

ORIGINAL ARTICLE

New departmental records for Paraguayan bats (Mammalia: Chiroptera)

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ABSTRACT

The authors reviewed unpublished specimens of Paraguayan Chiroptera and document 34 new departmental records for 23 species in 15 genera (three photographic and 155 specimen records) belonging to the families Noctilionidae, Molossidae, Phyllostomidae and Vespertilionidae. An updated distributional table of Paraguayan bats by department is provided. We encourage future researchers with the means to review other collections holding Paraguayan specimens to do so and further expand our understanding of Paraguayan bat distribution.

INTRODUCTION

Building on significant earlier contributions (Azara 1801, 1802, Thomas 1901, Foster 1905, Bertoni 1939, Podtiaguin 1944, Myers & Wetzel 1983, Willig et al. 2000), the distribution of the Paraguayan bat fauna is relatively well known thanks to a detailed study by López-González (2005) and some later publications that further revise it (Stevens et al. 2010, Smith et al. 2012, Stevens & Amarilla-Stevens 2012, Moratelli & Wilson 2013, Owen et al. 2014, Moratelli et al. 2015, Gamarra de Fox et al. 2016, Airaldi-Wood et al. 2018, Weber et al. 2019, Owen & Camp 2021, Smith & Teta 2022, Owen et al. 2023, Smith 2023, Torres et al. 2023). However, some Paraguayan departments remain poorly sampled and this has resulted in notable gaps in the published distribution data. We reviewed unpublished specimen collections and new records of Paraguayan Chiropterans to contribute to current distribution data aiming to provide a more complete understanding of the distribution of the Paraguayan Chiroptero fauna.

In this note we provide new departmental records for species within the families Noctilionidae, Molossidae, Phyllostomidae and Vespertilionidae. We also provide a departmental distribution data table for all Paraguayan species that allows an at-a-glance interpretation of the distributions of Paraguayan bats.

MATERIALS AND METHODS

Specimens referring to departmental records that are new according to the maps in López-González (2005) and subsequent additional Chiropteran distribution papers were reviewed and their identity confirmed using keys in Díaz et al. (2011). Specimens in the Museum of Texas Tech University collection (TTU) were reviewed by Heidi Amarilla-Stevens. Specimens in the Colección Zoológica Para La Tierra (CZPLT) were reviewed by Gersey Vargas, María Belén Barreto and Paul Smith. Specimens in the Natural History Museum of Geneva (MHNG) were reviewed by Manuel Ruedi.

Noctilionidae (1 species)

**Lesser Bulldog Bat *Noctilio albiventris* Desmarest, 1818
(2 specimens)**

- CZPLT 1328 Ruta IV 5 km east of Pilar (near roundabout), Ñeembucú department, 23 July 2023.
- MHNG-MAM-1697.060 Río Pirapó, Northeast of Yegros, Caazapá department, 3 March 1985.

Phyllostomidae (6 species)

**Great Fruit-eating Bat *Artibeus lituratus* Olfers, 1818
(31 specimens)**

- MHNG-MAM-1697.070–1697.072 Arroyo Yukuyry, 17 Km south of Yhu (Yukyry), Caaguazú department, 10 April 1985.
- MHNG-MAM-1697.078–1697.079 Arroyo Yukuyry, 17 Km south of Yhu (Yukyry), Caaguazú department, 12 April 1985.
- MHNG-MAM-1697.080–1697.083 Arroyo Güiraugua, 3 Km east of Dr Juan M. Frutos, Caaguazú department, 13 April 1985.
- MHNG-MAM-1697.084 Arroyo Güiraugua, 3 Km east of Dr Juan M. Frutos, Caaguazú department, 14 April 1985.
- MHNG-MAM-1697.085–1697.098 Arroyo Güiraugua, 3 Km east of Dr Juan M. Frutos, Caaguazú department, 14 April 1985.
- MHNG-MAM-1746.028 Arroyo Hondo, 10 Km northeast of Carayaó, Caaguazú department, 22 October 1989.
- MHNG-MAM-1809.031–1809.036 Juan E. O’Leary, Caaguazú department, 18 October 1987.

Flat-faced Fruit-eating Bat *Artibeus planirostris* (Spix, 1823) (6 specimens)

- CZPLT 033 Rancho Laguna Blanca, San Pedro department, 2 June 2010.
- CZPLT 358 Rancho Laguna Blanca, San Pedro department, 24 October 2012.
- CZPLT 370 Rancho Laguna Blanca, San Pedro department, 26 October 2012.
- CZPLT 374 Rancho Laguna Blanca, San Pedro department, 30 October 2012.
- CZPLT 382 Rancho Laguna Blanca, San Pedro department, 31 October 2012.
- CZPLT 393 Rancho Laguna Blanca, San Pedro department, 10 November 2012.

**Brazilian Big-eyed Bat *Chiroderma doriae* O. Thomas, 1891
(1 specimen)**

- TTU 95747 Yaguareté Forests 0.5 km west of headquarters, San Pedro department, September 1997.

**Ipanema Bat *Pygoderma bilabiatum* (Wagner, 1843)
(34 specimens)**

- TTU 99170 Estancia Golondrina, Caazapá department, 1 November 1996.
- MHNG-MAM-1697.017–1697.043 Arroyo Itay 8 Km east of San Juan Nepomuceno, Caazapá department, 31 October 1983.
- MHNG-MAM-1697.048–1697.050 Arroyo Moroti 10 Km south of Tavai, Caazapá department, 2 November 1983.
- TTU 99179, TTU 99186 Reserva Natural Privada Ypetí, Caazapá department, 2 November 1996.
- MHNG-MAM-1694.099 Panchito Lopez 15 Km west of Yabebyry, Misiones department, 23 October 1982.

**Greater Round-eared Bat *Tonatia bidens* Spix, 1823
(4 specimens)**

- CZPLT 630, CZPLT 632, CZPLT 745 Estancia San Luis, Concepción department, 16 November 1999.
- CZPLT 949 Estancia Garay Cué, Concepción department, 27 October 2001.

**Southern Little Yellow-eared Bat *Vampyressa pusilla*
Wagner, 1843 (2 specimens)**

- CZPLT 933 Estancia Nueva Gambach, Itapúa department, 1 February 2002.
- MHNG-MAM-1694.072 Río Aguaray, 20 Km south of San Juan Bautista, Misiones department, 17 October 1982.

Vespertilionidae (8 species)

Southern Yellow Bat *Lasiurus (Dasypterus) ega* (Gervais, 1856) (6 specimens)

- CZPLT 771 Reserva Natural Bosque Mbaracayú, Canindeyú department, 6 August 2001.
- CZPLT 773 Reserva Natural Bosque Mbaracayú, Canindeyú department, 31 August 2001.
- CZPLT 816 Reserva Natural Bosque Mbaracayú, Canindeyú department, 3 September 2001.
- CZPLT-985 Barrio San Miguel, Pilar, Ñeembucú department, 21 January 2021.
- MHNG-MAM-1746.030, MHNG-MAM-1746.060 Arroyo Tapiracuayi, “8 Km northwest of San

Estanislao, south of the arroyo”, San Pedro department, 25 October 1989.

Southern Hoary Bat *Lasiurus (Aeroestes) villosissimus* (É. Geoffroy, 1806) (1 specimen)

- MHNG-MAM-1633.050 Arroyo Azotey 230 Km north of Cororó (Ruta 3, 10 km north of Cororó), Concepción department, 10 October 1979.

Southern Red Bat *Lasiurus blossevillii* (Lesson & Garnot, 1826) (3 specimens)

- CZPLT 426 Rancho Laguna Blanca, San Pedro department, 6 October 2012.
- CZPLT 470 Rancho Laguna Blanca, San Pedro department, 15 September 2015.
- CZPLT 471 Rancho Laguna Blanca, San Pedro department, 16 September 2015.

An individual of this species was photographed in Pilar, Ñeembucú department on 15 May 2023 by MO (Fig. 1).

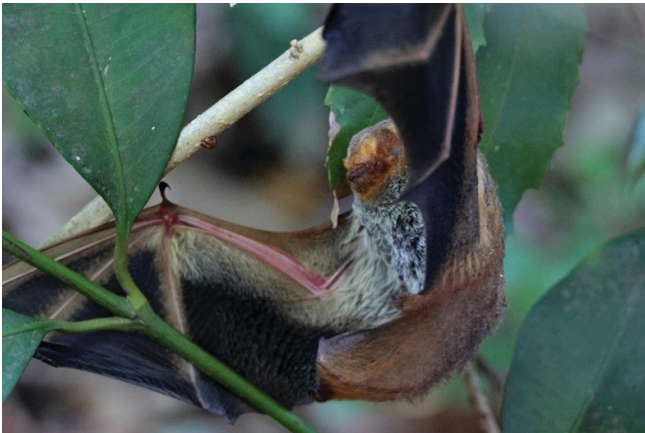


Fig. 1 - *Lasiurus blossevillii*, Pilar, Ñeembucú department, 15 May 2023 (Photo: Matthew Owen).

Brazilian Serotine *Eptesicus brasiliensis* (Desmarest, 1819) (1 specimen)

- TTU-M 96805 Yaguareté Forests, confluence of Río Verde, San Pedro department, 1 April 1998.

Diminutive Serotine *Eptesicus diminutus* Osgood, 1915 (1 specimen)

- MHNG-MAM-1744.098 11 km east of Estancia San Luis, Concepción department, 3 October 1989.

Common Brown Bat *Eptesicus furinalis* (d’Orbigny & Gervais, 1847) (10 specimens)

- MHNG-MAM-1928.029 Arroyo Tapiracuayi, “8 Km northwest of San Estanislao, south of the arroyo”, San Pedro department, 25 October 1989.
- TTU 95722, TTU 95723 Yaguareté Forests, 0.3 km south and 1.8 km west of Puesto Martillo, San Pedro department, 5 February 1998.

- TTU 96263 Yaguareté Forests, 2.5 km north and 1.2 km west of campamento, San Pedro department, 8 October 1997.

- TTU 96128–96130 Yaguareté Forests, 1.7 km east of headquarters, San Pedro department, 8 December 1997.

- TTU 96161, TTU 96162, TTU 96171 Yaguareté Forests, 1.7 km east of headquarters, San Pedro department, 28 December 1997.

Silver-tipped Myotis *Myotis albescens* (É. Geoffroy, 1806) (1 specimen)

- MHNG-MAM-1930.070 Arroyo Yhaca-mi, 4 Km north of Ñumi, Guairá department, 27 March 1985.

Riparian Myotis *Myotis riparius* Handley, 1960 (1 specimen)

- CZPLT 1011 Reserva Natural Bosque Mbaracayú, Canindeyú department, 8 August 2014.

Molossidae (8 species)

Cinnamon Dog-faced Bat *Cynomops abrusus* (Temminck, 1826) (7 specimens)

- TTU 116568 Estancia Punto Alto, Alto Paraguay department, 7 December 2002.
- CZPLT 1028 Reserva Natural Bosque Mbaracayú, Canindeyú department, 31 October 2001.
- TTU 96122, TTU 96126, TTU 96127, TTU 96142, TTU 96153 Yaguareté Forests, 1.7 km east of headquarters, San Pedro department, 8 December 1997.

Southern Dog-faced Bat *Cynomops planirostris* (Peters, 1866) (4 specimens)

- MHNG-MAM-1696.066–1696.068 Puerto Palma (on lake Itaipú), Alto Paraná department, 12 September 1981.
- CZPLT 1023 Reserva Natural Bosque Mbaracayú, Canindeyú department, 6 August 2001.

Dwarf Dog-faced Bat *Molossops temminckii* (Burmeister, 1854) (1 specimen)

- TTU 80178 Estancia Golondrina, Caazapá department, 11 October 1996.

Broad-eared Bat *Nyctinomops laticaudatus* (É. Geoffroy, 1805) (30 specimens)

- MHNG-MAM-1811.010–1811.017 Arroyo Alegre, 5 Km southeast of Estancia Primavera, Concepción department, 3 November 1987.
- MHNG-MAM-1811.018–1811.021 Arroyo Alegre, 5 Km southeast of Estancia Primavera, Concepción department, 4 November 1987.

- MHNG-MAM-1811.022–1811.025 Arroyo Alegre, 5 Km southeast of Estancia Primavera, Concepción department, 5 November 1987.
- MHNG-MAM-1699.040 Estancia Apendice, km 293 Transchaco, Presidente Hayes department, 2 November 1988.
- MHNG-MAM-1811.027–1811.039 Rio Aguaray-Guazu Km 117 Transchaco, Presidente Hayes department, 21 October 1987.

Dwarf Bonneted Bat *Eumops bonariensis* (Peters, 1874) (8 specimens)

- MHNG-MAM-1633.063 San Lorenzo near Asunción, Central department, 26 September 1978.
- MHNG-MAM-1699.031 Laguna Blanca, 20 Km east of Lima, San Pedro department, 20 October 1985.
- TTU 96103 Yaguareté Forests, 1.7 km east of headquarters, San Pedro department, 17 April 1997.
- TTU 96155–96159 Yaguareté Forests, 1.7 km east of headquarters, San Pedro department, 9 December April 1997.

Pallas's Mastiff *Molossus molossus* (Pallas, 1766) (1 specimen)

- MHNG-MAM-1810.080 Arroyo Pirayu-i, 40 Km north northwest of Capitan Meza, Itapúa department, 28 October 1986.

River Mastiff *Molossus fluminensis* Lataste, 1891

An individual found dead on 8 December 2012 by PS in an urban garden in Encarnación, Itapúa department (Fig. 2) is the first record for the department. Although the specimen was not collected (due to a lack of the relevant



Fig. 2 - *Molossus fluminensis*, Encarnación, Itapúa department, 8 July 2012 (Photo: Paul Smith).

permit), the forearm measurement of 50 mm combined with the blackish pelage confirms the identification as *M. fluminensis*. This species was formerly included in *M. rufus* É. Geoffroy, 1805 until it was recently split by Loureiro et al. (2020).

Brazilian Free-tailed Bat *Tadarida brasiliensis* (L. Geoffroy, 1824)

A single adult was captured and photographed at a roost under a bridge at Pirahú, Presidente Hayes department on 11 July 2022. The species was identified by the wrinkled upper lip in combination with the separation of the ears in dorsal view (Fig. 3) (Díaz et al. 2011). The species is known only from four previous localities in Paraguay in Central (Asunción), Boquerón (Fortín Toledo), Itapúa (Encarnación) and Guairá (Villarrica) departments (Ziegler et al. 2002, López-González 2005).



Fig. 3 - *Tadarida brasiliensis* showing wrinkled upper lip and dorsally separated ears, Pirahú, Presidente Hayes department, 11 July 2022 (Photo: Paul Smith).

Table 1. - Distribution of Paraguayan Chiroptera by department. Red X refers to a new record documented in this publication. Departmental ranking refers to an ordering of departments by documented Chiropteran species richness. Departmental codes as follows: Chaco region - APY (Alto Paraguay); BOQ (Boquerón); PHA (Presidente Hayes). Oriental region - AMA (Amambay); CON (Concepción); CAN (Carindeyú); *SAN (San Pedro); COR (Cordillera); CAA (Caaguazú); APA (Alto Paraná); CEN (Central); PAR (Paraguari); GUA (Guairá); CAZ (Caazapá); ÑEE (Ñeembucú); MIS (Misiones); ITA (Itapúa). An “=” sign indicates a tied ranking.

	APY	BOQ	PHA	AMA	CON	CAN	SAN	COR	CAA	APA	CEN	PAR	GUA	CAZ	ÑEE	MIS	ITA
EMBALLONURIDAE																	
<i>Peropteryx macrotis</i>	X				X												
<i>Saccoteryx leptura</i>	X																
NOCTILIONIDAE																	
<i>Noctilio albigentris</i>	X		X		X		X	X			X	X		X	X		X
<i>Noctilio leporinus</i>		X	X		X			X									
PHYLLOSTOMIDAE																	
<i>Chrotopterus auritus</i>	X		X		X	X	X	X	X	X	X	X	X				X
<i>Macrophyllum macrophyllum</i>				X													
<i>Phyllostomus discolor</i>	X																
<i>Phyllostomus hastatus</i>				X													
<i>Tonatia bidens</i>	X	X			X		X					X					X
<i>Lophostoma brasiliense</i>			X														
<i>Lophostoma sylvicolum</i>				X			X	X									
<i>Anoura caudifer</i>					X		X										
<i>Glossophaga soricina</i>			X		X	X	X	X			X	X	X		X	X	X
<i>Carollia perspicillata</i>			X		X	X	X	X	X		X	X	X	X	X	X	X
<i>Artibeus fimbriatus</i>			X		X	X	X	X		X	X	X	X	X	X	X	X
<i>Artibeus planirostris</i>	X		X		X		X	X	X	X	X	X	X	X	X	X	X
<i>Artibeus lituratus</i>			X		X		X	X	X	X	X	X	X	X	X	X	X
<i>Chiroderma doriae</i>							X	X	X	X	X	X	X	X	X	X	X
<i>Platyrrhinus lineatus</i>	X	X	X		X	X	X	X	X		X	X	X		X	X	X
<i>Pygoderma bilabiatum</i>			X		X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Sturnira lilium</i>	X		X		X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Vampyressa pusilla</i>							X	X	X	X	X	X	X	X	X	X	X
<i>Gardnerycteris crenulatum</i>	X					X	X	X	X	X	X	X	X	X	X	X	X

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	APY	BOQ	PHA	AMA	CON	CAN	SAN	COR	CAA	APA	CEN	PAR	GUA	CAZ	ÑEE	MIS	ITA
<i>Desmodus rotundus</i>	X	X	X	X	X	X	X	X	X		X	X			X		X
<i>Diaemus youngii</i>	X	X	X														
NATALIDAE																	
<i>Natalus macrourus</i>					X												
VESPERTILIONIDAE																	
<i>Eptesicus brasiliensis</i>				X			X										X
<i>Eptesicus diminutus</i>		X	X		X						X						X
<i>Eptesicus furiinalis</i>	X	X	X	X	X	X	X	X	X		X	X	X		X	X	X
<i>Histiotus velatus</i>													X				
<i>Histiotus macrotus</i>		X															
<i>Lasiurus blossevillii</i>	X	X	X		X	X	X	X	X		X	X	X		X	X	X
<i>Lasiurus (Aeroestes) villosissimus</i>	X	X			X				X		X	X					X
<i>Lasiurus (Dasypterus) ega</i>	X	X	X		X	X	X	X			X	X	X		X	X	X
<i>Myotis albescens</i>	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Myotis lavalii</i>												X					
<i>Myotis levis</i>										X							
<i>Myotis midastactus</i>			X														
<i>Myotis nigricans</i>	X	X	X	X	X	X	X	X	X		X	X	X		X	X	X
<i>Myotis riparius</i>		X	X	X	X	X	X	X	X	X		X			X	X	X
<i>Myotis ruber</i>												X					X
<i>Myotis cf. simus</i>							X									X	
MOLOSSIDAE																	
<i>Eumops auripendulus</i>	X		X		X				X		X						
<i>Eumops bonariensis</i>			X		X	X	X				X						
<i>Eumops dabbenei</i>			X														X

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	APY	BOQ	PHA	AMA	CON	CAN	SAN	COR	CAA	APA	CEN	PAR	GUA	CAZ	ÑEE	MIS	ITA
<i>Eumops glaucinus</i>	X	X	X		X	X											
<i>Eumops perotis</i>	X	X			X		X				X						
<i>Eumops patagonicus</i>	X	X	X		X	X	X	X			X	X	X				X
<i>Cynomops abrasus</i>	X	X	X		X	X	X	X	X		X	X	X	X			X
<i>Cynomops planirostris</i>	X	X	X		X	X	X	X	X	X	X	X	X	X			X
<i>Molossops temminckii</i>	X	X	X		X	X	X	X	X	X	X	X	X	X			X
<i>Molossus fluminensis</i>	X		X		X	X		X			X	X	X				X
<i>Molossus currentium</i>	X																
<i>Molossus molossus</i>	X	X	X		X	X	X	X			X	X	X				X
<i>Nyctinomops laticaudatus</i>	X	X	X		X	X	X	X			X	X					
<i>Nyctinomops macrotis</i>	X																
<i>Promops centralis</i>			X		X	X	X	X			X	X	X				X
<i>Promops nasutus</i>	X	X			X							X	X				
<i>Tadarida brasiliensis</i>		X	X								X		X				X
TOTAL SPECIES	31	23	30	16	40	27	25	30	13	14	30	31	21	9	21	19	28
DEPTL. RANKING	2=	10	4=	14	1	8	9	4=	16	15	4=	2=	11=	17	11=	13	7

DISCUSSION

Fifty-nine Chiropteran species are documented to occur in Paraguay. In this note we provide 34 new departmental records for 23 species in 18 genera (three photographic and 155 specimen records) of the families Noctilionidae, Molossidae, Phyllostomidae and Vespertilionidae.

The departments with the lowest recorded richness are all in the Atlantic Forest ecoregion: Caazapá (9 species), Caaguazú (13 species) and Alto Paraná (14 species). In fact, only 6 of the 17 Paraguayan departments have species lists that include 50% or more of the known Chiroptero fauna. The Paraguayan department with the highest chiropteran richness is Concepción (at the interface of Humid Chaco and Cerrado ecoregions) with forty recorded species (approximately 68% of the national total). Owen et al. (2023) evaluated six bat communities in three Paraguayan savanna ecoregions (Cerrado, Dry and Humid Chaco), and found taxonomic diversity was highest in the Humid Chaco communities, whereas species diversity was highest in the Cerrado community. Although it occupies only a small portion of the Paraguayan territory, it is clear that the Cerrado, along with the Humid Chaco, support an important part of the chiropteran fauna in Paraguay.

Whilst bats are regularly sampled in Paraguay and a large number of specimens are present in collections, it seems clear that many areas of the country are still incompletely inventoried, and that focusing future sampling on these areas is likely to be fruitful in expanding the knowledge of distribution at the national level. Furthermore, changing taxonomy and the frequency at which new species are being described within the Neotropics means that periodic revision of museum collections is also recommendable to correct misidentifications and uncover previously overlooked cryptic species. During the course of this work, we were unable to review specimens of which we were aware that are held in some US museums and which potentially represent additional departmental records to those noted here. We encourage future researchers with the means to review these collections to do so and further expand our understanding of Paraguayan bat distribution.

Moreover, emerging technologies such as sonar detectors and recorders, along with increasingly extensive sonographic synoptic libraries, are enabling new avenues of investigation into chiropteran distribution patterns. As an example, a recent presentation at an annual mammalogy congress in Asunción, reported the apparent presence of the emballonurid *Saccopteryx leptura* in Concepción department, which would be a new departmental record for the species. Although we welcome such new technologies and the resulting information, we are reluctant to accept such reports as confirmed records, pending either specimen or (for some species) photographic evidence (Biscardi et al. 2004). Nevertheless, we encourage the increasing use of these new methods, which can certainly guide further specimen-based research.

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