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SOUTHERN DISTRIBUTION OF *Nyctinomops laticaudatus* (É. GEOFFROY, 1805) (CHIROPTERA, MOLOSSIDAE) AND ITS FIRST RECORD IN THE PROVINCE OF TUCUMÁN, ARGENTINA

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Abstract: Although the geographical distribution of the free-tailed bat, *Nyctinomops laticaudatus* (Chiroptera, Molossidae), is well documented, it presents discontinuities that may be caused by insufficient sampling or misidentified specimens. These geographical distribution gaps can hamper the interpretation of the effects of anthropic impacts on this species and the estimation of its conservation status since, in most cases, it is not possible to define whether a gap represents a

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species' true absence. We compiled the southern records of the species and reported the first record in Tucumán Province, Argentina. We analyzed reports from the southernmost distribution, which consisted of 41 points of occurrence in Uruguay, Brazil, Paraguay, Bolivia, and Argentina. The information provided here may serve as a basis for future research on the conservation status of the species and its response to climate and environmental changes.

Keywords: free-tailed bat; geographical distribution; scientific-collection.

Currently, the genus *Nyctinomops* Miller, 1902 (Chiroptera, Molossidae) contains five species (Barquez *et al*. 2023), with the free-tailed bat, *Nyctinomops laticaudatus* (É. Geoffroy, 1805), being the smallest and having a great distributional range (Barquez *et al.* 2015). The type locality of the species is Asunción, Paraguay, and it is found in all tropical and subtropical regions of America, from México through Central America to northern Argentina, as well as in the Caribbean islands of Cuba and Trinidad and Tobago (Avila-Flores *et al.* 2002, Simmons 2005, Díaz *et al.* 2021).

The genus *Nyctinomops* was previously considered a subgenus of *Tadarida* Rafinesque, 1814 (Shamel 1931, Silva-Taboada & Koopman 1964, Barriga-Bonilla 1965, Barquez & Ojeda 1975), until Freeman (1981) recommended that *Nyctinomops* be recognized as a separate and valid genus. *Nyctinomops laticaudatus* is sympatric with *Tadarida brasiliensis* (I. Geoffroy, 1824) (Chiroptera, Molossidae), and because of their similarity in morphology and behavior, some erroneous identifications have been recorded (Zortéa & Taddei 1995). For example, a new species was described by Ruschi (1951) (*T. espiritosantensis*), which was later considered a junior synonym of *N. laticaudatus* (Zortéa & Taddei 1995).

Despite the general similarity in the external morphology of *N. laticaudatus* and *T. brasiliensis*, these species clearly differ from each other: *N. laticaudatus* has four lower incisors versus six lower incisors in *T. brasiliensis*, upper incisors parallel versus convergent tips, inner edge of ears joined in the middle of the head versus completely separated inner edge, and second

phalange of the fourth digit shorter (< 5 mm) versus second phalange longer (> 7 mm), being 2/3 of the length of the first digit (IV digit – 1st phalange: 12.0–15.0; 2nd phalange: 7.5–9.5) (Gregorin & Taddei 2002, Díaz *et al.* 2016).

The species of the genus *Nyctinomops* exhibit distinct morphological characteristics that allow them to be easily differentiated (Barquez *et al*. 2023). For example, *N. macrotis* is notably larger than the other species of the genus; *N. femorosaccus* stands out for the presence of a membranous sac along each leg, a unique characteristic within the genus (Barquez *et al*. 2023). *Nyctinomops laticaudatus* has a grayish coloration, with bicolored dorsal hairs that vary between gray and white, in addition to being the smallest species of the genus (Barquez *et al*. 2023). In contrast, *N. mbopicuare* has a reddish color and its dorsal hairs are tricolored, combining shades of red, brown and white (Barquez *et al*. 2023).

In most cases, gaps in knowledge about the geographical distribution of species are caused by insufficient sampling or failure to compile data (Delgado-Jaramillo *et al.* 2020). These gaps in the distribution of *N. laticaudatus*, as well as other species, are concerning because current rates of environmental degradation and expansion of anthropic activities cause impacts on bats (Bernard *et al.* 2011), which potentially lead to local extinction before formal recording and highlight the importance of accurate distribution data (Margules & Pressey 2000, IUCN 2001, Delgado-Jaramillo *et al.* 2020, Galletti 2023). For example, wind farms pose a threat to *N. laticaudatus* because of fatalities caused by collisions with turbines and changes in habitats (Barros *et al*. 2015). The aim of this research was to compile the southernmost localities where *N. laticaudatus* has been recorded and to report its first record from Tucumán Province, Argentina.

To identify the southern records of this species, we reviewed specimens of *N. laticaudatus* (n = 6) and *T. brasiliensis* (n = 804) from the Colección Mamíferos Lillo (CML), Universidad Nacional de Tucumán-Fundación Miguel Lillo, and from the Museo Argentino de Ciencias Naturales, Bernardino Rivadavia, Buenos Aires (Argentina) (see Amaral *et al.* 2023 for details and voucher numbers for each locality), following the characters given in the publications of Gregorin & Taddei (2002) and Díaz *et al.* (2016). Additionally, all literature records from southern

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Brazil, Argentina, Chile, Bolivia, Paraguay and Uruguay, which constitute the southern limits for the distribution of the species, as proposed by Barquez *et al.* (2015), were collected (Supplementary Material 1). It is important to mention that the species was previously cited to occur in Tucumán (Barquez *et al.* 1997, Barquez & Díaz 2009) but, after a later revision, it was found that the specimens were erroneously identified (Gamboa-Alurralde *et al.* 2017, Barquez & Díaz 2020). The records were obtained using the Google Scholar search engine with the keywords *Nyctinomops laticaudatus* + Brazil + Argentina + Uruguay + Paraguay + Bolivia + Chile. We also utilized records available on the *Specieslink* (CRIA 2023) and *Animal Diversity Web* (Myers *et al.* 2023) websites.

We identified 41 records in the region, including the southernmost parts of Brazil, Uruguay, Argentina, Paraguay, and Bolivia, except in Chile (Figure 1). In this region, shelters vary widely, from rocky formations near the sea (maximum altitude of 20 m) in the municipality of Torres, Brazil (Silva & Souza 1980), to elevations reaching 1630 m in Tarija, Bolivia (Anderson 1997).

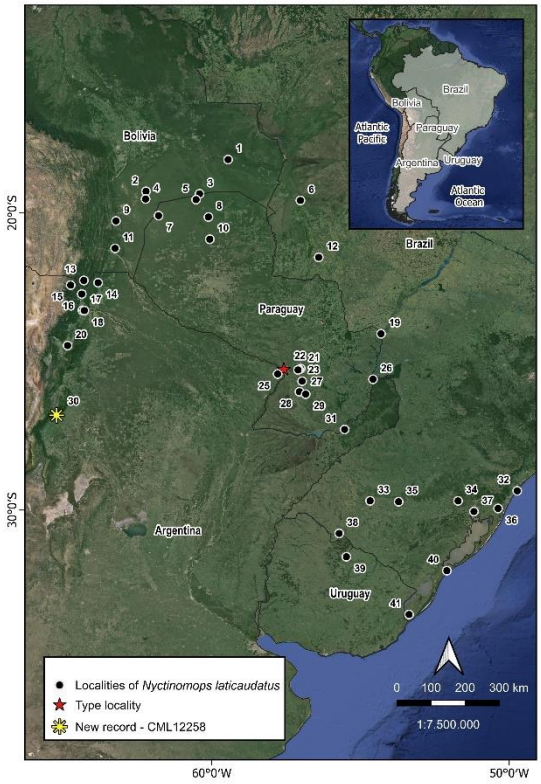

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Figure 1. Map of South America highlighting the southern records of *Nyctinomops laticaudatus* (Chiroptera, Molossidae) occurrence. The asterisk indicates the first record for the province of Tucumán, Argentina. For geographical coordinate references and records, see Supplementary Material I. References consulted include Silva & Souza (1980); Baud (1981); Ojeda & Mares (1989); Redford & Eisenberg (1992); Anderson (1997); Barquez *et al.* (1999); Willig *et al.* (2000); González (2001); Gil & Heinonen (2003); Pacheco & Freitas (2003); López-González (2005); Aguirre (2007); Pacheco *et al.* (2007); Weber *et al.* (2007); Cunha *et al.* (2009); Fabián *et al*. (2010); Quintela *et al.* (2011); González *et al*. (2013); Queirolo (2016); Boero (2020); Fischer *et al.* (2022); CRIA (2023) and Myers *et al.* (2023).

The species is widely distributed in southern Brazil, and the sympatry with *T. brasiliensis* throughout its distribution often results in erroneous identification of the specimens deposited in scientific collections. During the review of 810 specimens of *N. laticaudatus* and *T. brasiliensis* from the collections of Colección Mamíferos Lillo (CML) and Museo Argentino de Ciencias Naturales, Bernardino Rivadavia, only one was misidentified. In a previous study, seven specimens of *N. laticaudatus* were found to have been misidentified as *T. brasiliensis* from western Brazil (Amaral *et al.* 2023). As described in studies by Amaral *et al.* (2023), this incongruity in identifications interferes with the current distribution of *T. brasiliensis*. An additional example of possible erroneous identification between these species is evidenced by the recent record of *N. laticaudatus* mortality at wind towers in Santa Vitória do Palmar and Sant'Ana do Livramento, Brazil (SOL 2023). Although mortality of this species is not common in wind farms, it is extremely important that technicians verify the identity of any specimens found. Because of the high number of individuals of *T. brasiliensis* found dead in the region, it is possible that among them, there could be individuals of *N. laticaudatus* (Amaral *et al.* 2020).

In Uruguay, *N. laticaudatus* is considered extinct because the single record was from the 1940s (González *et al.* 2013); however, considering the current records from Brazilian border municipalities, the species may still be present in Uruguay, at least in some adjacent localities. Anderson (1997) included two subspecies in Bolivia, *N. l. laticaudatus* and *N. l. europs* Allen, 1889; the former is distributed in southern Bolivia and corresponds to the localities included in this research. In Paraguay, López-González (2005) recorded specimens on both sides of the Paraguay River, but there are no records from the lower and central Chaco.

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In Argentina, three species of the genus *Nyctinomops* occur (Barquez *et al.* 2023). *N. macrotis* was found in only seven locations distributed in the northwest of the country, with the southern limit in La Rioja. *Nyctinomops mbopicuare* has a single record from Misiones. *N. laticaudatus* has few records restricted to the northeastern and northwestern regions of the country, with no records between these two regions. Here, we report the first record of this species in Tucumán Province. The new specimen (CML 12258) was collected on 28 April, 2014 at San Miguel de Tucumán (26°49'13.58"S, 65°10'25.61"W, *datum* WGS84, 435 m a.s.l.). It is an adult male with abdominal testes and a forearm length of 43.4 mm. The collection site is a house located in a neighborhood close to landscaped areas such as the large Parque 9 de Julio. This record extends the distribution of the species 270 km south in northwestern Argentina, from the closest locality in Río Lavayén, Jujuy Province (Díaz & Barquez 1999; Figure 1 and Supplementary Material 1). The specimen was carefully analyzed for the presence of the diagnostic characters mentioned above, which are typical of the species, including the parallel upper incisors (Figure 2).

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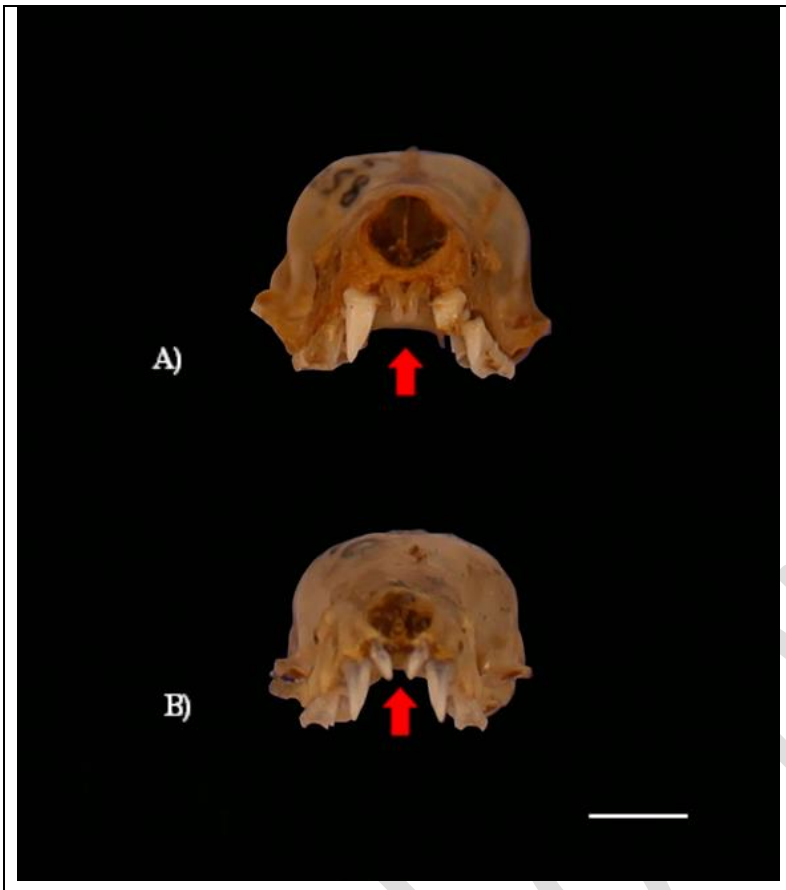

Figure 2. Frontal view of the skulls of a) *Nyctinomops laticaudatus* (CML 12258 – New record), red arrow indicating parallel upper incisors, and b) *Tadarida brasiliensis* (CML 2398), red arrow indicating convergent upper incisors. Scale: 0.5 cm.

At the southern limit of its geographic distribution, we suggest that this species has a low population density according to its presence in collections and bibliographic records, whereas in the northern hemisphere, a previous study reported thousands of individuals in colonies (Avila-Flores *et al.* 2002). Most of the recorded locations are represented by one or a few individuals, with the record by Silva & Souza (1980) being the most notable of an established colony. Additionally, the flight style above the treetops and consequently outside the reach of traditional mist nets may also contribute to the low capture rate of the species (Reis *et al*. 2007). This low population density and/or low capture directly reflects the presence of specimens in collections and the definition of geographical distribution limits, since a greater sampling effort is required for a record to occur.

Although this species has a wide distribution and the analysis of its conservation status must consider the global situation, we believe that the identification of the geographical boundaries of occurrence for this and other species is crucial for evaluating their conservation status, to implement assessment projects, mitigate impacts and support research on predictive models of species distribution in future scenarios (Rondinini *et al.* 2005, Di Marco *et al*. 2014). Thus, understanding the current distribution of *N. laticaudatus* helps us explore how this species may respond to various current and future pressures in South America.

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Supplementary Material

Supplementary Material 1. Localities where *Nyctinomops laticaudatus* (Chiroptera, Molossidae) was recorded in the southern South America.

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