

Re-evaluation of a Colombian record of *Sturnira thomasi* De La Torre and Schwartz, 1966 (Phyllostomidae: Stenodermatinae)

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Abstract

We discuss the first geographic record of *Sturnira thomasi* for Colombia, reported by Cuartas-Calle and Muñoz (1999) based on a single specimen. The species, previously known from two islands in the Lesser Antilles, was mainly characterized by the absence of the third lower molar, a trait also present in the Colombian specimen. We review morphological characters described for *Sturnira* species, which positively identify this specimen as *S. ludovici*, a montane species recorded from several other localities in the Central Andes of Colombia. At the same time, we show that the absence of a third molar is not a reliable character to identify *S. thomasi* because it is a trait that also occurs, at least, in *S. ludovici*. Based on the new identification of the specimen, we conclude the absence of *S. thomasi* in the Colombian territory. Morphological and geographic data are reviewed to support our conclusions.

Keywords: Colombia, dental anomalies, distribution, morphology, *Sturnira*.

Resumen

Re-evaluación de un registro colombiano de *Sturnira thomasi* de la Torre and Schwartz, 1966 (Phyllostomidae: Stenodermatinae). Se discute el primer registro geográfico de *Sturnira thomasi* para Colombia, el cual fue reportado por Cuartas-Calle y Muñoz (1999) en base a un único ejemplar. La especie se conoce de dos islas en las Antillas Menores, y se caracteriza por la ausencia del tercer molar inferior, algo también evidente en el ejemplar de Colombia. Se revisa los caracteres morfológicos descritos para *Sturnira*, los cuales permiten identificar esta especie como *S. ludovici*. Al mismo tiempo, se demuestra que la pérdida del tercer molar no es un carácter definitivo para identificar esta especie, dado que dicha pérdida también ocurre, al menos, en *S. ludovici*. En base a esta re-identificación del ejemplar se concluye que *S. thomasi* no está presente en Colombia. Se revisa datos morfológicos y geográficos que soportan nuestras conclusiones.

Palabras clave: Anomalías dentales, Colombia, distribución, morfología, *Sturnira*.

Introduction

The genus *Sturnira* is one of the most specious group of Neotropical bats (McCarthy et al. 2006), reaching its greater diversity over the Andean slopes (Gardner 2008). Its diet is primarily composed by fruits, with preference over those of *Solanum* spp. (Ibañez 1984), and many species have an important role as seed dispersers (Iudica 2000, Loayza and Loiselle 2008). Their principal diagnostic characters include a reduced uropatagium; hypoconid, entoconid, metaconid and paraconid cusps present and usually forming a valley in antero-posterior direction, and shoulder glands (epaulettes) visible in some species. However, due to incomplete or imprecise diagnoses for several species as well as keys depending on variable characters, misidentifications occur among species (see Contreras-Vega and Cadena 2000; McCarthy et al. 2005).

According to Simmons (2005), the following species are recorded for Colombia: *S. arathomasi* Peterson & Tamsitt, 1968; *S. bidens* Thomas, 1915; *S. bogotensis* Shamel, 1929; *S. erythromos* Tschudi, 1884; *S. lilium* E. Geoffroy, 1810; *S. luisi* Davis, 1980, *S. ludovici* Anthony, 1924; *S. magna* de la Torre, 1966; *S. mistratensis* Contreras-Vega & Cadena, 2000; and *S. tildae* de la Torre, 1959. Recently, McCarthy et al. (2006) described *S. koopmanhilli*, a new species partly distributed in Colombian territory, based in the gaps between molars and premolars, P2 longer than P3, lingual cusps of m1 and m2 indistinguishable, and protruding upper and lower incisors. This species, according to McCarthy et al. (2005, 2006) includes the misidentified report of *S. mordax* Goodwin 1938 by Alberico (1994).

S. thomasi de la Torre and Schwartz, 1966, is another species reported for Colombia by Cuartas-Calle and Muñoz (1999), a record based on a

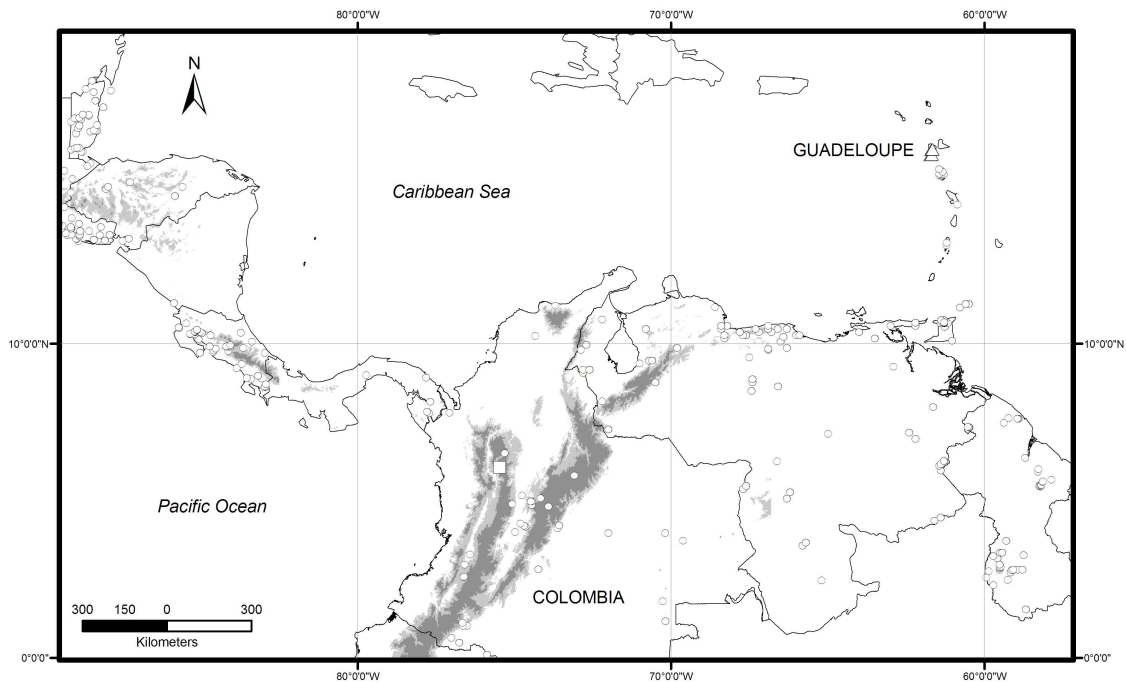


Figure 1. Map showing the known distribution of *S. thomasi* (triangles), the locality of the record of specimen MUA 11109 in the Central Cordillera (square), and the continuous distribution of *S. lilium* (circles) from Lesser Antilles to continental South and Central America (localities were taken from georeferenced records in MaNIS database; Manis 2009).

single specimen from a montane forest of the northern Cordillera Central (Alto de San Miguel, Municipio de Caldas, Departamento de Antioquia) at 2100 masl (Fig. 1). The sole diagnostic character for the identification of the Colombian specimen was the absence of the third lower molar (m3), as well as some concordance with other characters from the original description (de la Torre and Schwartz 1966). This record was not included in the most recent summary for *Sturnira* (Simmons 2005) neither in that for phyllostomid bats from the country (Mantilla-Meluk et al. 2009). *Sturnira thomasi* was known only for the islands of Guadeloupe (de la Torre and Schwartz 1966) and Montserrat (Pedersen et al. 1996, Genoways 1998) in the Lesser Antilles (Fig. 1). Many aspects, including the widely discontinuous geographic distribution (i.e. Lesser Antilles and Colombian highlands), major habitat differences between the semi-arid lowlands of the Antillean islands and the humid forested Colombian Andes, and the excessive weight given to a single character (absence of the third lower molar), prompt us to re-examine the taxonomic status of the single Colombian specimen identified as *S. thomasi* by Cuartas-Calle and Muñoz (1999).

Materials and Methods

The specimen reported by Cuartas-Calle and Muñoz (1999) is deposited at the Colección Teriológica, Universidad de Antioquia, Medellín, Colombia (CTUA) under the acronym MUA 11104. We contrasted the characteristics of this specimen to original descriptions by de la Torre and Schwartz (1966) and Genoways (1998), as well as to digital photos of four specimens of *S. thomasi* deposited in the Mammal Collection of the Natural Science Research Laboratory, Texas Tech University (TTU 19904-19907). Material of *S. ludovici* (n=23; see Appendix I) deposited at the CTUA and the Mammalogy Collection of the Museo de Ciencias Naturales del Colegio San Jose de la Salle (CSJ-M), in Medellín, were revised and compared with specimen MUA 11104, using the morphological characters suggested by Anthony (1924) and Pacheco and Patterson (1991, 1992). Historical records of *S. ludovici* (see Alberico et al. 2000, Contreras-Vega 2000, Muñoz 2001) were also considered to support the presence of this species in Colombia.

We also reviewed the distribution patterns of Antillean bats, as reported by Koopman (1968) and Baker and Genoways (1978), and discuss their

geographic occurrence in Colombian continental territory, with emphasis in *Sturnira* species. Additionally, we analyzed the probable occurrence of dental anomalies in *S. ludovici* and *S. thomasi* and records of this trait for the subfamily Stenodermatinae, because of the taxonomic implications these anomalies may play in their identification, just like it happened in some reports.

Results and Discussion

Taxonomic Analysis

Two lingual cusps patterns are easily differentiable in the first lower molar of *Sturnira* species: a vertical lingual notch present (entoconid, metaconid and paraconid well defined), or a vertical lingual notch absent. Davis (1980) used the term “serrated” for those individuals with a lingual notch present, and “not serrated” for those without it; however, it was Pacheco and Patterson (1991), who recognized it as a synapomorphy (derived state shared by an evolutionary lineage) uniting *S. thomasi* with *S. luisi*, *S. lilium*, *S. aratathomasi*, and *S. tildae*, to the exclusion of the “*ludovici* complex” (without lingual notch, or with “smooth cusps”); a finding later supported by Iudica (2000). This feature was not taken in account by Cuartas-Calle and Muñoz (1999) to support the identification of the single San Miguel’s specimen as *S. thomasi*. Rather, these authors stated, without detailing the evidence, congruence of characters and measurements between published data from five specimens from Guadeloupe and the single San Miguel’s specimen.

When we compare the Colombian specimen (MUA 11104) (Fig. 2) with digital photos of four *S. thomasi* specimens (TTU 19904-19907) from Guadeloupe and the original description, it is clear that a vertical notch is present in all TTU specimens but not in MUA 11104. Although this distinctive trait was not even mentioned in the account of *S. thomasi* by Jones & Genoways (1975), we can state that the Colombian specimen is not even a member of the “well-defined cusps group”, and therefore not a *S. thomasi*. On the other hand, MUA 11104 has a strongly depressed palatal (concave in transversal view), protruding upper central incisors (touching each other at mid point so the tips are usually apart), upper tooth rows subparallel, and a distinct protolophid in m1, all of these traits being diagnostic for *S. ludovici* (Pacheco and Patterson 1991) and consistent with other specimens from different localities along the Central Andes (see Appendix I). However, absence of the third lower molar, which was taken by Cuartas-Calle and Muñoz (1999) as a major diagnostic character for *S. thomasi*, is a trait which

shows variation within the species (Pacheco and Patterson 1991). In our samples of *S. thomasi*, we found abscission of both m3 (TTU 19905, 19907), both m3 present (TTU 19906), and presence of m3 on one side but absence in the other side (TTU 19904; Fig. 2). Clearly, this cannot be considered a reliable diagnostic character for *S. thomasi*, and a combination of characters should be used to identify species in this genus (see Pacheco and Patterson 1991, Giannini and Barquez 2003). In conclusion, our morphological study of specimen MUA 11104 reveals that this represents an atypical (see below) *S. ludovici*, and that *S. thomasi* is absent in Colombia.

The presence of *S. ludovici* in Colombia and, in fact, its distinction as a valid species remains a disputed fact. Koopman (1982) suggested a northern distribution for *S. ludovici* in South America, including the Biogeographic Chocó, the Andes of Ecuador, Colombia and Venezuela, the Caribbean coast, and Guyana. Pacheco and Patterson (1991, 1992) and McCarthy et al. (2005, 2006) take *S. ludovici* as a valid taxon, and so does Iudica (2000). On the contrary, Gardner (2008) relegated *ludovici* to a subspecies of *S. oporaphilum*; therefore the Colombian populations would be *S. o. ludovici*. Alberico et al. (2000), Muñoz (2001), and Simmons (2005), are among the authors who report *S. ludovici* for Colombia, as well as McCarthy et al. (2005, 2006) who examined specimens from southeastern Panama and northwestern Ecuador (near the Colombian border).

We follow the arguments provided by Pacheco and Patterson (1991, 1992), Iudica (2000), and McCarthy et al. (2005), accepting *S. ludovici* as a valid species. However, a strict taxonomic review is urgently needed in order to clarify the specific status of *S. ludovici*, *S. oporaphilum* and *S. hondurensis* (as suggested by Iudica 2000). Its presence in Colombia is documented by many historical reports. Hershkovitz (1949) made the first Colombian record, based on specimens from Sierra del Perijá (Norte de Santander). Thereafter, additional records have been made from several localities, including Bogotá, Cundinamarca Department (Tamsitt and Valdivieso 1963, Tamsitt et al. 1964), Puente Nacional, Santander Department (Tamsitt and Valdivieso, 1963), Cauca and Valle del Cauca departments (Aellen 1970), and Parque Nacional Natural Cueva de los Guacharos, Huila Department (Lemke et al., 1982). In addition, Alberico et al. (2000) and Contreras-Vega (2000) reported the species for Boyacá, Huila, Meta, Nariño, Risaralda, and Vaupes departments. In general, almost all published records (see Appendix I) for *S. ludovici* in Colombia come from elevations above 1200 m.



Figure 2. Dorsal view of skull and occlusal view of mandible of specimen MUA 11104 (top), from San Miguel, Colombia, reported as *S. thomasi* by Cuartas-Calle and Muñoz (1999), and TTU 19904 (bottom), a *S. thomasi* from Montserrat, Lesser Antilles (scale bar = 5 mm). Note the vertical notch of the first lower molar (absent in MUA 11104, present in TTU 19904), and a third lower molar (lost in both sides of MUA 11104, but absent in right tooththrow, and present in left tooththrow of TTU 19904). Photo of TTU 19904 taken by H. Garner.

Geographic Analysis

Sturnira thomasi was originally described from the Lesser Antilles, and until now all records are confined to two islands (Guadaloupe and Monserrat). The common presence of bat species in the continental territory and the Lesser Antilles has been suggested to represent dispersal processes originated in northern South America (Koopman 1968, Baker and Genoways 1978), but this appreciation was proven wrong by Genoways (1998). In addition, among the species occurring in the Lesser Antilles and northern South America (with a few reaching the Colombian Andes; Fig. 1), some show geographic differentiation (i.e., subspecies) along the islands, such as *Artibeus jamaicensis*, *Glossophaga longirostris*, *S. lilium*, and *Pteronotus davyi*, whereas others like *Anoura geoffroyi*, *Dermanura glauca*, and *Molossus molossus*, show no distinguishable population at all. In the case of *Sturnira lilium*, its range goes throughout the Lesser Antilles and most of Central and South America with well defined subspecies, specially along the islands (Genoways 1998, Gardner 2008), whereas no specimen record exists

connecting those for Guadaloupe and Monserrat islands with the one of *S. thomasi* from the Central Cordillera of Colombia. In addition, the altitudinal range of *S. thomasi* on those islands goes between 350-1000 m, against 2100 m of the Colombian record, and the habitat differences are equally marked between these two regions (see Jones and Genoways 1975).

Molar abscission in *Sturnira*: Causes and implications

Although absence of lower molars is considered a valid systematic character (e.g., Wetterer et al. 2000), few studies have explained its ontogenetic development (see Kavanagh et al. 2007). Abscission of third molar results in complete absence of tooth, without alveoli vestiges; which is differentiated from pathologic loss (traumatic origin) because of traces of the alveoli in closing process. According to Rui and Drehmer (2004), third molar abscission could occur by pressures during the ontogeny, thus indicating a trend to the reduction and posterior loss of the tooth.

Table 1. External (forearm) and craniodental measurements for specimens of *S. thomasi* and *S. ludovici*; measurements follow Genoways (1988). Data taken from de la Torre and Schwartz (1966) for the holotype of *S. thomasi*, and from Genoways (1988) for the single specimen of Montserrat and two of Guadeloupe. Data for the Colombian *S. thomasi* (MUA 11104; here re-identified as *S. ludovici*) and two *S. ludovici* (MUA 11315, 11333) from the same locality were taken by the senior author to the nearest 0.001 mm.

	<i>S. thomasi</i> (Holotype)	<i>S. thomasi</i> Montserrat	<i>S. thomasi</i> Guadeloupe	<i>S. ludovici</i> MUA 11104 Colombia	<i>S. ludovici</i> Colombia
Length of Forearm	48.1	44.7	46.1 – 47.7	46.65	46.2 – 46.9
Greatest length of skull	26.2	24.9	24.9 – 25.1	23.79	23.9 - 24.3
Condylbasal length	24.7	23.3	22.9 – 23.6	21.62	22.1 - 22.7
Zygomatic breadth	12.7	11.6	12.2 – 12.5	12.50	12.2
Mastoid breadth	12.1	10.9	11.7 – 11.8	12.16	12.7 – 13.6
Breadth of braincase	--	9.3	9.6 – 9.8	10.79	10.6 - 10.8
Breadth of interorbital constriction	6.3	5.8	5.9 – 6.0	6.39	6.5 – 6.6
Breadth of postorbital constriction	6	5.8	5.5 – 5.9	5.89	6.4 – 6.6
Length of maxillary toothrow	7.7	7.3	6.9 – 6.9	7.03	6.6 – 6.7
Breadth across upper molars	--	7.6	8.0 – 8.0	8.47	8.3 – 8.4
Length of mandibular toothrow	7.8	8.4	7.7 – 7.8	7.58	7.3 – 7.5

From the above, we can state that the Colombian specimen (MUA 11104), represents the first report of molar agenesis in *S. ludovici*. This particular dental anomaly has been described for bats of the genus *Artibeus* (Rui and Drehmer 2004) which, along with *Sturnira*, belongs to the subfamily Stenodermatinae. Therefore, it could be argued that the Colombian specimen of *S. ludovici* lacking the third lower molar represents an example of atavism, which is a trait present in more distant ancestral lineages but may appear in low frequency in some individuals within a population (Hall 1984). All the basic characteristics that allow recognizing this atavism are present in *S. ludovici* specimen: the individual is an adult specimen (all cranial sutures are developed), third molar abscission in the genus is seldom reported (so far only for *S. thomasi*), and its occurrence in *Artibeus* (Rui and Drehmer 2004) suggests its presence in a Stenodermatinae ancestor. Finally, there was no other individual with this condition among the other five specimens of *S. ludovici* collected at this locality (San Miguel; MUA 11310, 11315, 11333, 11334, 11354). In Table 1, measurement of the San Miguel's specimens are compared to published records of Antillean *S. thomasi* and Colombian *S. ludovici*; although the

Colombian individuals are very similar, there is no single measurements to separate *S. ludovici* from *S. thomasi*.

Conclusions

After checking and comparing the specimen MUA 11104, originally reported as the first record of *S. thomasi* in Colombia (Cuartas-Calle and Muñoz 1999), we found the specimen actually represents a *S. ludovici* with third molars abscission. *Sturnira ludovici* has a wide distribution range in the country, and additional individuals (four) were collected at the same locality during that sampling. The remaining morphologic traits associated with *S. ludovici* (see above) are consistent with the ones presented by MUA 11104. This fact reminds us that a careful study of morphologic and morphometric characters must be taken in account for a complete review of this genus and its species in Colombia.

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research. Staff of the library “Mi Rio” (Medellin) allowed access to unpublished reports of field collections by Cuartas. Finally, we acknowledge the Colección Teriológica, Universidad de Antioquia (CTUA, Medellin) and the Collection of the Museo de Ciencias Naturales del Colegio de San Jose (CSJ- M, Medellin) and its curator Danny Zurc for the facilities to review specimens and for access to associated information.

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APPENDIX I

Specimens examined in this study, with their respective localities.

Sturnira ludovici.- COLOMBIA (23):
Antioquia: Municipio de Caldas, Alto de San Miguel (MUA 11104, 11315, 11332, 11333, 11354); Municipio de Amalfi, Quebrada la Cancana (CSJ-M 061, 062); Municipio de Urao, Rio Calles (CSJ-M 521, 523-528; MUA 10752-10754, 10756, 10758, 10760, 10778), Puerto Triunfo, El Refugio (MUA 10346). *Caquetá*: Municipio de Florencia, Cristalina (MUA 10889).

Sturnira thomasi (Pictures).- GUADELUOPE (4): Base-Terre, 2 km E. Saint-Claude (TTU: 19904), Base-Terre, 1km W Vernou (TTU: 19905, 19906), Base-Terre, 1km S, 4 km W Vernou (19907).