



New record of *Myotis ciliolabrum* (Merriam, 1886) (Mammalia, Chiroptera) from the State of Mexico, Mexico

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Abstract. *Myotis ciliolabrum* (Merriam, 1886) is an insectivorous bat of the family Vespertilionidae and has a wide distribution from British Columbia, Alberta, and Saskatchewan in Canada, most of the western and central United States of America to central Mexico. In this study, we report one of the southernmost records from State of Mexico, based on two females collected in 1980 and stored in the Mammals Collection of the Universidad Autónoma Metropolitana. These records increases the knowledge on the distribution of this rare bat in Mexico.

Key words. Bats, Chiroptera, geographic distribution, Vespertilionidae, Western Small-footed Myotis

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INTRODUCTION

Myotis ciliolabrum (Merriam, 1886) is an insectivorous bat of the family Vespertilionidae and is endemic to North America (Hall 1981; Simmons 2005; Holloway and Barclay 2001; Ammerman et al. 2016). It is morphologically distinguished from other North American *Myotis* Kaup, 1829 species by its small size (length of forearm generally <34 mm), the length of the hind foot is small (<½ length of the tibia), the calcar is keeled, and the dark wings, ears, and face contrast strongly with the yellowish-brown dorsal region (Holloway and Barclay 2001; O'Shea et al. 2018). Beyond their insectivorous habit, little is known about the feeding habits, ecology, natural history, or geographic distribution limit (Holloway and Barclay 2001), especially in the southernmost part of its distribution in Mexico, where, until now, it was considered to be a rare species, with few localities recorded and few specimens available for study in scientific collections (Godínez Álvarez 2005).

This taxon has variously been accepted as either a separate species or a subspecies and of its sister species, *Myotis californicus* (Audubon & Bachman, 1842) and *Myotis leibii* (Audubon & Bachman, 1842), due to similar morphology and differing geography variation (Van Zyll de Jong 1984; Holloway and Barclay 2001; Ammerman et al. 2016). This bat also has nomenclatural problems that directly affect the recognized name of the species, but not the distribution of this species in Mexico (Verts and Carraway 1998; Holloway and Barclay 2001). Four scientific names have been used Western Small-footed Myotis, *M. ciliolabrum*, *M. leibii*, *M. melanorhinus*, and *M. subulatus* (Holloway and Barclay 2001), but based on the proposal by Van Zyll de Jong (1984), the name of the species has remained relatively stable as *M. ciliolabrum* with two subspecies, *M. ciliolabrum ciliolabrum* (Merriam, 1886) and *M. ciliolabrum melanorhinus* (Merriam, 1890), although several authors consider these subspecies as different species (Simmons 2005; Ramírez-Pulido et al. 2014).

In addition to nomenclatural and taxonomic problems, perhaps the main problem is the identification of *M. ciliolabrum* because it is easily confused with *M. californicus* (Holloway and Barclay 2001; O'Shea et al. 2018), as shown by the number of misidentifications in scientific collections (Watkins et al. 1972; López-Wilchis et al. 1994). Despite their slight genetic divergence (Rodríguez and Ammerman 2004; Stadelmann et al. 2007; Ammerman et al. 2016; Platt et al. 2018), these species can be distinguished by their echolocation (O'Farrell et al. 1999; Gannon et al. 2001), external characteristics (Constantine 1998; Gannon et al. 2001), and morphological measurements (Bogan 1974; Van Zyll de Jong 1985), including cranial measurements (Bogan 1974; Van Zyll de Jong 1985; Verts and Carraway 1998).

Myotis ciliolabrum is found in western North America, from British Columbia, Alberta, and Saskatchewan in Canada, through most of the western and central United States of America, to central Mexico. In



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Mexico the species' distribution is limited to the Mexican Altiplano in the western Sierra Madre Oriental and eastern Sierra Madre Occidental, to the southern record in Zacatecas (Holloway and Barclay 2001; Rodríguez and Ammerman 2004; Simmons 2005). Although this distribution is frequently represented in the literature, there are additional records in southern Mexico, in the states of Tlaxcala (López-Wilchis et al. 1994), Puebla (Polaco et al. 1992), and Michoacán (Villalpando and Alvarez 2000), which have been overlooked in the literature. Here, we report one of the southernmost records of *M. ciliolabrum* (Figure 1), which adds to knowledge on the distribution of this uncommon species in Mexico.

METHODS

In a routine review of the Mammal Collection of the Universidad Autónoma Metropolitana, Unidad Iztapalapa (UAMI), we found two specimens of *Myotis ciliolabrum* erroneously identified as *M. californicus*. These are adults because the union of the metacarpals and phalanges are completely ossified (Van Zyll de Jong 1985).

For taxonomic identification, descriptions, and comparisons, we used several references, including Bogan (1974), Van Zyll de Jong (1985), Simpson (1993), Constantine (1998), Rodríguez and Ammerman (2004), and Álvarez-Castañeda et al. (2017). We obtained data on sex, collection date, weight, location, collector's name, and somatic measurements (including total length, head and body, hind legs, and length of the ear) from the tag of each specimen.

External and cranial measurements were taken with digital vernier calipers (Mitutoyo; with 0.01 mm precision) following Van Zyll de Jong (1985) and Constantine (1998): total length (TL), length of tail (LT), length of foot (LF), length of ear (LE), length of forearm (LFO), greatest length of skull (GLS), length of maxillary toothrow (LMT), condyle-premaxillary length (CPL), condylocanine length (CCL), length of P4–M3 series (LPM), cranial breadth (CRB), mastoid breadth (MAB), least interorbital breadth (LIB), rostral breadth at M1–M2 (ROB), rostral breadth across canines (ROC), cranial depth (CRD), and height of coronoid process (HCP).

RESULTS

Myotis ciliolabrum melanorhinus (Merriam, 1890)

Figure 2

Myotis subulatus melanorhinus—Hall and Kelson 1959; Hall 1981.

Myotis leibii melanorhinus—Glass and Baker 1965.

Myotis ciliolabrum melanorhinus—Van Zyll de Jong 1984.

Myotis melanorhinus—Simmons 2005; we maintain the taxon as *M. c. melanorhinus*; see discussion by Ammerman et al. (2016) and O'Shea et al. (2018).

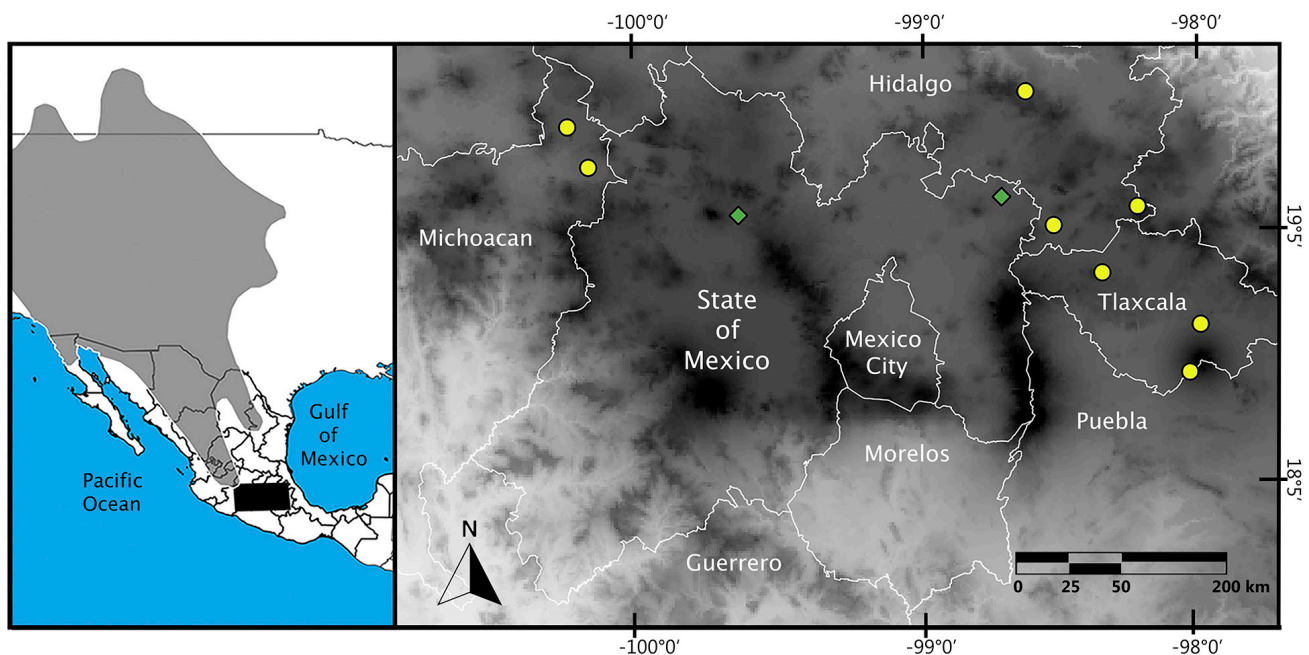


Figure 1. Distribution of *Myotis ciliolabrum*. **A.** Geographic distribution of *M. ciliolabrum* in North America (adapted from Holloway and Barclay 2001; Rodríguez and Ammerman 2004; Simmons 2005). **B.** Localities of specimens identified as *M. ciliolabrum* in the southernmost areas of its geographical distribution. Diamonds = new records from the State of Mexico; circles = localities of the neighboring states (see Polaco et al. 1992; López-Wilchis et al. 1994; Villalpando and Álvarez 2000).

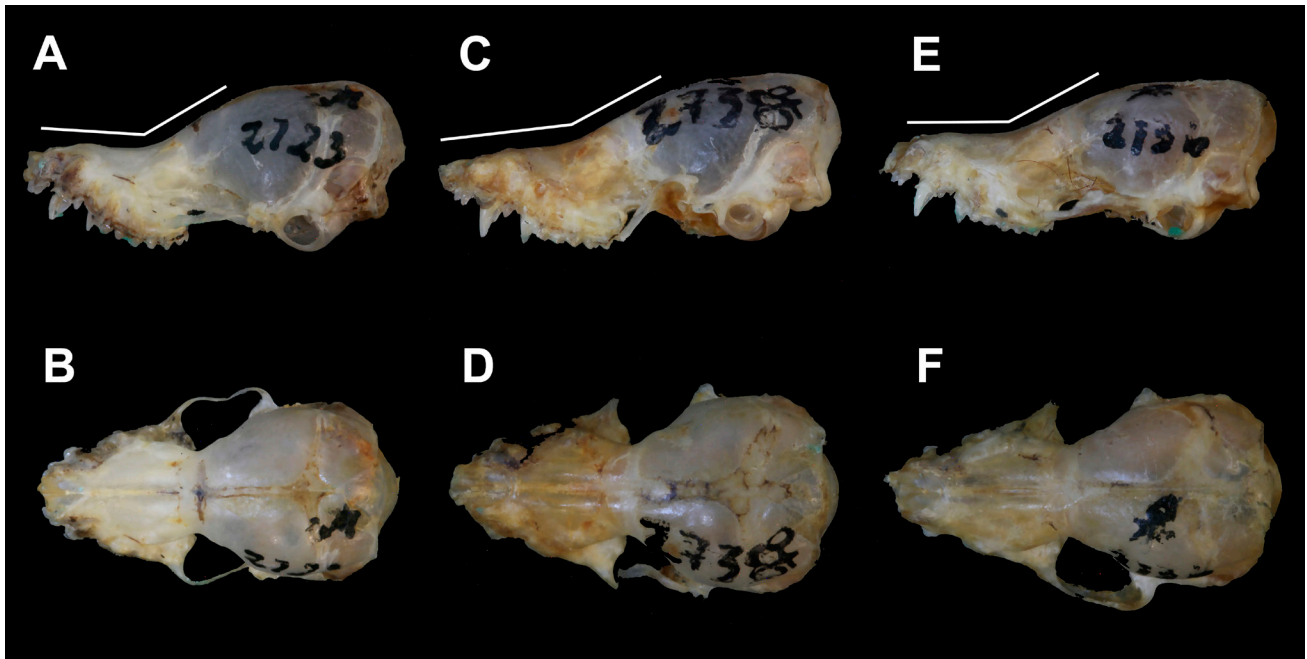


Figure 2. Comparisons of lateral and dorsal view of skull of *Myotis californicus* and *M. ciliolabrum* from the State of Mexico. **A, B.** *M. californicus* (2723 UAMI). **C, D.** *M. ciliolabrum* (2738 UAMI). **E, F.** *M. ciliolabrum* (2736 UAMI). See Table 1 for measurements and morphometric differences.

New records. MEXICO – Estado de México • Ex-Hacienda Xala, 8 km N, 2 km E Otumba; 19°45'22"N, 098°39'03"W; 3085 m alt.; 11.III.1980; G. Ceballos G. leg. (collector number 248); 1 ♀; adult, skull, and skin (UAMI 2736) • 11 km W, 3 km N Tepotzotlán; 19°44'17"N, 099°40'03"W; 2380 m alt.; 29.V.1980; C. Galindo L. leg. (collector number 116); 1 ♀; adult, skull, and skin (UAMI 2738).

Identification. The examined specimens can be identified as belonging to the *leiibil/ciliolabrum/californicus* group by their small size, with length of forearm (normally <34 mm), by the small hind foot (<7 mm and <1/2

Table 1. Summary of morphological measurement of the *Myotis ciliolabrum* (2736 UAMI, 2738 UAMI) and three specimens of *M. californicus* from the State of Mexico. For abbreviations see Methods. All measurements are in millimeters.

Measurement	<i>M. ciliolabrum</i>		<i>M. californicus</i>
	UAMI 2738	UAMI 2136	UAMI 14850, 2722, 2723
TL	84	85	(77.0–84.0)
LT	39	37	(36.0–38.0)
LF	5	6	(6.0–7.0)
LE	14	13	(12.0–14.0)
LFO	33.6	35	(32.5–34.1)
GLS	13.7	14.1	(12.7–13.3)
LMT	5.2	5.2	(4.7–5.2)
CPL	13.4	13.3	(11.4–12.4)
CCL	12.3	12.6	(11.3–11.9)
LPM	3.6	3.9	(3.3–3.7)
CRB	7.3	7.1	(6.5–6.7)
MAB	7.3	7.2	(6.4–6.9)
LIB	3.4	3.6	(3.3–3.5)
ROB	5.7	5.4	(5.0–5.4)
ROC	3.7	3.5	(3.2–3.6)
CRB	5.8	5.8	(5.3–5.9)
HCP	3.1	3.2	(2.6–2.8)

length of the tibia), and a typically keeled calcar (Miller and Allen 1928; Van Zyll de Jong 1985; Verts and Carraway 1998; Alvarez-Castaneda et al. 2017). Cranially *M. ciliolabrum* differs from *M. californicus* by the angle formed between the rostrum and the frontal of the skull, which is visibly less pronounced (Figure 2). Externally, the ears, facial mask, and wing membranes of our specimens are black, which strongly contrasts with the pale dorsal hair and therefore different than in *M. californicus*, which is usually darker in color. In addition, when comparing some morphometric measurements (Table 1), those of *M. ciliolabrum* are larger, mainly in the greatest length of skull (GLS), condyle–premaxillary length (CPL), condylocanine length (CCL), cranial breadth (CRB), mastoid breadth (MAB), and height of coronoid process (HCP). The coloration, rostrum shape, and measurements of these specimens are clearly different, and they separate *M. ciliolabrum* from the sister and sympatric *M. californicus* (Bogan 1974; Van Zyll de Jong 1985; Constantine 1998).

DISCUSSION

The bats of the Mexican State of Mexico have been studied for many years (Herrera 1890; Villa-Ramírez 1953). This state is one of the most intensively sampled regions in Mexico (Ramírez-Pulido et al. 1995) and several lists of mammals have been published that include bats of this region (Ramírez-Pulido et al. 1995; Ramírez-Pulido et al. 1997; Chávez and Ceballos 1998; González-Ruiz et al. 2004; Chávez et al. 2009). The presence of *Myotis ciliolabrum* in the State of Mexico has been reported in the literature until now. Our records are the first from the State of Mexico, although this species has already been reported in the neighboring states of Michoacán, Hidalgo, Tlaxcala, and Puebla (Polaco et al. 1992; López-Wilchis et al. 1994; Villalpando and Álvarez 2000). Godínez Álvarez (2005) mapped the distribution of *M. ciliolabrum* further south in Michoacán and Guerrero. However, there are no confirmed records of this species in Guerrero (Lukens and Davis 1957; Almazán-Catalán et al. 2009), Morelos (Davis and Russell 1952, 1954; Álvarez-Castañeda 1996), or southern Michoacán, although there are confirmed records from northern Michoacán (Villalpando and Álvarez 2000; Wang et al. 2003; Núñez Garduño 2005; Monterrubio-Rico et al. 2014). Additionally, there is a lack of distributional records from other regions in southern Mexico (Ramírez-Pulido et al. 1986, 1990, 1994, 2000, 2017), and until now the distribution of *M. ciliolabrum* in southern Mexico has not been confirmed. Therefore, the present records represent the southernmost limit of the known range of *M. ciliolabrum*, and, together with the other records mentioned, confirms that this species has its southern limits in the foothills of the Transversal Neovolcanic Belt (TNB) and not Zacatecas, as has often been represented in the literature (Holloway and Barclay 2001; Rodríguez and Ammerman 2004; Simmons 2005).

The specimens examined were collected in tall xerophytic brush with an abundance of prickly pear (*Opuntia* sp.), maguey (*Agave* sp.), and mesquite (*Prosopis* sp.), with isolated individuals of *Juniperus*. These semi-arid places are common habitats for *M. ciliolabrum* (Holloway and Barclay 2001).

An exhaustive review of the specimens deposited in scientific collections is highly desirable, especially those identified as *M. californicus* with which *M. ciliolabrum* is frequently confused. With such a review, misidentified specimens might be “rediscovered” and, thus, improve our understanding of the distribution and habitat of *M. ciliolabrum*, which would be beneficial for assessing the conservation status of this species in Mexico and allow for better conservation plans to be developed. Despite its wide geographical distribution in western North America, *M. ciliolabrum* should be considered a rare species in Mexico where relatively few occurrence data are known.

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ADDITIONAL INFORMATION

Conflict of interest

The authors declare that no competing interests exist.

Ethical statement

No ethical statement is reported.

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Author contributions

Conceptualization: NGR, JRP, DFGM. Formal analysis: EN, NGR, JRP, ASM, ACC, DFGM. Funding acquisition: NGR, JRP. Writing – original draft: EN, NGR, JRP, ASM, ACC, DFGM. Writing – review and editing: NGR, JRP, DFGM.

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Data availability

All data that support the findings of this study are available in the main text.

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