



First record of the Vulnerable bat *Furipterus horrens* (Cuvier, 1828) (Chiroptera: Furipteridae) in the state of Paraná, southern Brazil

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Abstract

We report the first record of *Furipterus horrens* (Cuvier, 1828) in the state of Paraná, southern Brazil. A male specimen was captured using a harp trap in the entrance of a cave in the Parque Municipal Gruta do Bacaetava. The morphometric data and morphological characters of the specimen are within the known range documented for this species. This new record fills a gap in the known distribution of *F. horrens* and provides potentially valuable information that can be used to plan conservation measures.

Key words

Araucaria Forest; Thumbless Bat; Cave Bat; karst area; Parque Municipal Gruta do Bacaetava.

Academic editor: Paúl M. Velazco | Received 9 January 2017 | Accepted 19 May 2017 | Published 21 July 2017

Citation: Portella TP, Kaku-Oliveira NY, Barros JS, Sessegolo GC (2017) First record of the Vulnerable bat *Furipterus horrens* (Cuvier, 1828) (Chiroptera: Furipteridae) in the state of Paraná, southern Brazil. Check List 13 (4): 127–134. <https://doi.org/10.15560/13.4.127>

Introduction

The Thumbless Bat, *Furipterus horrens* (Cuvier, 1828), belongs to the family Furipteridae in which only 2 genera are included: *Amorphochilus* Peters, 1877 and *Furipterus* Bonaparte, 1837. It is one of the smallest Neotropical bats, with a weight spanning 3–5 g (Nowak 1994) and can be recognized by the presence of a dense grayish fur, a truncated and disc-shaped muzzle, pointed ears and inconspicuous thumbs (Gardner 2008). They feed exclusively on flying insects (Nowak 1994), and although the limited information on habitat use, *F. horrens* inhabits mainly caves, especially nearby forested areas and streams (Handley 1976, Uieda et al. 1980, Guimarães and Ferreira 2014).

Furipterus horrens occurs from Costa Rica to southern Brazil, including Bolivia, Colombia, French Guiana,

Guyana, Peru, Suriname, Trinidad and Tobago, and Venezuela (Gardner 2008, Peracchi et al. 2011). In Brazil, this species is present in all regions, with confirmed records in 14 states: Amazonas, Bahia, Ceará, Distrito Federal, Espírito Santo, Goiás, Minas Gerais, Pará, Pernambuco, Piauí, Rio de Janeiro, Santa Catarina, São Paulo, Sergipe, and Tocantins (Leal et al. 2014).

Although *Furipterus horrens* is widely distributed it has been rarely recorded in Brazil, and it is currently categorized as Vulnerable in the Brazilian Red List of threatened species (MMA 2014). The sensitivity of this species to environmental alterations and the growing depletion of caves, which are their main natural diurnal roost, are one of the greatest threats to the conservation of *F. horrens* populations (Guimarães and Ferreira 2014).

A recent study on the conservation status of caves in

Brazil estimated that only 35% of the caves recorded in the database of the federal government have been effectively protected until 2012 (Sessegolo 2013). Therefore, new occurrence records and data on colonies of *F. horrens* are very important to protect this species. Thus, we report the first record of *F. horrens* in the state of Paraná, southern Brazil, in one of the few protected areas in the state dedicated to cave protection, namely the Parque Municipal Gruta do Bacaetava in the municipality of Colombo.

Methods

The Parque Municipal Gruta do Bacaetava is located in the Atlantic Forest biome in a secondary vegetation of Ombrophilous Misty Forest (IBGE 2012). The Gruta do Bacaetava (25°13'55" S, 049°12'27" W WGS84, elevation 978 m) is 695 m long and 2 main passages: the lower passage, where the Bacaetava River is located, receives a large number of tourists than the higher passage, which is dry and less visited.

On 29 May 2015 during a bat survey part of the review of the management plan of the Parque Municipal Gruta do Bacaetava 1 specimen of *Furipterus horrens* was collected. Two mist nets (12 × 3 m and 6 × 3 m) were used to cover the openings of the lower passage. Additionally, a harp trap was set up at the opening of the higher passage and the remaining spaces between the trap and the opening were closed (Fig. 1). The traps were operated between 17:30 h and 21:50 h. The captured specimens were weighted and sexed, and their developmental stage (adult or young) and reproductive conditions were recorded. We caught a male specimen of *F. horrens* at the higher passage at 17:50 h using a harp trap (Fig. 2). Along with the specimen of *F. horrens* we captured 1 specimen of *Desmodus rotundus* Geoffroy, 1810.

The specimen of *Furipterus horrens* was fixed in 10% formaldehyde and preserved in 70% ethanol, with a subsequent extraction of the skull. After recording the external and cranial measurements following Moratelli et al. (2011), the individual was deposited at the Coleção



Figure 1. Harp trap installed in the superior entrance of Gruta do Bacaetava, Parque Municipal Gruta do Bacaetava, Colombo, Paraná, southern Brazil.



Figure 2. Adult male *Furipterus horrens* (DZUP-CCMZ 2185) captured at Gruta do Bacaetava in the Parque Municipal Gruta do Bacaetava, Colombo, Paraná, southern Brazil.

Científica de Mastozoologia da Universidade Federal do Paraná (DZUP-CCMZ 2185). The specimen was collected under permit number 43322-2 by ICMBIO/SISBIO.

Results

Our voucher specimen conforms with all the morphological characteristics of *Furipterus horrens*: small size; dense and long grayish fur, with the ventral region lighter than the dorsal; a greatly reduced thumb which are involved in the wing membrane up to the base of the vestigial nail; pointed ears and short and triangular tragus; large uropatagium exceeding the feet in length when extended and tail extending a little less than $\frac{3}{4}$ the length of the uropatagium; long an cartilaginous calcar; wide and round cranium, with a short rostrum about half the length of the braincase; short palate does not extending well beyond the last molar (Husson 1962, Uieda et al. 1980, Nowak 1994, Reis and Gazarini 2007, Gardner 2008).

The external and craniodental measurements of our specimen fall within the range reported in the literature: forearm length = 36.15 mm; ear length = 9.45 mm; tragus length = 3 mm; tail length = 30.35 mm; hind foot length = 6.35 mm; greatest length of the skull = 12.32 mm; condyloincisive length = 11.31 mm; condylocanine length = 10.49 mm; basal length = 10.32 mm; zygomatic breadth = 7.42 mm; mastoid breadth = 6.32 mm; braincase breadth = 6.09 mm; postorbital breadth = 3.28 mm; breadth across upper molars = 4.66 mm; maxillary tooththrow length = 4.48 mm; mandibular length = 8.16 mm; mandibular tooththrow length = 5.40 mm; and weight = 4 g (Husson 1962, Uieda et al. 1980, Pol et al. 2003, Reis and Gazarini 2007, Gardner 2008, Sato et al. 2011, Novaes et al. 2012, Duda et al. 2012, Leal et al. 2014).

Discussion

Furipterus horrens has been recorded in the states of São Paulo, in the municipality of Iporanga (Trajano 1984, Trajano and Gnaspini-Netto 1990), and in Santa

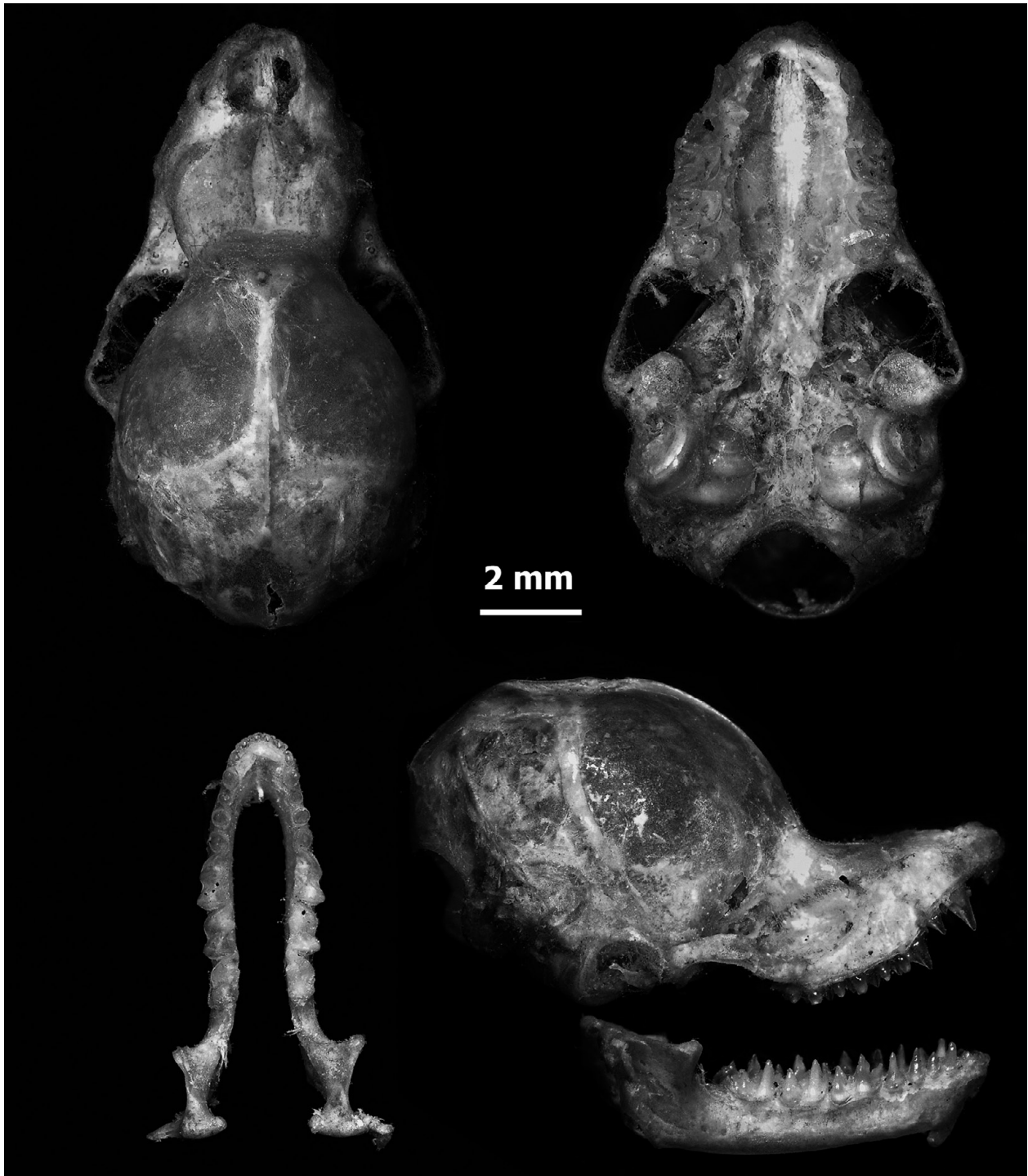


Figure 3. Dorsal, ventral and lateral views of the skull, and dorsal and lateral views of the mandible of a *Furipterus horrens* (DZUP-CCMZ 2185) specimen collected at Gruta do Bacaetava, Parque Municipal Gruta do Bacaetava, Colombo, Paraná, southern Brazil.

Catarina, municipality of Corupá (Lima 1926, Cherem et al. 2004) near the border with Paraná (Fig. 4, Table 1). Thus, it was expected that this species would occur in Paraná. With this new record, the number of bat species known to Paraná has now increased to 70 (Bianconi et al. 2009, Scultori et al. 2009, Passos et al. 2010, Moratelli et al. 2011, Carvalho et al. 2014). Although recently there has been an increase in the number of bat records in the Atlantic Forest of Paraná, a number of factors such as fewer long-term monitoring schemes and the routine use of mist nets for recording species have been detrimental

to improving the knowledge on Paraná's bat diversity (Varzinczak et al. 2016).

Because the mist net is the most effective technique to catch frugivorous bats of the family Phyllostomidae, insectivorous bats species inhabiting forests are usually under sampled when this method is used; this is probably due to their capacity to detect this type of trap by echolocation (Kunz and Parsons 2009). Previous studies in the states of Ceará, Distrito Federal, and Tocantins showed that individuals of *F. horrens* were able to detect mist nets and maneuver to avoid them (Uieda et al. 1980, Bredt et

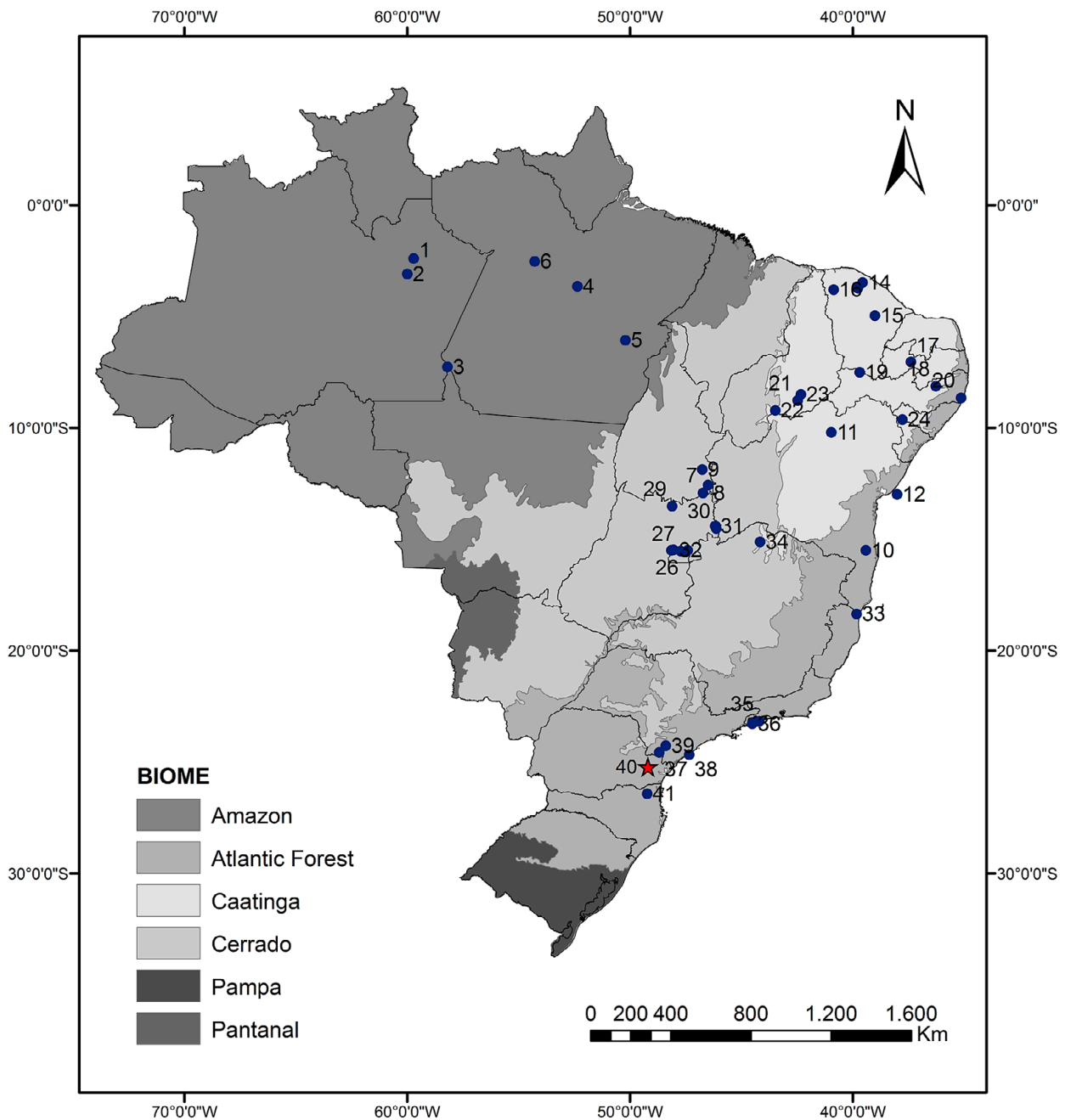


Figure 4. Known records of *Furipterus horrens* in Brazil (blue circles), including the new record (red star) from the Parque Municipal Gruta do Bacaetava in Colombo, Paraná, southern Brazil. Numbers refer to entries in Table 1.

al. 1999, Sato et al. 2011). Uieda et al. (1980) and Bredt et al. (1999) used insect nets instead of mist nets to sample this species with great success. Additionally, visual inspections during the daylight hours (active search) and mist nets were used in an inventory of bat species in forested areas in the states of Piauí, Rio de Janeiro and Tocantins, but only active searching was successful in detecting *F. horrens* (Esbérard et al. 2006, Gregorin et al. 2008, Novaes et al. 2012). In most of the cases in which *F. horrens* was captured with mist nets, the nets were installed blocking the main opening of the structures (e.g. cave) used as roosting spots (Trajano 1984, Trajano & Gnaspini-Netto 1990, Bredt et al. 1999, Silva et al. 2001, Esbérard et al. 2005, Sato et al. 2011, Leal et al. 2014). In addition, *F. horrens* have been captured from their

roosting spots either by hand or using insect nets in the states of Ceará, Espírito Santo, and Rio de Janeiro (Pol et al. 2003, Fabián 2008, Duda et al. 2012). Similar results were obtained by Simmons and Voss (1998) in Paracou, French Guiana, in which 12 out of 13 specimens of *F. horrens* recorded were caught with active search and only 1 specimen was shot during flight.

Although active search during daylight hours has been used successfully to detect *F. horrens* (Simmons and Voss 1998, Pol et al. 2003, Esbérard et al. 2006, Gregorin et al. 2008, Noaves et al. 2012), this method was not effective to find this species at Gruta do Bacaetava. This might be attributed to the presence of small gaps between rocks and passages that are too small to allow access to a collector but not to a small bat such as *F. horrens*.

Table 1. Localities records of *Furipterus horrens* in Brazil. The numbers refer to points shown in Figure 4.

| No. | Locality | State | Biome | Latitude (S) | Longitude (W) | Author |
|-----|-------------------------------------|------------------|-----------------|--------------|---------------|---|
| 1 | Rei Preto da Eva | Amazonas | Amazon | 02°24' | 059°43' | Sampaio et al. (2003) |
| 2 | Manaus | Amazonas | Amazon | 03°06' | 0060°00' | Piccinini (1974) ¹ |
| 3 | Maués | Amazonas | Amazon | 07°16' | 058°12' | Guimarães (2014) |
| 4 | Altamira ³ | Pará | Amazon | 03°39' | 052°22' | Voss and Emmons (1996), Robinson (1998) ² |
| 5 | Parauapebas | Pará | Amazon | 06°04' | 050°13' | Tavares et al. (2012) ¹ |
| 6 | Santarém | Pará | Amazon | 02°32' | 054°17' | Piccinini (1974) ¹ |
| 7 | Arraias | Tocantins | Cerrado | 12°55' | 046°44' | Sato et al. (2011) |
| 8 | Aurora do Tocantins | Tocantins | Cerrado | 12°34' | 046°30' | Novaes et al. (2012) |
| 9 | Dianópolis | Tocantins | Cerrado | 11° 52' | 046° 46' | Guimarães (2014) |
| 10 | ? (Southern Bahia) | Bahia | Atlantic Forest | ? | ? | Faria et al. (2006) |
| 11 | Campo Formoso | Bahia | Caatinga | 10°12' | 040°58' | Guimarães (2014) |
| 12 | ? (Bahia) | Bahia | Atlantic Forest | ? | ? | Gervais (1856) |
| 13 | Irauçuba | Ceará | Caatinga | 03°44' | 039°47' | Fabián (2008) ¹ |
| 14 | Itapipoca | Ceará | Atlantic Forest | 03°29' | 039°34' | Piccinini (1974) ¹ |
| 15 | Quixadá | Ceará | Caatinga | 04°58' | 039°01' | Astúa and Guerra (2008) ¹ |
| 16 | Ubajara ³ | Ceará | Caatinga | 03°48' | 040°52' | Uieda et al. (1980), Silva et al. (2001), Fabián (2008) |
| 17 | Santa Terezinha | Paraíba | Caatinga | 07°02' | 037°24' | Leal et al. (2014) |
| 18 | Brejo da Madre de Deus ³ | Pernambuco | Caatinga | 08°08' | 036°17' | Sousa et al. (2004) ¹ , Astúa and Guerra (2008) ¹ |
| 19 | Exu | Pernambuco | Caatinga | 07°30' | 039°42' | Mares et al. (1981) ¹ |
| 20 | Rio Formoso | Pernambuco | Atlantic Forest | 08°39' | 035°09' | Bonato and Facure (2000) |
| 21 | Coronel José Dias | Piauí | Caatinga | 08°46' | 042°29' | Guimarães (2014) |
| 22 | Caracol | Piauí | Caatinga | 09°13' | 043°29' | Gregorin et al. (2008) |
| 23 | São Raimundo Nonato | Piauí | Caatinga | 08°30' | 042°20' | Araújo et al. (1998) ¹ |
| 24 | Canindé de São Francisco | Sergipe | Caatinga | 09°38' | 037°47' | Astúa and Guerra (2008) ¹ |
| 25 | Brasília | Distrito Federal | Cerrado | 15°30' | 047°25' | Bredt and Uieda (1996) |
| 26 | Brazlândia | Distrito Federal | Cerrado | 15°30' | 048°09' | Bredt et al. (1999) |
| 27 | Planaltina | Distrito Federal | Cerrado | 15°32' | 047°44' | Bredt et al. (1999) |
| 28 | Sobradinho | Distrito Federal | Cerrado | 15°33' | 047°49' | Bredt et al. (1999) |
| 29 | Cavalcante | Goiás | Cerrado | 13°31' | 048°07' | Guimarães (2014) |
| 30 | Damianópolis | Goiás | Cerrado | 14°31' | 046° 08' | Guimarães (2014) |
| 31 | Mambai ³ | Goiás | Cerrado | 14°24' | 046°11' | Coimbra et al. (1982) ¹ , Esbérard et al. (2005) |
| 32 | Padre Bernardo ³ | Goiás | Cerrado | 15°29' | 048°03' | Bredt et al. (1999), Bredt and Magalhães (2006) ² |
| 33 | Conceição da Barra | Espírito Santo | Atlantic Forest | 18°21' | 039°50' | Duda et al. (2012) |
| 34 | Itacarambi ³ | Minas Gerais | Caatinga | 15°07' | 044°10' | Tavares et al. (2010), Guimarães (2014) |
| 35 | Angra dos Reis | Rio de Janeiro | Atlantic Forest | 23°10' | 044°12' | Esbérard et al. (2006) |
| 36 | Parati | Rio de Janeiro | Atlantic Forest | 23°17' | 044°31' | Pol et al. (2003) |
| 37 | Iporanga ³ | São Paulo | Atlantic Forest | 24°34' | 048°42' | Trajano (1984), Trajano & Gnaspini (1991) |
| 38 | Peruibe | São Paulo | Atlantic Forest | 24°40' | 047°21' | Gimenez & Ferrarezi (2004) ¹ |
| 39 | Ribeirão Grande ³ | São Paulo | Atlantic Forest | 24°16' | 048°24' | Portfors et al. (2000), Passos et al. (2003) |
| 40 | Colombo | Paraná | Atlantic Forest | 25°13' | 049°12' | Present study |
| 41 | Corupá | Santa Catarina | Atlantic Forest | 26°25' | 049°14' | Lima (1926), Cherem et al. (2004) |

¹Coordinates according to Duda et al. (2012), Novaes et al. (2012) and/or Leal et al. (2014).²Coordinates according to Guimarães (2014).³Locality correspond to more than 2 records.

In this study, in addition to the widely used mist net, we also used a harp trap. Although this type of trap has been rarely used to catch bats in the Neotropical region, it has been employed routinely with great success in the Paleotropical region and has allowed the catching of species that are not easily sampled with the mist net (Kingston et al. 2003, Struebig et al. 2006, Sedlock et al. 2008, Sedlock et al. 2011). It noteworthy that the success of biodiversity assessments of bats is improved if different kinds of sampling methodologies (i.e. mist nets, harp trap, echolocation, and active search) are simultaneously used, as shown in a study in the Parque Estadual de Intervalos, São Paulo State, Brazil (Portfors et al. 2000). In that study, different sampling methodologies were used

and were able to catch *F. horrens* in the harp trap only.

Although *Furipterus horrens* has been recorded in the hollows of fallen trees (Voss and Emmons 1996) and buildings (Fabián 2008, Duda et al. 2012), this species is more frequently found in caves as showed elsewhere (Uieda et al. 1980, Trajano 1984, Trajano and Gnaspini-Netto 1990, Bredt et al. 1999, Portfors et al. 2000, Silva et al. 2001, Pol et al. 2003, Esbérard et al. 2005, Tavares et al. 2010, Sato et al. 2011, Novaes et al. 2012, Leal et al. 2014, Felix et al. 2016). Furthermore, most of the records obtained outside caves were based on small colonies of 1–6 specimens while records obtained in caves were based on large colonies ranging from 10–250 specimens (Uieda et al. 1980, Bredt et al. 1999, Silva et al. 2001,

Novaes et al. 2012). In French Guiana, *F. horrens* was recorded 9 times in hollows of falling trees, but in none of these records were 2 adults captured together (Simmons and Voss 1998). In a hollow of a fallen tree in Costa Rica, LaVal (1977) found 59 males that were gone after 3 months. In addition, Bretd et al (1999) recorded colonies of *F. horrens* in several caves in central west Brazil that were studied for long periods varying from 3 to 5 years, suggesting that this is a cave-dwelling species. Studies done in the Gruta Ubajara, in Ceará, northeastern Brazil, suggested that *F. horrens* had been using that cave for 21 years, with the first record made in 1977 (Uieda et al. 1980) and the most recent in 1998 (Silva et al. 2001). Therefore, based on the criteria proposed by Arita (1993) and Guimarães and Lopes (2014) and on the available information on *F. horrens* habitat use, we also consider this species to be a cave bat.

The record of *Furipterus horrens* in the Parque Municipal Gruta do Bacaetava, which is one of the few caves available to this species in the region (Sessegolo et al. 1996), stresses the importance in Brazil of protecting caves. Surveys using different sampling methods such as active search in the cave during daylight hours, complemented with the use of harp traps and bioacoustics techniques, are further required to produce an accurate regional distributional map that can be used in conservation efforts for *F. horrens*.

Acknowledgements

We are very grateful to managers and workers of the Parque Municipal Gruta do Bacaetava. The following people helped in the fieldwork: Willians P. Munguia, Tarik Kardush and Fabiano Andrade. We would like to thank Mauricio M. Zenker for the English version of this manuscript and Fernando C. Passos, curator of the UFPR mammal collection, for accepting and cataloging the voucher specimen.

Authors' Contributions

TP and JB collected the data, TP and NK identified the specimen, TP, NK, JB, and GS wrote the text.

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