



First record of *Lasiurus egregius* (Peters, 1870) (Chiroptera, Vespertilionidae) in Paraná state, southern Brazil

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Abstract

Lasiurus egregius (Peters, 1870) is an insectivorous bat species known from Central and South America. This species has few confirmed records throughout its distribution. Here we report the first record of *L. egregius* from the northern coast of Paraná state, southern Brazil. We captured a female individual of *L. egregius* using an ultrathin mist-net installed over a river knee, at Salto Morato Natural Reserve, municipality of Guaraqueçaba. This is the fourteenth locality with confirmed occurrence of *L. egregius*, being eight of them in Brazil. The knowledge on the bat fauna in Paraná has been increasing in recent decades, mainly due to the new studies in coast areas of this state. In addition to contributing to the knowledge of the bat fauna from Paraná, the new record of *L. egregius* reinforces the essential role of the Salto Morato Natural Reserve in conserving bats in the southern portion of the Atlantic Forest.

Keywords

Aeorestes, Atlantic Forest, Atlantic bats, Big-Red Bat, Salto Morato, Lasiurini, new record.

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Introduction

Bats are the second most diverse group of mammals in the world, only after Rodentia (Simmons 2005). In the Neotropics, the best known family of bats are the leaf-nosed bats, Phyllostomidae, because of its diversity (Baker et al. 2012) and the effectiveness of mist nets in sampling them (O’Farrell and Miller 1999). Mainly due to their height of flight and greater capacity to detect nets, insectivorous bats, such as those of the family

Vespertilionidae, are less studied in the Neotropical region. However, Vespertilionidae are the most species-rich family of bats, having more than 44 genera and 350 species (Corbet and Hill 1991; Nowak 1999). Among the vespertilionid bats are the hairy-tailed bats from the tribe Lasiurini (Simmons 2005).

The tribe Lasiurini is composed of a single genus, *Lasiurus* Gray, 1831 (Gardner and Handley 2008). The taxonomy of this tribe has been the subject of debate, with some taxonomists using molecular tools to suggest

splitting this tribe into three distinct genera (hoary, yellow and red bats), *Dasypterus* Peters, 1871, *Aeorestes* Fitzinger, 1870, and *Lasiurus* Gray, 1831 (Baker et al. 1998; Baird et al. 2015, 2017). The segregation of these groups has been debated and contested mainly because there is no phenotypic discontinuity, the genus is monophyletic and therefore it does not solve any phylogenetic problem, and this new arrangement would create nomenclatural instability (see Ziegler et al. 2016; Novaes et al. 2018). Based on these arguments, we adopted the position of Gardner and Handley (2008) who treated *Lasiurus* as the only representative of the tribe Lasiurini.

The genus *Lasiurus* currently consists of 15 species, of which nine are known from South America (Gardner and Handley 2008). Among these, seven species occur in Brazil (Nogueira et al. 2018): *Lasiurus salinae* Thomas, 1902, *Lasiurus castaneus* Handley, 1960, *Lasiurus ebe-nus* Fazzolari-Corrêa, 1994, *Lasiurus blossevillii* (Lesson & Garnot, 1826), *Lasiurus cinereus* (Palisot de Beauvois, 1796), *Lasiurus ega* (Gervais, 1856), and *Lasiurus egre-gius* (Peters, 1870). The last four species have confirmed records in the southern states of Brazil (Marinho-Filho 1996; Pacheco et al. 2007), and only *L. egre-gius* has no record in the state of Paraná (Passos et al. 2010).

When compared to the average size of vespertilionids in South America (see Gardner 2008; Díaz et al. 2016), *L. egre-gius* is considered a large bat (Bianconi and Pedro 2007). The species has uniform reddish coloration with hair covering the first third of the well-developed uropatagium (Gardner and Handley 2008; Díaz et al. 2016). Its ears are slightly wider than long, and the inner edge of the tragus is straight, while the outer rim is curved (López-Baucells et al. 2014). The forearm ranges from 48 to 50 mm long (Emmons and Feer 1997; Lim and Engstrom 2001). The dental formula is as follows: incisors 1/3, canine 1/1, premolars 1/2 and molars 3/3 (Bianconi and Pedro 2007). Little is known about *L. egre-gius*, such as geographical range, population size and other information (López-Baucells et al. 2014), which may contribute to this species' classification as Data Deficient by the IUCN (Sampaio et al. 2016).

Lasiurus egre-gius is known to occur in Panama, Honduras, French Guiana, and Brazil (Peracchi et al. 2011). The specimen cited from Colombia as *L. egre-gius* (Bejarano-Bolina et al. 2007) was misidentified and is in fact *L. blossevillii* (Morales-Martínez and Ramírez-Chaves 2015). Morales-Martínez and Ramírez-Chaves (2015) noted the lack of confirmed records of *L. egre-gius* in Colombia but considered it as probable occurring there.

In Brazil, *L. egre-gius* has records from all regions, in the states of Amazonas (López-Baucells et al. 2014), Pará (Kalko and Handley 2001), Roraima (Capaverde-Junior et al. 2014), Pernambuco (Sousa et al. 2004, Silva 2007), Minas Gerais (Stutz et al. 2004), Santa Catarina (Cherem et al. 2004), and Rio Grande do Sul (Giménez and Gianinni 2011). This species was recorded in urban areas and natural habitats (Lima 2008; Pacheco et al. 2010), which suggests that it has greater ecological

tolerance. In local spatial terms, *L. egre-gius* occurs more frequently in open spaces, even though its morphology suggests the ability to forage in cluttered environments such as forest understories (López-Baucells et al. 2014). We describe the first record of *L. egre-gius* from the state of Paraná, southern Brazil, and thereby contribute to the knowledge of the distribution of this rare Neotropical bat.

Methods

We captured the specimen of *Lasiurus egre-gius* at the Salto Morato Natural Reserve (Reserva Natural Salto Morato in Portuguese; RNSM), which is located in the municipality of Guaraqueçaba, northern coast of Paraná state (Fig. 1). The RNSM has an area of 2,340 ha and is inserted in the Environmental Protection Area (Área de Proteção Ambiental, in Portuguese) of Guaraqueçaba municipality (Straube and Urben-Filho 2005).

This region where the RNSM is inserted corresponds to the largest continuous remnant of Atlantic Forest in Brazil, because the RNSM is adjacent to other conservation units in the states of Paraná and São Paulo. The predominant forest formation of the region is Ombrophilous Dense Forest (IBGE 2012). In the RNSM, the great variation in relief creates three subformations: Lowland Submontane, Montana, and Alto Montana Dense Forests (IBGE 2012). Within the Köppen system of climate classification, the RNSM region has a Cfa climate, characterized by a humid mesothermic climate, with hot summers and no defined dry season (Alvares et al. 2013).

We carried out bat surveys on the Submontana Dense Forest environments, during 10 continuous nights. Bats were captured using 10 mist nets per night: two nets each 12 × 2.6 m; four nets each 9 × 2.6 m; two nets each 6 × 2.6 m (all Avinet, polyester, with mesh openings of 32 mm) and two nets each 6 × 3 m (Ecotone®, 0.08 mm nylon, with mesh openings of 14 mm). The Ecotone nets are special for capturing insectivorous bats. Nets were installed along trails, at forests edges, and over water bodies. The nets were kept open for 6 hours after twilight and were visited in 15 minute intervals. Sampling effort was 13,104 net meter-hours and was calculated according to the protocol by Straube and Bianconi (2002).

The specimen of *L. egre-gius* was collected as a voucher material, as it was the first record of the species in the state and also to confirm its identification in the laboratory. The voucher was preserved in 70% alcohol and was deposited in the scientific collection of the Laboratório de Zoologia e Ecologia de Vertebrados (LABZEV) of the Universidade do Extremo Sul Catarinense. The cranium was prepared for morphometry in the laboratory (Table 1). The species was identified using the keys by Gardner and Handley (2008), Miranda et al. (2011), and Diaz et al. (2016). The permits for the fieldwork were obtained at the Sistema de Autorização e Informação em Biodiversidade (SISBIO 53718-1) and the Comitê de Ética para o Uso de Animais of the Universidade do Extremo Sul Catarinense (UNESC 064/2018-2).

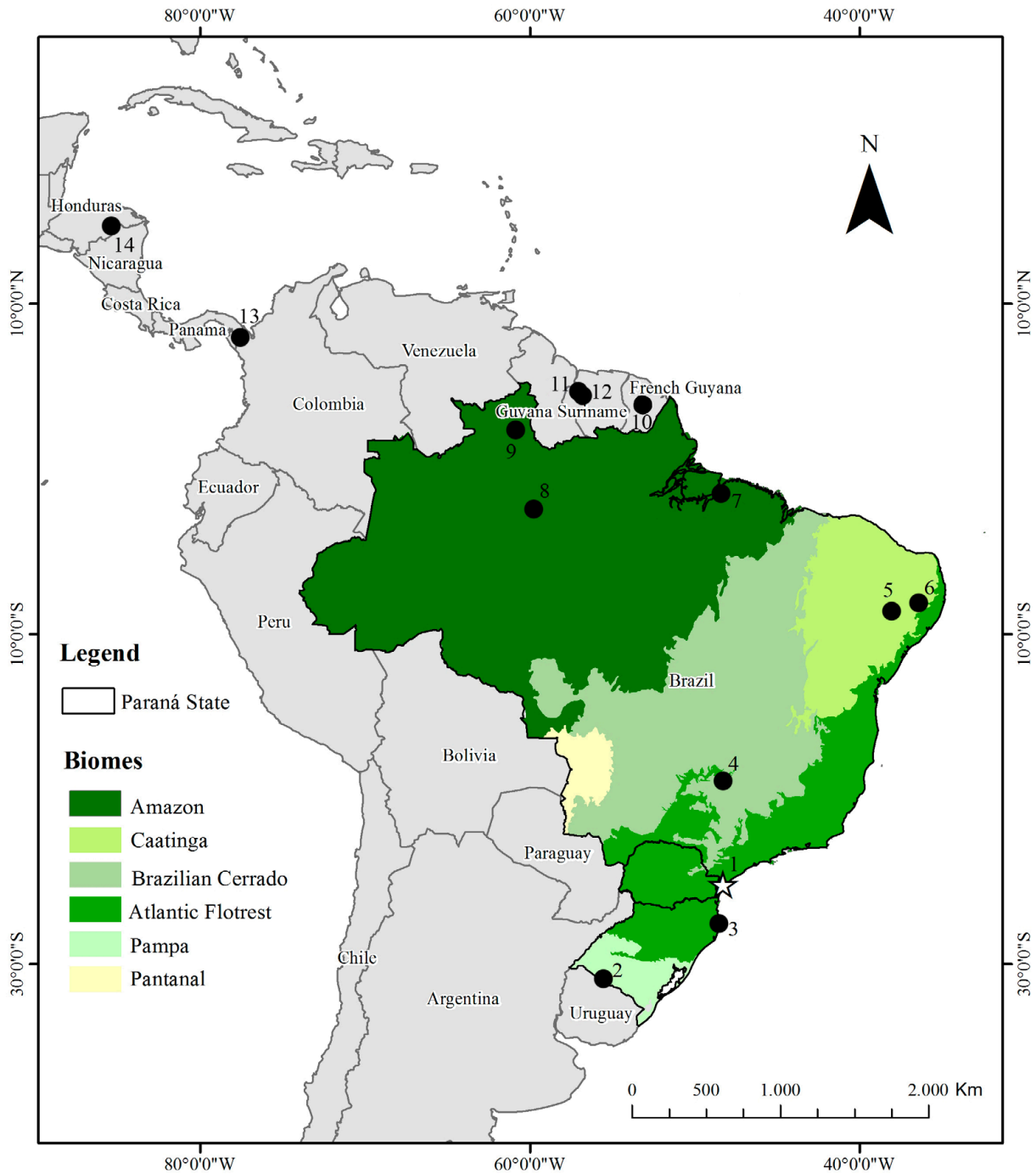


Figure 1. Distribution of *Lasiurus egregius* in Central and South America. The black dots correspond to previously known occurrences, and the red star to the new record of this species in the RNSM, Guaraqueçaba, northern coast of Paraná, southern Brazil. For the list occurrences and sources, see Table 2.

Results

New record. Brazil: Paraná state: municipality of Guaraqueçaba: Salto Morato Natural Reserve (25°10'25\"S, 048°17'51\"W; 59 m a.s.l.; Fig. 2), coll. by F. Carvalho, K.P. Supi, L. S. Biz and B.F.L. Luciano, 22 Jan. 2019 at 23:30 h (1 ♀, LABZEV861; Fig. 3).

The specimen of *L. egregius* was captured using a ultrathin mist-net (Ecotone®) installed over a river knee (Fig. 2).

Identification. The following characters were observed: (1) wing membranes dark; (2) uropatagium densely

covered by hairs up to 1/3 its length; (3) coloration uniformly reddish; and (4) forearm greater than 45 mm (48–52 mm) long.

Discussion

With the new record of *L. egregius* from RNSM, 71 species of bats are now confirmed as occurring in Paraná state (Passos et al. 2010; Carvalho et al. 2014; Portella et al. 2017). Knowledge of the bat fauna in Paraná has increased over the last several decades, mainly with

Table 1. Morphometry of the specimen of *Lasiurus egregius* captured in the RNSM (present study), and data from other species of the genus occurring in Brazil. Data sources: *L. egregius* – López-Baucells et al. (2014); *L. blossevillii* – Simons and Voss (1998); Rodrigues and Ribas (2011); Cláudio et al. (2018); Verde et al. (2017); *L. cinereus* – Shump and Shumpz (1982); Myers and Wetzel (1983); Cláudio et al. (2018); *L. ega* – Myers and Wetzel (1983); Bolzon (2008); Leal and Gomes-Silva (2015); Cláudio et al. (2018); *L. ebenus* – Cláudio et al. (2018). The characters analyzed were: FA = forearm; CCL = canine condyle length; BCL = Basal condyle length; ICL = incisor condyle length; JL = jaw length; GLS = greatest length of skull; BW = braincase width; LW = zygomatic width; PWC = palatal width between canines. All measurements are expressed in millimeters.

Characters	Present study	<i>L. egregius</i>	<i>L. blossevillii</i>	<i>L. cinereus</i>	<i>L. ega</i>	<i>L. ebenus</i>
FA	49.5	47.4–48.8	36.8–42.2	50.2–52.55	42.9–50.0	45.6–45.7
CCL	16.0	—	10.83–12.11	13.21–16.69	13.25–15.63	14.12–13.72
BCL	16.3	16.1	—	15.4–15.7	13.5–15.9	—
ICL	16.7	16.4	11.27–12.40	14.72–14.85	14.29–16.7	13.56–13.93
JL	13.1	—	—	6.35–6.42	6.24–6.74	5.53–5.57
GLS	16.3	—	11.38–13.67	14.92–16.06	14.1–17.15	13.52–13.90
BW	9.3	—	6.96–7.48	8.56–8.92	7.92–8.9	8.18–8.28
LW	12.0	11.8	7.58–8.88	11.2–11.6	10.1–12.0	—
PWC	5.4	6.4	4.10–4.73	5.75–6.45	5.90–6.62	5.52–5.59

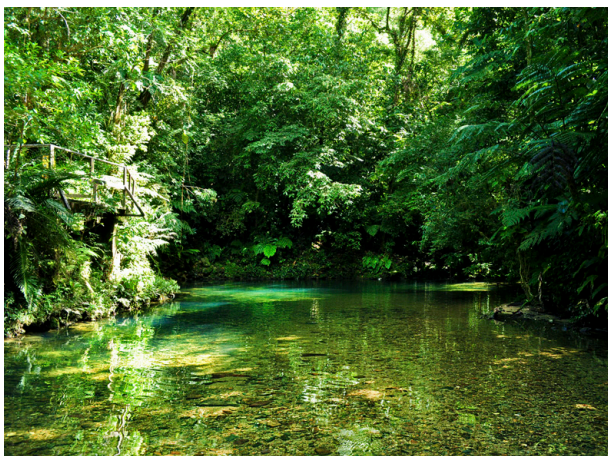


Figure 2. The site where the new record of *Lasiurus egregius* was captured: Salto Morato Natural Reserve, Paraná, southern Brazil.

regard to the distribution of species (Gazarini and Bernardi 2007; Passos et al. 2010; Portella et al. 2017). Even for areas considered to be of lower priority for bat sampling, such as the northern coast of Paraná (Miretzki 2003), new species have been added to the state's fauna in the last decade (Scultori et al. 2009a, 2009b, 2009c; Carvalho et al. 2014). This has contributed to the understanding of distributional patterns of species in Paraná and along the south coast of Brazil.

This is the fourteen confirmed occurrence of *L. egregius* (Table 2) and one of nine from Brazil (Fig. 1). Although this species is considered widely distributed in Central and South America, it is rarely captured throughout its whole geographic range (Passos et al. 2010) and with few individuals captured at each locality (Kalko and Handley 2001; Silva 2007; Lim 2009; Mora 2012). The good maneuverability and high capacity for echolocation are characteristics that decrease the likelihood of its capture (López-Baucells et al. 2014). Another factor that can contribute to its perceived rarity is that individuals of genus *Lasiurus* are usually captured over water bodies (Cláudio et al. 2018), which are hardly ever sampled in studies of bat assemblages (López-Baucells

et al. 2014). Mist netting over water bodies increases the probability of capturing insectivorous bats (Costa et al. 2012), and, therefore, it should be a more-used protocol in the study bat biodiversity.

Records of *L. egregius* from throughout its geographic range were mostly made in large forest remnants (e.g. Kalko and Handley 2001; Silva 2007; Sousa et al. 2004; Lim 2009; Mora 2012), as well was the case in our study. In the last few years, studies in the RNSM (e.g. Kaku-Oliveira 2010; Carvalho et al. 2014; Carvalho 2015) have revealed the occurrence of rare species for Atlantic Forest, such as *Thyroptera tricolor* Spix, 1823, *Vampyroides caraccioli* (Thomas, 1889), *Glyphonycteris sylvestris* Thomas, 1896, and *Lamproncycteris brachyotis* (Dobson, 1879). In addition to contributing to the knowledge of the bat fauna from Paraná, the new record of *L. egregius* reinforces the importance of the RNSM for conserving bats in the southern portion of the Atlantic Forest (Carvalho et al. 2018). The continuity of bat surveys, especially in the context of a long-term bat monitoring within the RNSM, may provide better understanding of the bat fauna of this huge Atlantic Forest fragment in southern Brazil.

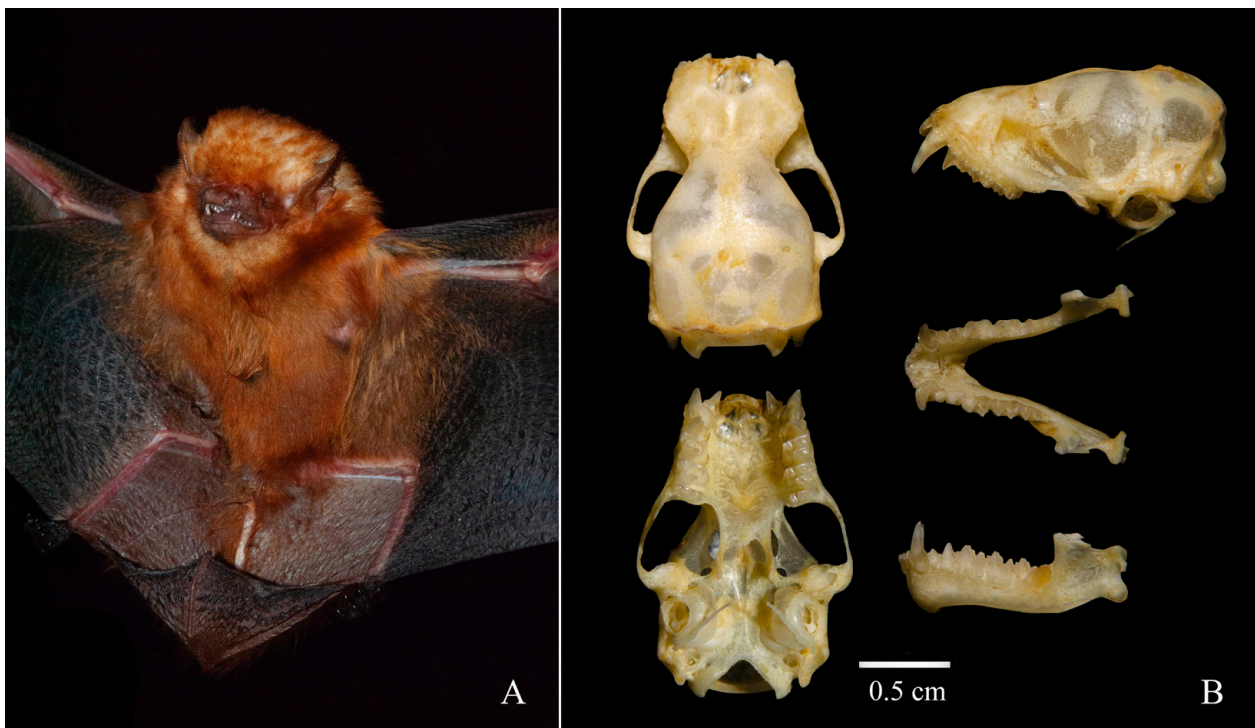
Little information about the morphology of *L. egregius* is available in the literature, and even less is available for cranial characteristics. Comparing the measurements of our specimen with Brazilian Amazon specimens (López-Baucells et al. 2014), we observed that our specimen is larger in all measured values, excepting for the palatal width between the canines. We encourage additional study of cranial characteristics of *L. egregius* that compare specimens from different regions, which will improve knowledge of bat morphology and ecology and will lead to increased confidence in identifications of this species throughout its whole range.

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Table 2. Localities with confirmed records of *Lasiurus egregius* in Central and South America. For Santa Catarina, there is no information of region or locality where the material was collected. The codes are represented in the distribution map of in Figure 1.

Code	Country	Locality	Latitude	Longitude	Reference
1	Brazil	Paraná	25°10'13"S	048°17'51"W	Present study
2	Brazil	Rio Grande do Sul	30°53'00"S	055°31'00"W	Giménez and Giannini (2011)
3	Brazil	Santa Catarina	—	—	Cherem et al. (2004)
4	Brazil	Minas Gerais	18°55'00"S	048°17'00"W	Stutz et al. (2004)
5	Brazil	Pernambuco	08°39'14"S	038°01'53"W	Sousa et al. (2004)
6	Brazil	Pernambuco	08°08'43"S	036°26'00"W	Silva and Marinho (2010)
7	Brazil	Pará	01°28'07"S	048°27'00"W	Kalko and Handley (2001)
8	Brazil	Amazonas	02°26'55"S	059°46'14"W	López-Balcells et al. (2014)
9	Brazil	Roraima	02°49'11"S	060°40'24"W	Capaverde-Jr. (2014)
10	Guiana Francesa	Guiana Francesa	04°56'20"S	053°18'16"W	Williams et al. (1990)
11	Suriname	Bakhuis Mountains	04°32'46"S	057°03'46"W	Lim (2009)
12	Suriname	Bakhuis Mountains	04°27'33"S	056°51'30"W	Lim (2009)
13	Panamá	Panamá	08°01'00"S	077°33'00"W	Handley (1960)
14	Honduras	Guayabo de Catacamas	14°43'13"S	085°22'43"W	Mora (2012)

**Figure 3.** Female of *Lasiurus egregius* (Peters, 1870) (LABZEV861) captured in the RNSM, northern coast of Paraná, southern Brazil. **A.** The individual in the field, immediately after capture. **B.** Ventral, dorsal, and lateral views of the skull, and ventral and lateral views of the mandible.

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Authors' Contributions

FC, KPS, LSB and BFLl collected the data; FC identified the specimen; and FC, DASB, KPS, LSB, BFLl and JJZ wrote the text.

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