

Article

Morphological, craniodental, and molecular characterization of *Platyrrhinus guianensis* (Chiroptera, Phyllostomidae) and second record for Brazil

Amanda C. da S. Lima¹ , Samira B. Mendes² , Ana P. M. Olímpio¹, Fábio H. S. Cardoso³ ,
Cleison L. da S. Costa² , Elmary da C. Fraga⁴ , Maria C. Barros⁴, Iracilda Sampaio¹ 

1. Universidade Federal do Pará (UFPA), Departamento de Ciências Biológicas, Programa de Pós-Graduação em Genética e Biologia Molecular (PPGBM), Rua Augusto Corrêa, 01, Guamá, 66075-110 Belém, PA, Brazil. (amanda01.cristiny@outlook.com; priscila_cx2006@hotmail.com; ira@ufpa.br)
2. Universidade Estadual do Maranhão (UEMA), Departamento de Química e Biologia, Programa de Pós-graduação em Biodiversidade e Biotecnologia da Rede Bionorte-PPGBIO-NORTE, Cidade Universitária Paulo VI, Av. Lourenço Vieira da Silva, 1000, 65055-310 São Luís, MA, Brazil. (britosamira503@gmail.com; cleisonluis89@gmail.com)
3. Universidade Estadual do Maranhão (UEMA), Centro de Ciências Agrárias, Programa de Pós-Graduação em Ciência Animal (PPGCA); Cidade Universitária Paulo VI, Av. Lourenço Vieira da Silva, 1000, 65055-310, São Luís, MA, Brazil. (fabiohenrique16s@hotmail.com)
4. Universidade Estadual do Maranhão (UEMA), Departamento de Química e Biologia, Laboratório de Genética e Biologia Molecular, Campus Caxias, Praça Duque de Caxias s/n°, 65604-000 Caxias, MA, Brazil. (elmaryfraga@yahoo.com.br, mbdene@yahoo.com.br)

Received 02 February 2024
Accepted 29 October 2024
Published 13 January 2025

ABSTRACT. The genus *Platyrrhinus* Saussure, 1860 is one of the most speciose within the Phyllostomidae family in the Neotropical region, with 19 documented species worldwide, nine of which are found in Brazil. *Platyrrhinus guianensis* Velazco and Lim, 2014 was first recorded in the Guiana Shield, followed by a record in the Brazilian Amazon. This study represents the second record of *P. guianensis* in Brazil, specifically in the Maranhão (MA) Amazon biome (Turiçu/MA – 01°39'36"S and 45°22'12"W). Morphological, craniodental, and molecular characters were employed for species identification. The specimen exhibited a dark brown dorsal fur, a conspicuous wide and white dorsal stripe, dark gray ventral fur, a forearm length of 38.5 mm, a short skull without a fossa in the scaly root of the zygomatic arch, with two styler cusps on the posterior crest of the upper second premolar, one styler cusp on the anterior crest of the lower second premolar, and upper internal incisors bilobed and convergent. Molecular results supported the morphological identification, confirming the occurrence of *P. guianensis* in the Maranhão Amazon. Molecular results provide the first public sequence of *P. guianensis* for the 16S rRNA gene and a new sequence for the COI gene, which will be useful in future studies for the species. These results supported the morphological identification, confirming the occurrence of *P. guianensis* in the Maranhão Amazon. This record extends the known distribution of this species approximately 1428.32 km to the east within the Amazon biome in Brazil.

KEYWORDS. Biodiversity, Amazon biome, bats, mitochondrial genes, geographical extension.

RESUMO. Caracterização morfológica, craniodental e molecular de *Platyrrhinus guianensis* (Chiroptera, Phyllostomidae) e segundo registro para o Brasil. O gênero *Platyrrhinus* Saussure, 1860 é um dos mais especiosos da família Phyllostomidae na Região Neotropical, com 19 espécies documentadas no mundo e nove para o Brasil. *Platyrrhinus guianensis* Velazco and Lim, 2014 foi registrada pela primeira vez para o Escudo das Guianas, depois um registro para a Amazônia brasileira e este estudo corresponde ao segundo registro de *P. guianensis* para o Brasil no bioma amazônico maranhense (Turiçu/MA – 01°39'36"S e 45°22'12"W). Caracteres morfológicos, craniodentais e moleculares foram usados para a diagnose da espécie. O espécime apresentou pelagem dorsal marrom-escura, faixa dorsal larga e branca conspicua, pelos ventrais cinza-escuros, antebraço com 38,5 mm, crânio curto sem fossa na raiz escamosa do arco zigomático, duas cúspides estilares na crista posterior do segundo pré-molar superior, uma cúspide estilar na crista anterior do segundo pré-molar inferior, e os incisivos internos superiores bilobados e convergentes. Os resultados moleculares fornecem a primeira sequência pública de *P. guianensis* para o gene 16S rRNA e uma nova sequência para o gene COI, que serão úteis em estudos futuros para a espécie. Esses resultados apoiaram a identificação morfológica, confirmando a ocorrência de *P. guianensis* na Amazônia maranhense. Este registro estende a distribuição conhecida desta espécie aproximadamente 1428,32 km a leste dentro do bioma Amazônia no Brasil.

PALAVRAS-CHAVE. Biodiversidade, bioma Amazônia, morcegos, genes mitocondriais, extensão geográfica.

Within order Chiroptera, the family Phyllostomidae stands out for harboring the highest bat richness in the Neotropical region, making it the most diverse bat family in Brazil (GARBINO *et al.*, 2024). These bats exhibit a variety of feeding habits, including hematophagy, carnivory, nectarivory, pollenivory, insectivory, omnivory, and

frugivory (BAKER *et al.*, 2012). Studies focusing on poorly known areas and conservation priorities, coupled with molecular investigations, have enhanced our understanding of diversity within Phyllostomidae, leading to the discovery of new species, new records, and expanded distribution ranges (MIRETZKI *et al.*, 2002; LIMA *et al.*, 2021). The

genus *Platyrrhinus* Saussure, 1860, subjected to numerous taxonomic studies in the last two decades, serves as an example. The recognized diversity within this genus has increased from ten to 19 species since 2005 (SIMMONS, 2005; VELAZCO, 2005; VELAZCO & GARDNER, 2009; VELAZCO & LIM, 2014; VELAZCO *et al.*, 2018; PALACIOS-MOSQUERA *et al.*, 2020; SIMMONS & CIRRANELLO, 2023; VELAZCO *et al.*, 2023).

Platyrrhinus is the second most speciose genus within the Phyllostomidae (SIMMONS & CIRRANELLO, 2023). Belonging to the subfamily Stenodermatinae, these frugivorous bats are endemic to the Neotropics, exhibiting a wide geographic distribution from southern Mexico to Paraguay and northern Argentina, with the majority of species found in the Andes region (VELAZCO & LIM, 2014; VELAZCO *et al.*, 2018; PALACIOS-MOSQUERA *et al.*, 2020; VELAZCO *et al.*, 2023).

In Brazil, there are records of nine species within the genus: *Platyrrhinus angustirostris* Velazco, Gardner & Patterson 2010, *P. aurarius* (Handley & Ferris, 1972), *P. brachycephalus* (Rouk & Carter, 1972), *P. fusciventris* Velazco, Gardner & Patterson, 2010, *P. guianensis* Velazco & Lim, 2014, *P. incarum* (Thomas, 1912), *P. infuscus* (Peters, 1881), *P. lineatus* (E. Geoffroy Saint-Hilaire, 1810), and *P. recifinus* (Thomas, 1901), the latter being endemic to Brazil (GARBINO *et al.*, 2024).

Platyrrhinus is presented from other genera of Stenodermatinae by a combination of three characters: two accessory cusps on the posterior surface of the second upper premolar, three upper molars and the presence of a fringe of hairs on the margins of the uropatagium. Although other genera also have these characters, no other has all three at the same time (LIM, 1993; VELAZCO, 2005).

Five species were first identified as part of the *Platyrrhinus helleri* complex: *P. angustirostris*, *P. fusciventris*, *P. helleri*, *P. incarum*, and *P. matapalensis* (VELAZCO, 2005; VELAZCO & PATTERSON, 2008; VELAZCO *et al.*, 2010). During systematic, taxonomic, and population structure reviews of *Platyrrhinus*, VELAZCO (2009) observed that a population of small *Platyrrhinus*, part of the *P. helleri* complex occurring in Guyana and Suriname, was grouped as a sister clade to *P. recifinus* and based on these results TAVARES & VELAZCO (2010) extended the distribution of *P. recifinus* to the Guiana Shield. The relationship of this population of small *Platyrrhinus* with *P. recifinus* was recovered in CLARE *et al.* (2007, 2011) who named it *P. helleri* PS2. However, VELAZCO & LIM (2014) formally described this population as a new species, *P. guianensis*.

Platyrrhinus guianensis is distinguished from its congeners by a combination of external and craniodental characteristics, such as the lack of a fossa on the squamosal root of the zygomatic arch, presence of two stylar cusps on the posterior crest of the upper second premolar and one stylar cusp on the anterior crest of the lower second premolar. Additionally, it is characterized by unicolored dark gray

ventral hairs, a wide and bright white dorsal stripe, long and visibly dense pale yellow fur along the uropatagium margin, and a smaller size with a shorter skull compared to *P. recifinus* (VELAZCO & LIM, 2014).

The name *P. guianensis* reflects its endemic distribution in the Guiana region of South America, given that this species is known in Guyana and Suriname (VELAZCO & LIM, 2014) and has been more recently documented in the Amazon biome in Brazil (LOPES *et al.*, 2023). Thus, this study aims to characterize, through morphological, craniodental, and molecular data, the species *P. guianensis* and also to expand its geographic distribution by reporting its second record in Brazil, which represents a new record for the state of Maranhão.

MATERIALS AND METHODS

In June 2016, a specimen of *Platyrrhinus guianensis* was collected in the municipality of Turiaçu/Maranhão (MA) in the Amazon biome (01°39'36"S and 45°22'12"W; Fig. 1) under IBAMA/SISBIO license number 42670-3. Turiaçu is located at the mouth of the Turiaçu River, characterized by a predominantly hot and humid tropical climate, with an average temperature ranging from 26°C to 32°C. The vegetation in the region to which the municipality belongs includes four main types: the Amazon Hyleia, mainly in the areas of indigenous reserves, with large trees; cocais forest, typical of Maranhão lands; natural fields of undergrowth, which occur mainly in the Turiaçu and Pinheiro regions; and the vegetation cover of mangroves and beaches along the Atlantic coast (PASTANA, 2001). The collection took place in the peri-urban zone that has humid forest, typical of the Amazon Hyleia.

For collection, nocturnal expeditions were carried out for six hours a day of capture (from 18:00 to 00:00 h), where 10 mist nets were used, 3 m high by 9 and 12 m long, 25 mm mesh, armed in strategic points such as near streams, trails, caves and fruit trees. The specimen was photographed, euthanized, labeled, weighed, placed on ice, and transported to the GENBIMOL complex, which houses the Genetics Laboratory at the *Universidade Estadual do Maranhão*, Campus Caxias, where the muscle tissue was extracted and stored in 70% ethanol for subsequent molecular analyses. The specimen preparation was approved by the Ethics and Animal Experimentation Committee (CEFA) of the *Universidade Estadual do Maranhão* (UEMA), under protocol number 044/2019.

At the laboratory, the skull was processed according to LIMA *et al.* (2021), and identification was based on external and craniodental characters following VELAZCO & LIM (2014). Based on these authors, the following measurements were taken: total body length, forearm length, ear length, tragus length, foot length, greatest length of skull, condyloincisive length, condylocanine length, braincase breadth, zygomatic

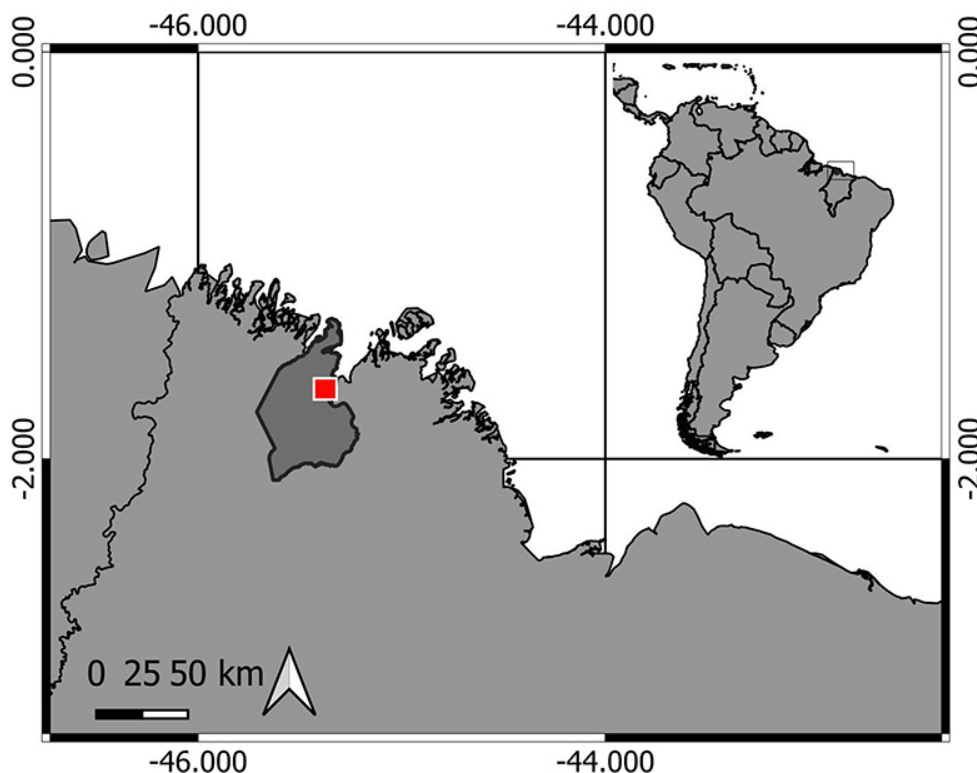


Fig. 1. Area where the specimen of the present study was collected, Amazon biome, state of Maranhão, Brazil.

breadth, postorbital breadth, mastoid breadth, maxillary tooth row length, width at M2, dentary length and mandibular tooth row length (all recorded in mm). The four external and 11 craniodental measurements were taken using a manual caliper (0-150 mm, accuracy of 0.02 mm), and body mass was measured with a portable dynamometer (accuracy of 1g, in grams). For its long term conservation, the specimen was fixed in 10% formalin and stored in 70% alcohol. The specimen was deposited in the Natural History Collection of the *Universidade Federal do Piauí* (CHNUFPI), Campus Amílcar Ferreira Sobral (CAFS), Floriano, Piauí, Brazil.

Total DNA was extracted from muscle tissue using the Wizard Genomic DNA Purification Kit from Promega (Promega Corporation, USA) following the manufacturer's instructions (www.promega.com.br). The mitochondrial genes Cytochrome Oxidase Subunit 1 (COI) and 16S rRNA were amplified via Polymerase Chain Reaction (PCR) using the primers LCO-1490 and HCO-2198 (FOLMER *et al.*, 1994) and L1987 and H2609 (PALUMBI *et al.*, 2002), respectively. Positive PCR products were purified with the "ExoSap-IT" kit (Applied Biosystems, USA) following the manufacturer's recommendations (<https://www.thermofisher.com>) and subjected to DNA sequencing using the "Big dye" Kit, the dideoxy-termination method (SANGER *et al.*, 1977) on the ABI Prism™ 3500 DNA sequencer (Applied Biosystems, USA).

The sequence for the COI gene (GenBank accession number OR900742) was edited and aligned in the BIOEDIT 7.0 program (HALL, 1999), in a database with 17 other sequences of 600 base pairs (bp) each, representing the following species: *Platyrrhinus brachycephalus* (ROM 113713, ROM 113802), *P. fusciventris* (ROM115643, ROM115473), *P. guianensis* (ROM113584), *P. incarium* (ROM 113487), and *Vampyrodes caraccioli* (ROM 108696-external group), obtained from studies by CLARE *et al.* (2007); *P. angustirostris* (ROM 105127, ROM104436), *P. guianensis* (ROM 113991, ROM 114070); *P. helleri* (ROM 99614, ROM 108325); *P. recifinus* (ROM 111106, ROM 111134), from CLARE *et al.* (2011); *P. guianensis* (INPISISJAT_B06) from LOPES *et al.* (2023); and *P. matapalensis* (QCAZ:18238) from CAMACHO *et al.* (2022). For the 16S rRNA gene, there are no sequences of *P. guianensis* in the BLAST platform (<https://www.ncbi.nlm.nih.gov/nucleotide>).

In the MEGA 11 program (TAMURA *et al.*, 2021), a genetic divergence matrix and a Neighbor-Joining (NJ) phylogenetic tree were generated through the Kimura-2-parameters algorithm (K2P= I+G), using the COI gene. The significance of the clusters was estimated by bootstrap analysis, based on 1000 replications (FELSENSTEIN, 1985). For confirmation of identification and assessment of similarity, the sequence from this study was plotted on the BOLD Systems v4 platform (www.boldsystems.org) and BLAST (<https://blast.ncbi.nlm.nih.gov/Blast.cgi>).

RESULTS

The collected specimen corresponds to a non-lactating female of *P. guianensis* (Field code: RRM163; voucher specimen museum code: CHNUFPI655), and the following external measurements were measured: total body length 50.2 mm, right forearm 38.5 mm, ears 14 mm, tragus 6 mm, and foot 9.52 mm, with a body weight of 13 g (Tab. I). The characteristics of the specimen that supported its morphological identification were: broad and white facial stripes, with dark brown dorsal fur, a wide and conspicuous white dorsal stripe, dark gray ventral fur, and the posterior margin of the uropatagium forming an inverted 'U' shape, with a fringe of dense and pale yellow fur along the posterior margin of the uropatagium. Furthermore, the tragus and ears had well-evident anterior and posterior yellow borders, as well as yellowed lateral edges of the nose leaf, with the lower edge of the nose leaf completely free from the upper lip (Fig. 2).

The species was also identified by a set of craniodental characters: short skull, two infraorbital foramina, and posterior edge of the hard palate in a 'V' shape, absence of fossa in the scaly root of the zygomatic arch, and poorly developed paraoccipital and paracondylar processes. There

were two stylar cusps on the posterior crest of the upper second premolar and one stylar cusp on the anterior crest of the lower second premolar, and the upper internal incisors were bilobed and convergent (Fig. 3, Tab. II).

As there are no sequences of *Platyrrhinus guianensis* for the 16S rRNA gene in online platforms, this study provides the first public sequence of the species for this gene (GenBank accession number OR900601). The closest similarity was found with *P. matapalensis*, also part of the *P. helleri* complex, with 98.17%.

For the COI marker, the intraspecific genetic divergence of *Platyrrhinus guianensis* in this study ranged from 0 to 1% with the species found in Guyana, Suriname, and the state of Amazonas in Brazil. The NJ phylogenetic tree grouped all analyzed *P. guianensis* with 99% bootstrap support, forming a sister clade with *P. recifinus* (Fig. 4). When the sequence was submitted to the BOLD Systems platform, a similarity of 99.33% was observed with *P. guianensis* from Guyana (ROM113584) and Suriname (ROM114070, ROM113991). On the BLAST platform, the similarity was 99.33% with *P. guianensis* from Guyana, 99.17% with *P. guianensis* from Suriname and Amazonas in Brazil (INPISISJAT- B06).

Tab. I. External measurements of *Platyrrhinus guianensis* Velazco & Lim, 2014, obtained from a specimen collected in Turiaçu, Maranhão, Brazil (present study - CHNUFPI655), the Guiana Shield (VELAZCO & LIM, 2014), and Uruará/Amazonas (LOPES *et al.*, 2023). All the measurements are expressed in mm with the exception of the weight, which is expressed in g.

Measurements (mm)	Present study	Lopes <i>et al.</i> (2023)	Velazco & Lim (2014)				
	CHNUFPI655 ♀	INPISISJAT-B06 ♀	Holotype ROM 113465 ♀	Paratype ROM 113991 ♀	Paratype ROM 108487 ♂	Paratype ROM 114070 ♂	Paratype ROM 114195 ♂
Forearm length	38.5	39	40	38	39	39	39
Total length	50.2	–	59	56	59	58	54
Foot length	9.52	–	12	12	12	10	11
Ear length	14	–	16	17	16	16	17
Tragus length	6	–	–	–	–	–	–
Weight in grams	13	–	15	13	12	13	13

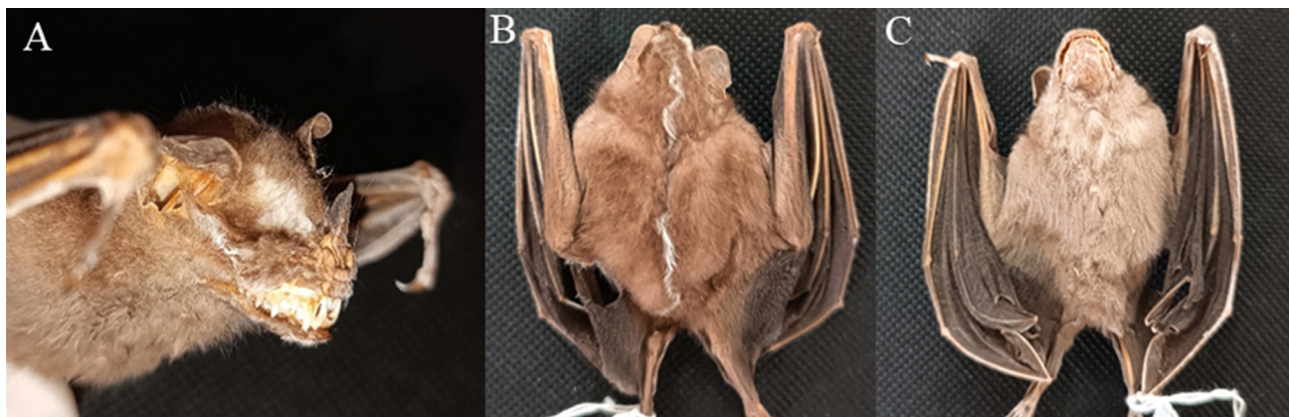


Fig. 2. Specimen of *Platyrrhinus guianensis* Velazco & Lim, 2014 (female, CHNUFPI655), collected in the municipality of Turiaçu/Maranhão, Amazon biome: A, lateral view of the rostrum showing broad and white facial stripes; B, dorsal view showing dark brown fur and wide white dorsal stripe; C, ventral view showing dark gray fur and 'U'-shaped uropatagium.

This study corresponds to the second record of *Platyrrhinus guianensis* in Brazil, and the first for the state of Maranhão. This study extends the distribution of *P. guianensis* by 1,262.7 km from the nearest record of the

species in Iconja Landing, Sipaliwini River, Suriname, and expands by 1,428.32 km from the other record in the country, specifically in the biome Amazon (Fig. 5).

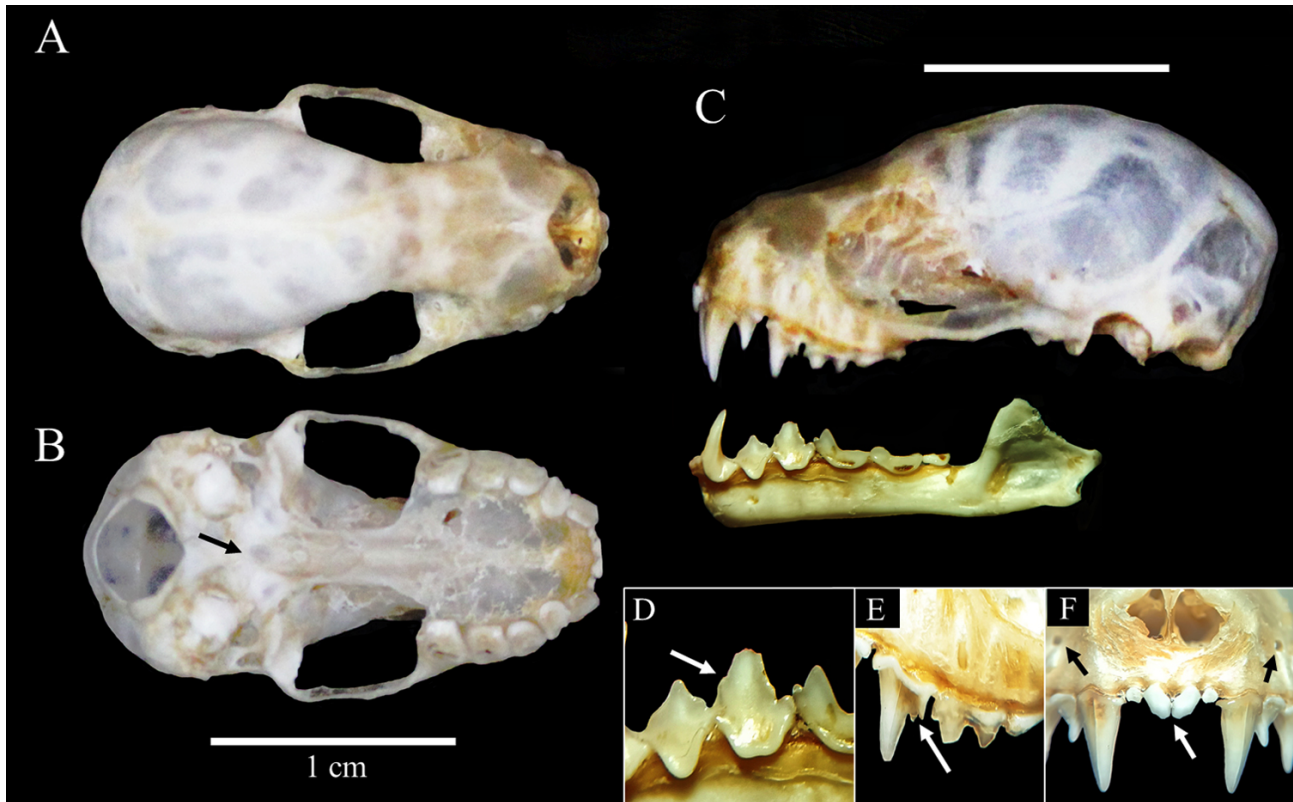


Fig. 3. Skull of the studied specimen of *Platyrrhinus guianensis* Velazco & Lim, 2014 (CHNUFPI655): A, dorsal showing a short skull; B, ventral view showing a posterior edge of the hard palate in a 'V' shape; C, lateral view of the skull and mandible; D, zoom in a stylar cusp on the anterior crest of the lower second premolar; E, zoom in two stylar cusps on the posterior crest of the upper second premolar; F, frontal view with emphasis on the bilobed and convergent upper internal incisors and two infraorbital foramina.

Tab. II. Cranial measurements (in mm) of the specimen of *Platyrrhinus guianensis* Velazco & Lim, 2014 (CHNUFPI655) obtained in Turiaçu, MA, Brazil (present study), including the values of the type series of *P. guianensis* from Uruará, Amazonas.

Measurements (mm)	Present study	LOPES <i>et al.</i> (2023)		VELAZCO & LIM (2014)			
	CHNUFPI655 ♀	INPISISJAT-B06 ♀	Holotype ROM 113465 ♀	Paratype ROM 113991 ♀	Paratype ROM 108487 ♂	Paratype ROM 114070 ♂	Paratype ROM 114195 ♂
GLS	21.9	22.1	22.0	21.0	21.9	21.5	21.2
CIL	20	20	20.0	19.2	19.9	19.7	19.1
CCL	19.2	–	19.5	18.8	19.3	19.2	18.6
BB	9	12	9.4	8.9	8.9	9.0	9.1
ZB	12	9.5	12.7	12	12.2	12.0	12.3
PB	5.1	6	5.4	5.1	5.3	5.5	5.1
MB	10.5	14.1	11	10.5	10.4	10.5	10.5
MTRL	7.9	7.5	7.9	7.6	7.4	7.6	7.7
M2-M2	8.5	8.9	9.1	8.9	8.9	8.5	8.8
DENL	14.5	15	14.5	13.9	14.2	14.3	14.3
MANDL	8.7	8.5	8.3	8.2	8.2	8.1	8.6

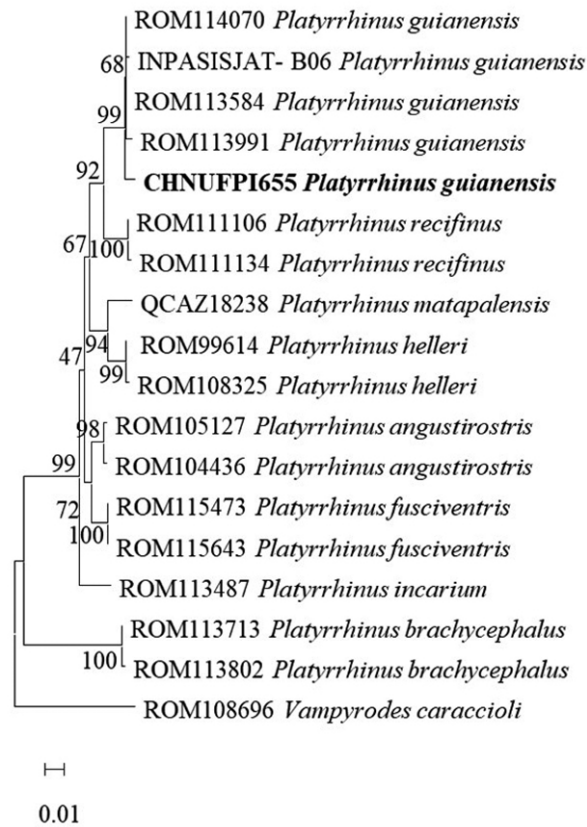


Fig. 4. Neighbor-Joining (NJ) phylogenetic tree for *Platyrrhinus* species using the K2P (I+G) algorithm based on COI gene data. The specimen from this study is highlighted in bold, and bootstrap values are indicated.

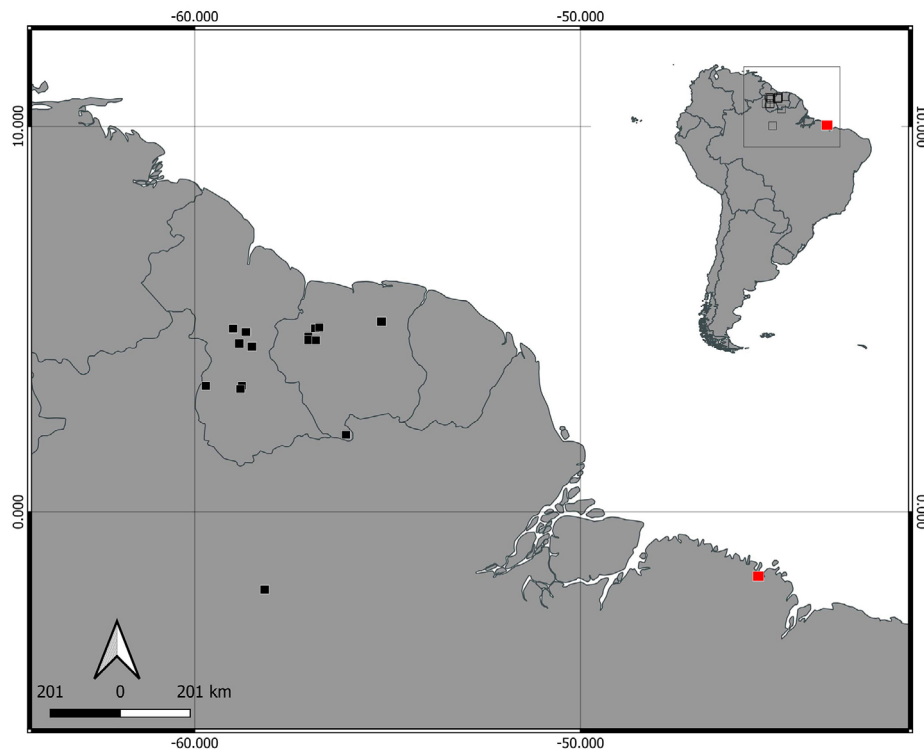


Fig. 5. Geographical distribution of the known specimens of *Platyrrhinus guianensis* Velazco & Lim, 2014, in the Neotropical region. The area where the specimen of this study was collected is indicated by a red square in the state of Maranhão.

DISCUSSION

All morphological and craniodental characteristics analyzed in this study are consistent with VELAZCO & LIM (2014). However, the measurements of *P. guianensis* can be confused with *P. angustirostris*, *P. brachycephalus*, *P. fusciventris*, *P. helleri*, *P. incarum*, and *P. matapalensis*, because their external and cranial measurements overlap. *Platyrrhinus guianensis* occurs sympatrically with *P. angustirostris*, *P. brachycephalus*, *P. fusciventris*, and *P. incarum* in the Brazilian Amazon, and can be easily confused with these species without careful identification (LOPES *et al.*, 2023).

However, *P. guianensis* can be distinguished from *P. brachycephalus* and *P. matapalensis* by the presence of an accessory cusp on the anterior crest of the lower second premolar, as *P. brachycephalus* has two accessory cusps and *P. matapalensis* lacks an accessory cusp on the lower second premolar. In relation to *P. angustirostris*, *P. fusciventris* and *P. incarum* differ in fur, as *P. guianensis* and *P. angustirostris* have dark gray, *P. incarum* has gray-brown, and *P. fusciventris* has brown ventral pelage; *P. guianensis*, *P. angustirostris*, and *P. fusciventris* have unicolor while *P. incarum* has bicolor ventral pelage. Regarding the dorsal stripe, in *P. guianensis* it is wide, bright white, and conspicuous, but in *P. angustirostris*, *P. fusciventris*, and *P. incarum*, it is narrow. Regarding the tragus and anterior and posterior edges of the ears, in *P. guianensis* and *P. fusciventris* they are bright yellow and in *P. angustirostris* and *P. incarum* they are whitish. Concerning the lateral edges of the proximal half of the nose leaf and edges of the horseshoe, in *P. guianensis* and *P. fusciventris* they are yellow, while in *P. angustirostris* and *P. incarum* they are whitish. Regarding the posterior margin of the uropatagium, in *P. guianensis*, *P. angustirostris*, and *P. incarum*, it has a 'U' shape, and in *P. fusciventris* it has a 'V' shape. The fringe of hair along the posterior margin of the uropatagium in *P. guianensis* is long, visibly dense, and pale yellow (VELAZCO & LIM, 2014).

The analyses for the COI gene revealed a high degree of similarity (99.33%) with *P. guianensis* from Guyana and genetic divergence less than 2% compared to *P. guianensis* from Guyana, Suriname and Amazonas in Brazil. This consistency with the threshold observed by CLARE *et al.* (2011) using the COI marker, where an intraspecific threshold of 2% for bat species was observed, supports the species identification. Furthermore, although *P. guianensis*, *P. fusciventris*, and *P. incarum* are sympatric and show significant morphological similarities, our phylogenetic analysis demonstrated that they are not sister species. According to VELAZCO *et al.* (2010) and VELAZCO & LIM (2014), this suggests that these species are examples of cryptic species, contributing to the underestimation of bat diversity, especially in tropical areas.

Some studies have used the 16S rRNA gene for bat studies, notably BAKER *et al.* (2003), who found its

efficacy in resolving phylogenetic relationships in bats of the Phyllostomidae family. In the mitochondrial genome, the 16S rRNA gene is one of the most conserved genes with low mutation rates but has variable regions that allow phylogenetic studies at the species level (NAEGELE *et al.*, 2006). Thus, this study provides a 16S rRNA sequence for *P. guianensis*, which can contribute to elucidating phylogenetic relationships within the genus *Platyrrhinus*.

Until now, *P. guianensis* was known in Guyana and Suriname (VELAZCO & LIM, 2014) and more recently in state Amazonas, Brazil (LOPES *et al.*, 2023). Therefore, this study suggests that the species may be undersampled in Brazil, and a careful evaluation in different collections can help expand the species' records in the country. Moreover, it has been observed that the species has a preference for more humid forest habitats, consistent with records of most *Platyrrhinus* species. However, the species was also collected in savanna habitats (VELAZCO & LIM, 2014), expanding the possibilities of *P. guianensis* occurrence in different Brazilian biomes.

Furthermore, careful attention is required in the identification of *Platyrrhinus* species, as some species show significant morphological similarities, especially those occurring sympatrically, such as *P. guianensis*, *P. fusciventris* and *P. incarum*. The genetic data, in line with morphological and craniometric identification, provided conclusive evidence of *P. guianensis* occurrence in the Amazon biome in Maranhão, Brazil.

Acknowledgments. ACSL, SBM, APMO, and FHSC were supported by doctoral fellowships by *Coordenação de Aperfeiçoamento de Pessoal de Nível Superior* (CAPES). This study was financed in part by CAPES-Financial Code 001 and the *Fundação de Amparo à Pesquisa e ao Desenvolvimento Científico e Tecnológico do Maranhão* (FAPEMA).

REFERENCES

- BAKER, R. J.; BININDA-EMONDS, O. R. P.; MANTILLA-MELUK, H.; PORTER, C. A. & VAN DEN BUSSCHE, R. A. 2012. Molecular timescale of diversification of feeding strategy and morphology in New World leaf-nosed bats (Phyllostomidae): a phylogenetic perspective. *In*: GUNNELL, G. F. & SIMMONS, N. B. eds. **Evolutionary history of bats: fossils, molecules and morphology**. Cambridge, Cambridge University Press, p. 385-409.
- BAKER, R. J.; HOOFFER, S. R.; PORTER, C. A. & VAN DEN BUSSCHE, R. A. 2003. Diversification among New World Leaf-Nosed Bats: an evolutionary hypothesis and classification inferred from digenomic congruence of DNA sequence. **Occasional Papers of the Museum of Texas Tech University**, 230:1-32.
- CAMACHO, M. A.; CADAR, D.; HORVÁTH, B.; MERINO-VITERI, A. & MURIENNE, J. 2022. Revised phylogeny from complete mitochondrial genomes of phyllostomid bats resolves subfamilial classification. **Zoological Journal of the Linnean Society** 196(4):1591-1607. <https://doi.org/10.1093/zoolinnean/zlac055>
- CLARE, E. L.; LIM, B. K.; ENGSTROM, M. D.; EGER, J. L. & HEBERT, P. D. N. 2007. DNA barcoding of Neotropical bats: species identification and discovery within Guyana. **Molecular Ecology Notes** 7:184-190. <https://dx.doi.org/10.1111/j.1471-8286.2006.01657.x>
- CLARE, E. L.; LIM, B. K.; FENTON, M. B. & HEBERT, P. D. N. 2011. Neotropical bats: estimating species diversity with DNA barcodes. **PLoS ONE** 6(7):22648. <http://dx.doi.org/10.1371/journal.pone.0022648>

- FELSENSTEIN, J. 1985. Confidence limits on phylogenies: An approach using the bootstrap. **Evolution** **39**(4):783-791.
- FOLMER, O.; BLACK, M.; HOEH, W.; LUTZ, R. & VRIJENHOEK, R. 1994. DNA primers for amplification of mitochondrial cytochrome c oxidase subunit I from diverse metazoan invertebrates. **Molecular Marine Biology and Biotechnology** **3**(5):294-299.
- GARBINO, G. S. T.; GREGORIN, R.; LIMA, I. P.; LOUREIRO, L.; MORAS, L. M.; MORATELLI, R.; NASCIMENTO C.; NOGUEIRA, M. R.; NOVAES R. L.; PAVAN, A. C.; TAVARES, V. C. & PERACCHI, A. L. 2024. Updated checklist of bats (Mammalia: Chiroptera) from Brazil. **Zoologia (Curitiba)** **41**:e23073.
- HALL, T. A. 1999. BioEdit: a user-friendly biological sequence alignment editor and analysis program for Windows 95/98/NT. **Nucleic acids symposium** **41**:95-98.
- LIM, B. K. 1993. Cladistic reappraisal of stenodermatine bat phylogeny. **Cladistics** **9**:147-165.
- LIMA, A. C. S.; COSTA, C. L. S.; MENDES, S. B.; CARDOSO, F. H. S.; CAMPOS, B. A. T. P.; FRAGA, E. F. & BARROS, M. C. 2021. Occurrence of *Sturnira tilda* De La Torre, 1959 (Chiroptera: Phyllostomidae) in the state of Maranhão, Brazil. **Papéis Avulsos de Zoologia** **61**:20216172. <http://doi.org/10.11606/1807-0205/2021.61.72>
- LOPES, G. P.; OLIVEIRA, R. C.; SANTOS, T. C. M.; VELAZCO, P. M.; BOBROWIEC, P. E. D.; SILVA, M. N. F. & FARIAS, T. H. I. P. 2023. First record of *Platyrrhinus guianensis* Velazco and Lim, 2014 (Chiroptera, Phyllostomidae) for Brazil. **Mammalia** **87**(6):591-595. <https://doi.org/10.1515/mammalia-2023-0057>
- MIRETSKI, M.; PERACCHI, A. L. & BIANCONI, G. V. 2002. Southernmost records of *Sturnira tilda* de la Torre, 1959 (Chiroptera: Phyllostomidae) in Brazil. **Mammalia** **66**(2):306-309.
- NAEGELE, M. P.; DA COSTA, P. I. & ROSA, J. A. 2006. Polymorphism of the ITS-2 region of the Ribosomal DNA of the Triatominae *Rhodnius domesticus*, *R. pictipes*, *R. prolixus* and *R. stali*. **Medical and Veterinary Entomology** **20**(4):353-357.
- PALACIOS-MOSQUERA, L.; CUADRADO-RIOS, S.; LEON, M. M.; VILLEGAS-ROSAS, S.; ZAMORA-VELEZ, O. A.; PEREZ-AMAYA, N. J.; JIMENEZ-ORTEGA, A. M.; MANTILLA-MELUK, H. & VELASCO, P. M. 2020. Systematics and taxonomy of *Platyrrhinus chocoensis* (Chiroptera: Phyllostomidae) based on morphometric and genetic analyses: implications for biogeography and conservation. **Mammalian Biology** **100**:113-124. <https://doi.org/10.1007/s42991-020-00007-z>
- PALUMBI, S.; MARTIN, A.; ROMANO, S.; McMILLAN, W. O.; STICE, L. & GRABOWSKI, G. 2002. **The simple fool's guide to PCR**, version 2.0. University of Hawaii, Honolulu.
- PASTANA, J. M. N. org. 2001. **Programa Levantamentos Geológicos Básicos do Brasil – PLGB**: Turiaçu, Folha SA. 23-V-D [e] Pinheiro, Folha SA.23-Y-B. Estados do Pará e Maranhão. Brasília: CPRM/DIEDIG/DEPAT, 5-12. Available at <https://rigeo.cprm.gov.br/bitstream/doc/3062/1/rele_turiaçu_pinheiro.pdf>. Accessed on 22 September 2023.
- SANGER, F.; NICHLEN, S. & COULSON, A. R. 1977. DNA sequencing with chain termination inhibitors. **Proceedings of the National Academy of Sciences of the USA, Cambridge** **74**(12):5463-5467. <https://doi.org/10.1073/pnas.74.12.5463>
- SIMMONS, N. B. 2005. Order Chiroptera. In: WILSON, D. E. & REEDER, D. M. eds. **Mammals species of the world: a taxonomic a geographic reference** **3**:312-529. Baltimore, Johns Hopkins University Press.
- SIMMONS, N. B. & CIRRANELLO, A. L. 2023. **Bat Species of the World: A Taxonomic and Geographic Database**. Available at <<https://batnames.org/about.html>>. Accessed on 22 September 2023.
- TAMURA, K.; STECHER, G. & KUMAR, S. 2021. MEGA11: Molecular evolutionary genetics analysis version 11. **Molecular biology and evolution** **38**(7):3022-3027. <https://doi.org/10.1093/molbev/msab120>
- TAVARES, V. D. C. & VELAZCO, P. M. 2010. *Platyrrhinus recifinus* (Chiroptera: Phyllostomidae). **Mammalian Species** **42**:119-123. <https://doi.org/10.1644/859.1>
- VELAZCO, P. M. 2005. Morphological phylogeny of the bat genus *Platyrrhinus* Saussure, 1860 (Chiroptera: Phyllostomidae) with the description of four new species. **Fieldiana Zoology** (new series) **150**:1-53. [https://doi.org/10.3158/0015-0754\(2005\)105\[1:MPOTBG\]2.0.CO;2](https://doi.org/10.3158/0015-0754(2005)105[1:MPOTBG]2.0.CO;2)
- VELAZCO, P. M. 2009. **Historical diversification in the Neotropics: evolution and variation of the bat genus *Platyrrhinus***. Ph.D dissertation, University of Illinois at Chicago, Chicago.
- VELAZCO, P. M. & GARDNER, A. L. 2009. A new species of *Platyrrhinus* (Chiroptera: Phyllostomidae) from western Colombia and Ecuador, with emended diagnoses of *P. aquilus*, *P. dorsalis*, and *P. umbratus*. **Proceedings of the Biological Society of Washington** **122**(3):249-281. <https://doi.org/10.2988/08-40.1>
- VELAZCO, P. M.; GARDNER, A. L. & PATTERSON, B. D. 2010. Systematics of the *Platyrrhinus helleri* species complex (Chiroptera: Phyllostomidae), with descriptions of two new species. **Zoological Journal of the Linnean Society** **159**:785-812. <http://dx.doi.org/10.1111/j.1096-3642.2009.00610.x>
- VELAZCO, P. M.; GUEVARA, L. & MOLINARI, J. 2018. Systematics of the broad-nosed bats, *Platyrrhinus umbratus* (Lyon, 1902) and *P. nigellus* (Gardner and Carter, 1972) (Chiroptera: Phyllostomidae), based on genetic, morphometric, and ecological niche analyses. **Neotropical Biodiversity** **4**:118-132. <https://doi.org/10.1080/23766808.2018.1494481>
- VELAZCO, P. M. & LIM, B. K. 2014. A new species of broad-nosed bat *Platyrrhinus* Saussure, 1860 (Chiroptera: Phyllostomidae) from the Guianan Shield. **Zootaxa** **3796**:175-193. <https://doi.org/10.11646/zootaxa.3796.1.9>
- VELAZCO, P. M.; LY, G.; McALLISTER, J. & ESQUIVEL, D. A. 2023. Geographic variation in select species of the bat genus *Platyrrhinus*. **THERYA** **14**(1):121-130. <https://doi.org/10.1515/mammalia-2023-0057>
- VELAZCO, P. M. & PATTERSON, B. D. 2008. Phylogenetics and biogeography of the broad-nosed bats, genus *Platyrrhinus* (Chiroptera: Phyllostomidae). **Molecular Phylogenetics and Evolution** **49**:749-759. <https://doi.org/10.1016/j.ympev.2008.09.015>