of Canindé do São Francisco, Sergipe State	Present Study (capture and collection)
80	-40.483333	-9.400000	Juazeiro Municipality, Bahia State	Miretzki (2005)
81	-39.050000	-14.433333	Ilhéus Municipality, Castelo Novo, Bahia State	Miretzki (2005); Farias *et al.* (2006); Azevedo (2013)
82	-39.185987	-14.651437	Ilhéus Municipality, Castelo Novo, left bank of the River Almada, Ilhéus, Bahia State	MBML-Mamíferos (SpeciesLink, 2018)
83	-39.333333	-15.416667	Santa Luzia Municipality, Bahia State	Santos (2001)
84	-39.650000	-15.450000	Pau Brasil Municipality, Bahia State	Santos (2001)
85	-39.533333	-15.950000	Itapebí Municipality, Bahia State	Farias *et al.* (2006)
86	-38.754301	-12.327886	Recôncavo Baiano, Conceição do Jacuípe municipality, Bahia State	SISBIO-DIBIO/ICMBio 60143 (PortaBio, 2016)
87	-55.733333	-14.483333	SESC Serra Azul, Cabeceiras do Rio Cuiabá Environmental Protection Area - Mato Grosso State	Louzada *et al.* (2015)
88	-52.357828	-14.665354	Mineração Caraíba, Nova Xavantina - Mato Grosso State	CM (SpeciesLink, 2018)
89	-51.966667	-17.400000	Mato Grosso do Sul State	Reis *et al.* (2007)
90	-47.950000	-15.733333	Urban area of the Federal District	Bredt and Uieda (1996)
91	-48.150000	-15.450000	Morro Cave (GO 072*), Goiás, Padre Bernardo, Cristal Farm, Federal District	Bredt *et al.* (1999)
92	-48.116667	-15.566667	Dois Irmãos Cave (DF 012*), Farm Dois Irmãos, Brazlândia, Federal District	Bredt *et al.* (1999)
93	-47.800000	-15.866667	Volks Clube Cave (DF 007*), Boca da Mata Allotment, Paranoá, Federal District	Bredt *et al.* (1999)
94	-47.850000	-15.700000	Saúva's Cave, Environmental Protection Area Cafuringa, Farm Sete Lagoas, Federal District	Portella (2010)

Table 2. Continuation.

Country	Coordinates			
Code	Lat y	Long x	Locality	Reference or Acronym of the Collection/Source
95	-48.166667	-15.500000	Sal-Fenda Cave, Cafuringa Environmental Protected Area, Farm Santa Sarah, Federal District	Portella (2010)
96	-46.133333	14.500000	Cave Lapa of Rio das Pedras IV, Goiás State	Esbérard *et al.* (2001)
97	-43.183333	-14.400000	Judite's Cave, municipalities of Mambaí and Buritinópolis, Nascentes do Rio Vermelho Environmental Protected Area, Goiás State	Esbérard *et al.* (2001, 2005)
98	-46.100000	-14.500000	Rio das Pedras' Cave, municipality of Mambaí, Goiás State	Esbérard *et al.* (2001)
99	-46.183333	-14.433333	Cave Lapa of the Farm Extrema, Environmental Protection Area Nascentes do Rio Vermelho, Goiás State	Esberárd *et al.* (2005)
100	-46.200000	-14.450000	Cave Lapa of the Farm Buritizinho, Environmental Protection Area Nascentes do Rio Vermelho, Goiás State	Esberárd *et al.* (2005)
101	-46.150000	-14.450000	Arroz Farm's Cave, Environmental Protection Area Nascentes do Rio Vermelho, Goiás State	Esberárd *et al.* (2005)
102	-49.933333	-17.150000	Joel's Cave Lapa, municipality of Indiara, Vale do Rio dos Bois, Goiás State	Silva *et al.* (2009)
103	-47.300000	-15.483333	Pedra Gruta Toca da Onça Complex, Goiás State	Chaves *et al.* (2012)
104	-42.533333	-19.466667	Ipatinga Municipality, Minas Gerais State	Miretzki (2005)
105	-41.233333	-20.550000	Limoeiro Cave, Castelo, Espírito Santo State	Hernándes-Camacho and Cadena (1978)
106	-40.800000	-20.783333	Iconha Municipality, Espírito Santo State	Miretzki (2005)
107	-40.483333	-20.383333	Jatuaíba, Araçatiba, Viana, Espírito Santo State	Miretzki (2005)
108	-40.483333	-20.666667	São João Jaboti, Guarri, Espírito Santo State	Miretzki (2005)
109	-40.589942	-20.635219	São João Jabuti, Traíra Farm, Pedra's Cave, Guarri, Espírito Santo State	MBL-Mamíferos (SpeciesLink, 2018); Mamíferos ES (SpeciesLink, 2018)
110	-40.333333	-20.316667	Fonte Grande District, municipality of Vitória, Espírito Santo State	Lopez and Ditchfield (2009)
111	-48.133333	-18.366667	Pinheiros Municipality, Córrego do Veado, Espírito Santo State	Azevedo (2013)
112	-40.133333	-19.050000	Sooretama Municipality, Reserve of Sooretama, Espírito Santo State	Azevedo (2013)
113	-40.366667	-19.883333	Ibiraçu Municipality, Morro da Vargem Area of Relevant Ecological Interest, Espírito Santo State	Azevedo (2013)
114	-40.333333	-20.300000	Vitória Municipality, Fonte Grande State Park, Espírito Santo State	Azevedo (2013)
115	-40.483333	-20.266667	Cariacica Municipality, Duas Bocas Biological Reserve, Espírito Santo State	Azevedo (2013)
116	-39.716667	-18.416667	Itaúnas Grotto, Itaúnas municipality, Espírito Santo State	Miretzki (2005); CM (SpeciesLink, 2018); Mamíferos_ES (SpeciesLink, 2018)
117	-39.712500	-18.420133	Itaúnas Cave, Conceição da Barra, Espírito Santo State	MBML-Mamíferos (SpeciesLink, 2018)

Table 2. Continuation.

Country	Coordinates			
Code	Lat y	Long x	Locality	Reference or Acronym of the Collection/Source
118	-41.083333	-20.833333	Monte Líbano Grotto, Cachoeiro de Itapemirim municipality, Espírito Santo State	Miretzki (2005); Mamíferos_ES (SpeciesLink, 2018); MBML-Mamíferos (SpeciesLink, 2018)
119	-40.466667	-20.266667	Duas Bocas Biological Reserve, Cariacica, Espírito Santo State	Hélder-José *et al.* (2016); MBML-Mamíferos (SpeciesLink, 2018)
120	-40.326936	-19.273288	Santo Izidório, Rio Bananal municipality, Espírito Santo State	MBML-Mamiferos (SpeciesLink, 2018)
121	-40.814035	-20.786953	Iconha Municipality, Espírito Santo State	Mamíferos-ES (SpeciesLink, 2018); MBML-Mamíferos (SpeciesLink, 2018)
122	-40.306409	-19.372385	Francisco Pagotto Grange, Rio Bananal Municipality, Espírito Santo State	SISBIO-DIBIO/ICMBio 44043 (PortaBio, 2016)
123	-41.566667	-21.633333	São Fidélix Municipality, Rio de Janeiro State	Peracchi e Albuquerque (1986)
124	-44.033333	-22.950000	Hotel Portobello, Km 47 of the road BR 110 (Rio-Santos), Mangaratiba municipality, South coast, Rio de Janeiro State	Esberárd *et al.* (1997)
125	-48.366667	-21.966667	Santana Cave, Cantagalo municipality, Rio de Janeiro State	Esberárd *et al.* (1997)
126	-43.416667	-22.416667	Antas Farm, Paty de Alferes municipality, Rio de Janeiro State	Esberárd *et al.* (1997)
127	-44.700000	-23.216667	Sono Beach, Paraty municipality, south coast, Rio de Janeiro State	Esberárd *et al.* (1997)
128	-44.100000	-22.983333	Rio das Pedras Ecological Reserve, Km 55 of the road BR 110, Mangaratiba municipality, South coast, Rio de Janeiro State	Esberárd *et al.* (1997)
129	-42.116667	-22.300000	Paraíso Ecological Station, Magé Municipality, Rio de Janeiro State	Esberárd *et al.* (1997)
130	-48.583333	-24.583333	Furnas do Iporanga (= Iporanga), São Paulo State	Trajano (1982)
131	-48.400000	-24.266667	Intervales State Park, Rio Grande municipality, São Paulo State	Portfors *et al.* (2000); Passos *et al.* (2003)
132	-48.583333	-24.583333	Iporanga Municipality, São Paulo State	Miretzki (2005)
133	-47.066667	-24.383333	Jureia Municipality, São Paulo State	Miretzki (2005)
134	-48.700000	-24.516667	Água Suja Cave (SP 25*), municipality of Iporanga, State Park Upper Ribeira-Santana, São Paulo State	Miretzki (2005); Arnone (2008)
135	-48.650000	-24.550000	Alambari de Baixo Cave (SP 12*), municipality of Iporanga, São Paulo State	Arnone (2008)
136	-48.700000	-24.583333	Areias de Cima Cave (SP 18*), municipality of Iporanga, São Paulo State	Arnone (2008)
137	-48.700000	-24.583333	Areias de Baixo Cave (SP 18*), municipality of Iporanga, São Paulo State	Arnone (2008)
138	-48.666667	-24.550000	Córrego Seco Cave (SP 49*), municipality of Iporanga, São Paulo State	Arnone (2008)

Table 2. Continuation.

Country	Coordinates			
Code	Lat y	Long x	Locality	Reference or Acronym of the Collection/Source
139	-48.683333	-24.516667	Couto's Cave (SP 20*), municipality of Iporanga, State Park Upper Ribeira -Santana, São Paulo State	Arnone (2008)
140	-48.716667	-24.533333	Laje Branca Cave (SP 30*), municipality of Iporanga, São Paulo State	Arnone (2008)
141	-48.683333	-24.516667	Morro Preto's Cave (SP 21*), municipality of Iporanga, Park State Touristic Alto Ribeira, State Park Upper Ribeira -Santana, São Paulo State	Arnone (2008)
142	-48.700000	-24.516667	Santana's Cave (SP 41*), municipality of Iporanga, State Park Upper Ribeira - Santana, São Paulo State	Arnone (2008)
143	-48.053910	-24.238991	Saiabadela municipality, São Paulo State	Lopez and Ditchfield (2009)
144	-48.066667	-24.233333	Sete Barras municipality, Farm Intervales, São Paulo State	Azevedo (2013)
145	-47.333333	-24.316667	Peruíbe Municipality, Jureia-Itatins Ecological Station, São Paulo State	Azevedo (2013)
146	-47.076407	-24.382163	Verde River's Base, Jureia-Itatins Ecological Station, São Paulo State	MZV_BR (SpeciesLink, 2018)
147	-48.700000	-24.516667	Água Suja Cave, Apiaí municipality, São Paulo State	SinBiota (SpeciesLink, 2018)
148	-47.226366	-24.247137	iBiosphere Institute Field Base, Pedro Toledo municipality, São Paulo State	SISBIO-DIBIO/ICMBio 6618 (PortaBio, 2016)
149	-51.1901	-19.677	Fundãozinho Farm, inside of Grotto, Paranaíba, Mato Grosso do Sul State	DZSJRP_Chiroptera (SpeciesLink, 2018)
150	-51.1901	-19.677	Fundãozinho Farm, Rochas' Bridge on the River Sucuriú, Paranaíba municipality, Mato Grosso do Sul State	DZSJRP_Chiroptera (SpeciesLink, 2018)
151	-47.0906	-16.0297	Cabeceira Grande Municipality, Minas Gerais State	MM (SpeciesLink, 2018)

Note: (*) Caves codes based on National Registry of Speleological Information from Brazilian Speleological Society.

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