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Myotis ciliolabrum.

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Myotis ciliolabrum (Merriam, 1886)

Western Small-footed Myotis

Vespertilio ciliolabrum Merriam, 1886:2. Type locality "about 1 mi. from Castle Rock, near Banner, Trego County, Kansas."
V[espertilio] nitidus henshawi Allen, 1893:103. Type locality "near [Ft.] Wingate, New Mexico."
Myotis orinomus Elliot, 1903:228. Type locality "La Grulla, 8000 ft., Sierra San Pedro Martir, Baja California."
Myotis subulatus Miller and Allen, 1928:164. Type locality "vic. Jct. Arkansas River and Apishapa Creek, Colorado."
Myotis leibii Glass and Baker, 1965:205. Type locality "Erie Co., Ohio."
Myotis ciliolabrum van Zyll de Jong, 1984:2519. First use of current name combination.

CONTEXT AND CONTENT. Order Chiroptera, suborder Microchiroptera, family Vespertilionidae, subfamily Vespertilioninae, genus *Myotis*, subgenus *Selysius*, *leibii* group (Findley 1972). Two subspecies are recognized (van Zyll de Jong 1984):

M. c. ciliolabrum Merriam, 1886:2, see above.
M. c. melanorhinus Merriam, 1890:46. Type locality "Little Spring, North base of San Francisco Mountain, Coconino County, Arizona," altitude 8,250 feet (*henshawi* and *orinomus* are synonyms).

DIAGNOSIS. *Myotis ciliolabrum* (Fig. 1) is distinguished by its short hind feet (<one-half the length of the tibia), distinctly keeled calcar, black wing membranes, ears and face contrasting with paler fur elsewhere, and small size (length of forearm generally <34 mm—Findley 1972; van Zyll de Jong 1985). *M. ciliolabrum* is most similar to *M. leibii* and *M. californicus*, but is sympatric only with the latter (Hall 1981). Fourteen cranial and dental characteristics in canonical variate analysis showed 3 nonoverlapping, distinct clusters representing the 3 species within the *leibii* group (van Zyll de Jong 1984). *M. ciliolabrum* differs from *M. californicus* in having a less steeply sloping frontal area of the cranium (van Zyll de Jong 1985); a flatter, broader skull (Miller and Allen 1928); larger hindfoot; and greater rostral breadth (Bogan 1974). Externally, *M. californicus* lacks a black facial mask (black snout and facial hair—van Zyll de Jong 1985) and is generally darker in color. In British Columbia, the 2 species were distinguished in the field by distance from tip of nostrils to hairline, which is greater in *M. ciliolabrum* (1.5 times width between nostrils) than in *M. californicus* (equal to width between nostrils—van Zyll de Jong 1985; Woodsworth 1981). In San Bernadino Co., California, *M. ciliolabrum* has an exserted, sharply tapered tail tip extending 1.5–2.5 mm beyond border of uropatagium, whereas tip of last vertebra of *M. californicus* is continuous with border of uropatagium (Constantine 1998). *M. leibii* has a flatter cranium, and dorsal pelage has a distinct golden sheen (van Zyll de Jong 1985). None of the skull characteristics previously used or cluster analysis of 16 skull characters distinguished specimens of *M. ciliolabrum* and *M. californicus* from Oregon (Verts and Carraway 1998).

GENERAL CHARACTERISTICS. The western small-footed myotis is of small size (length of forearm generally <34 mm; mass ca. 4.5 g—van Zyll de Jong 1985; Verts and Carraway 1998). Ears are relatively long (11–16 mm), reaching or exceeding tip of snout by ca. 1 mm when laid forward. Tragus is slender, tapering, and ca. one-half as long as ear (Miller and Allen 1928). Extreme tip of tail is free in some specimens, extending 1.5–2.5 mm beyond tapered adjacent halves of uropatagium (Constantine 1998). Foot is small (<9 mm) and less than one-half as long as tibia. Calcar has a distinct keel. Muzzle and chin are black, forming a black face mask (Miller and Allen 1928). Ears and tragus are blackish, and sides of face from muzzle to ears are blackish brown. Fur extends slightly onto tail membrane below body (Hall 1981). *M. c. ciliolabrum* is pale, flaxen above, and nearly white below, whereas *M. c. melanorhinus* is a richer, less pallid, yellow, with buff underparts (Miller and Allen 1928; van Zyll de Jong 1985). The western small-footed myotis has slight sexual dimorphism, with females generally larger than males (Hall 1946). In Nevada, nonpregnant females weighed 4.7 g (range, 3.3–5.9; $n = 5$), whereas males averaged 4.0 g (range, 3.5–4.7; $n = 10$—Hall 1946). Pregnant females can weigh up to 7 g (Jones et al. 1983).

Specimens of *M. ciliolabrum* are larger in the southern United States than in the northern United States or Canada (van Zyll de Jong 1985). Average external measurements (in mm; range in parentheses; $n = 34$) from New Mexico were: total length, 89.1 (80–99); length of tail, 41.5 (37–49); length of hind foot, 7.7 (6–9); length of ear, 14.7 (12–16); and length of forearm, 33.5 (31.28–35.77—Bogan 1974). Average skull (Fig. 2) dimensions (in mm; range in parentheses; $n = 20$) from Arizona were: greatest length of skull, 14.4 (13.5–14.7); mastoid width, 7.32 (6.97–7.57); least interorbital breadth, 3.20 (3.04–3.45); cranial depth, 4.70 (4.35–4.91); length of maxillary toothrow, 5.60 (5.43–5.81); and maxillary width at M3, 5.56 (5.25–5.81—Hoffmeister 1986). Measurements (in mm) of 4 male and 10 female *M. ciliolabrum*, respectively, from

FIG. 1. *Myotis ciliolabrum* from southeastern Alberta. Photograph by Robert Barclay.

FIG. 2. Dorsal, ventral, and lateral view of skull and lateral view of mandible of *Myotis ciliolabrum*. (Provincial Museum of Alberta, Z79.125.76 female, from Dinosaur Provincial Park, Alberta, Canada). Greatest length of skull 14.5 mm. Photographs by Gerald Newlands.

Oregon were: total length, 79 (75–86), 83 (78–91); length of tail, 39 (33–46), 39 (35–45); length of ear, 14 (12–16), 14 (12–16); length of forearm, 29.7 (23.4–33.0), 31.9 (29.6–33.6); condylobasal length, 13.5 (13.2–13.8), 13.5 (13.1–13.9); least interorbital breadth, 3.21 (3.15–3.27), 3.15 (3.04–3.30); zygomatic breadth, 8.17 (7.91–8.43), 8.12 (7.80–8.49); breadth of braincase, 6.59 (6.42–6.80), 6.53 (6.30–6.76); mastoid width, 6.80 (6.71–6.97), 6.83 (6.51–7.17); and length of mandible, 9.29 (9.18–9.48), 9.29 (8.94–9.74—Verts and Carraway 1998). Mean and parenthetical range measurements (in mm) of specimens from Canada (n = 19–52 for external characters; n = 40 for skull measurements) were: total length, 84.9 (76–90); length of tail, 39.2 (31–43); length of hind foot, 6.5 (6–7); length of ear, 13.8 (13–15); length of forearm, 32.2 (30–33); length of skull, 13.7 (13.0–14.5); mastoid width, 7.0 (6.8–7.4); least interorbital breadth, 3.2 (3.0–3.5); cranial depth, 4.5 (4.1–4.7); length of maxillary toothrow, 5.2 (4.8–5.5); and maxillary width at M3, 5.3 (5.0–5.6—van Zyll de Jong 1985).

DISTRIBUTION. *Myotis ciliolabrum* occurs in western North America, ranging from British Columbia, Alberta, and Saskatchewan, Canada, to Chihuahua, Coahuila, and Zacatecas, Mexico (Fig. 3; Hall 1981). The western small-footed myotis does not occur along the Pacific coast of Washington, Oregon, and most of California, and ranges from 300 to 3,300 m (Nagorsen and Brigham 1993; Swenson 1970). *M. ciliolabrum* and *M. leibii* both occur in Oklahoma, with the latter restricted to the eastern part of the state and the former only in the west (Hall 1981). Three specimens were caught near Tlaxco, Tlaxcala, Mexico, extending the range 148 km east and 103 km south from previous records (López-Wilchis 1999; López-Wilchis et al. 1994). No specimens have been reported between the former range limit in Zacatecas and Tlaxcala, suggesting that the southern specimens may belong to a disjunct population. The northern range limit also has been extended (Nagorsen and Brigham 1993).

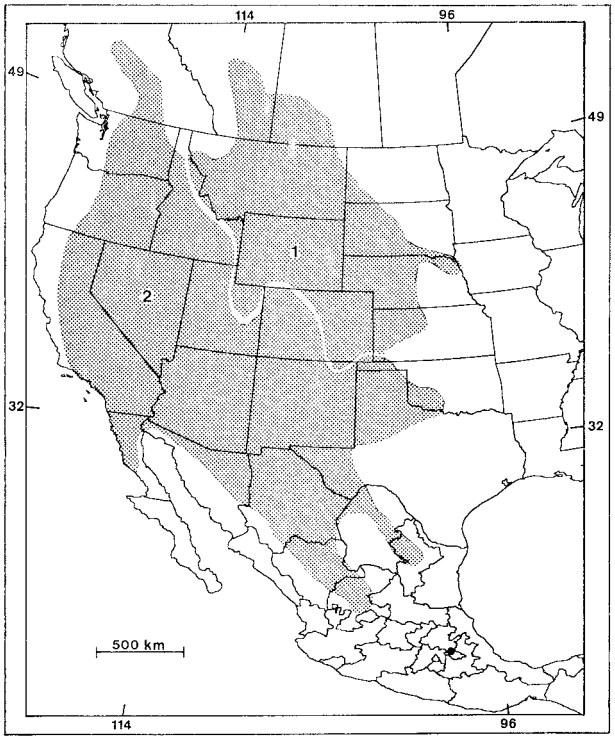

FIG. 3. Geographic distribution of *Myotis ciliolabrum* in North America (adapted from Hall 1981): 1, *M. c. ciliolabrum*; 2, *M. c. melanorhinus*. Dot represents range extension from López-Wilchis et al. (1994).

FOSSIL RECORD. Fossil remains of *M. ciliolabrum* occur in late Pleistocene deposits in a cave in Wyoming (Kurtén and Anderson 1980).

FORM AND FUNCTION. *Myotis ciliolabrum* has a low aspect ratio and low wing loading. Farney and Fleharty (1969) gave the wing span as 242 mm; wing area, 0.0083 m^2; tail area, 0.0015 m^2; aspect ratio, 7.0; and wing loading, 6.5 N/m^2, whereas Norberg and Raynor (1987) recalculated these values using a different method (wing area, 0.0096 m^2; aspect ratio, 6.1; wing loading, 6.7 N/m^2). Baculum is saddle-shaped, concave ventrally, with a dorsal prominence posterior to midpoint (van Zyll de Jong 1984). *M. ciliolabrum* has relatively poor urine concentrating ability, but similar to that of bats such as *M. lucifugus* taken from mesic habitats (Geluso 1978). Urine concentration of *M. ciliolabrum* (3,170 mOsmol/kg) is lower than that of *M. californicus* (3,560 mOsmol/kg). *M. ciliolabrum* regulates water loss behaviorally by selecting enclosed roosts and roosting communally (Bassett 1986). Percent mass loss of individual *M. ciliolabrum* held in cages in their natural roost sites more than 12 h was 6.4%, compared with 10.5% percent for *M. lucifugus* and 15.8% for *M. thysanodes* (Studier et al. 1970). Dental formula is: i 2/3, c 1/1, p 3/3, m 3/3, total 38 (Nagorsen and Brigham 1993). Western small-footed myotis masticate their food to a fine degree (Jones et al. 1973).

ONTOGENY AND REPRODUCTION. Parturition dates vary across the geographical range of the western small-footed my-

otis. In late May, 4 female *M. ciliolabrum* with dependent young were found in California (Koford and Koford 1948). Both lactating and pregnant females were caught in late June in British Columbia (Fenton et al. 1980). In New Mexico, pregnant females were captured throughout June, and lactating females were captured in late June and most of July (Findley et al. 1975). Pregnant females have been reported well into July in Nevada (Hall 1946), and 7 lactating and 2 postlactating females were found in late July in South Dakota (Tuttle and Heaney 1974).

Myotis ciliolabrum generally has 1 young per litter (Findley et al. 1975; Hall 1946; Koford and Koford 1948), although an incident of twinning was noted in South Dakota (Tuttle and Heaney 1974). In California, a female gave birth to a dead young 20 mm long (Koford and Koford 1948). Mass of a neonate in British Columbia was 1.1 g with a forearm length of 12.4 mm (Holroyd et al. 1994). Tuttle and Heaney (1974) noted the condition and flight abilities of several juveniles of various ages in South Dakota. The smallest juvenile recorded weighed 1.6 g, had a forearm length of 14.5 mm, and had no body fur. Six juveniles with forearm lengths of 14.5–24.5 mm were nonvolant. Juveniles with forearm lengths of 27.0–30.0 mm could maintain flight briefly. Only a subadult with a forearm length of 31.0 mm was volant.

In Alberta, a breeding male was caught in late August (Schowalter and Allen 1981). Testes were 1.8 mm long, and cauda epididymidis was 6.0 mm long. No subadult male was in breeding condition, as evidenced by their considerably shorter cauda epididymides (mean = 2.0 mm, $n = 16$). Subadults also weighed considerably less than adult males (subadults: mean = 4.5 g, $n = 8$; adults: mean = 6.0 g, $n = 5$).

ECOLOGY. *Myotis ciliolabrum* is common in arid desert, badland, and semiarid habitats, although higher elevation, more mesic habitats are used in the southern part of the range (Barclay 1993; Dalquest 1948; Findley et al. 1975; Larrison and Johnson 1981). In British Columbia, the western small-footed myotis occurs in dry interior valleys to 850 m (Nagorsen and Brigham 1993), whereas in southeastern Alberta it is common in riparian zones in badland and grassland areas (Holloway and Barclay 2000; Smith 1992). In Washington, western small-footed bats are found in rocky or sandy areas, far from trees (Dalquest 1948). *M. ciliolabrum* is relatively common in piñon (*Pinus edulis*)–juniper (*Juniperus*) forests in New Mexico (Chung-MacCoubrey 1996) and Great Basin desert scrub and piñon–juniper forest (1,000–2,740 m) in California (Szewczak et al. 1998). Several individuals were collected in deciduous and conifer timbers in Nebraska (Jones 1964), and in Arizona the western small-footed myotis is most common in yellow pine (*Pinus*) zones (Findley et al. 1975).

Myotis ciliolabrum feeds on a variety of flying insects, particularly Lepidoptera, but also Diptera, Hemiptera, and Coleoptera (Jones et al. 1973; Warner 1985; Whitaker et al. 1981; Woodsworth 1981). In British Columbia, western small-footed bats also ate Trichoptera (Woodsworth 1981).

Myotis ciliolabrum primarily roosts in rock crevices, caves, and tunnels (Armstrong 1972; Koford and Koford 1948; Quay 1948; Tuttle and Heaney 1974), but also roosts in abandoned nests of swallows (Merriam 1886) and under loose pine bark (Jones 1964). In South Dakota, 12 diurnal roosts were in horizontal fractures in boulders, crevices in vertical stream banks, and water erosion crevices in the ground (Tuttle and Heaney 1974). Crevice roosts averaged 6.5 cm in depth (range, 2.5–20.5 cm). The shallowest roosts only received a few hours of direct sunlight, whereas the deepest roost received direct sun most of the day. Average temperature in 7 maternity roosts was 27°C (range, 26–29°C), averaging 5°C lower than ambient. In nonmaternity roosts, temperatures averaged 29°C, only 1°C lower than ambient temperature. Crevice opening dimensions were small, with none >9 cm and most <3.5 cm (Tuttle and Heaney 1974).

Myotis ciliolabrum occasionally roosts in buildings during the day (Dalquest 1948; Jones 1964). A maternity colony was found under the wallpaper of an abandoned house in California (Koford and Koford 1948). *M. ciliolabrum* also has a variety of night roosts, including buildings (Dalquest 1948; Schowalter and Allen 1981), a concrete underpass (Dalquest 1948), and a bridge (Davis and Cockrum 1963). *M. ciliolabrum* also uses natural caves (Robbins et al. 1977; Smith 1992; Woodsworth 1981) and mine adits (Nagorsen and Brigham 1993) as night roosts. In southern Alberta, individuals use their diurnal roosts as night roosts (Holloway 1998). A male *M. ciliolabrum* was captured while roosting under a large rock that projected horizontally outward (Jones and Stanley 1962). *M. ciliolabrum* occasionally uses night roosts in mixed-species groups, particularly with *Eptesicus fuscus* (Jones 1964), *Corynorhinus townsendii* (Pearson et al. 1952), and *C. mexicanus* (López-Wilchis 1999).

Reproductive *M. ciliolabrum* roost during the day solitarily or in small groups. Ten of 12 roosts in South Dakota contained only a single bat (Tuttle and Heaney 1974). In southern Alberta, *M. ciliolabrum* roosts in small colonies (mean = 4.0 individuals, range, 2–6; $n = 8$—Holloway 1998). A maternity colony of at least 19 females and dependent young roosted in a house in California (Koford and Koford 1948). Adult males are absent from colonies of nursing females and may be solitary (Quay 1948; Tuttle and Heaney 1974). However, both sexes have been caught together in the same foraging areas (Schowalter and Allen 1981).

Myotis ciliolabrum hibernates throughout most of its summer range. Individuals hibernate in abandoned mines and caves as well as in crevices or holes drilled into rock (Nagorsen et al. 1993; Perkins et al. 1990). *M. ciliolabrum* hibernates during winter in British Columbia where temperatures range from −3 to 9°C. In Colorado, individuals were found hibernating at 2.7°C (Armstrong 1972). *M. ciliolabrum* hibernates in small numbers, with only 1–6 bats within a cave (Perkins et al. 1990). Individuals of both sexes usually hibernate solitarily (Hall 1946; Perkins et al. 1990; Szewczak et al. 1998), but clusters of 2 individuals have been observed (Nagorsen et al. 1993). Bats wedge into cracks and crevices in the ceiling of hibernacula and position their undersides against the ceiling, with their heads facing outward. Western small-footed bats will hibernate with *Corynorhinus townsendii* and *Eptesicus fuscus* (Armstrong 1982; Pearson et al. 1952; Swenson 1970; Szewczak et al. 1998). *M. ciliolabrum* is active well into autumn and emerges as early as March (Jones et al. 1983).

Myotis ciliolabrum molts throughout June and July, with reproductive females molting later than other adults (Jones et al. 1983). One male taken on 23 June in South Dakota was molting over most of his body (Anderson and Jones 1971).

Western small-footed bats are parasitized by chiggers, *Leptotrombidium myotis* (Jones et al. 1973), and several nymphal mites of the subfamily Liponyssinae (Krutzsch 1955). One of 10 *M. ciliolabrum* examined was infected with the stomach nematode *Longibucca lasiura* (Measures 1994). One *M. ciliolabrum* was infected with endoparasitic oocysts of *Eimeria pilarensis* (Scott and Duszynski 1997). Most western small-footed myotis are free of ectoparasites (Dooley et al. 1976; Krutzsch 1955) and a single specimen examined by the Texas Department of Health was not infected with rabies (Schmidly 1991).

BEHAVIOR. *Myotis ciliolabrum* is a slow, maneuverable flier (Norberg and Rayner 1987; Schowalter and Allen 1981) with erratic flight patterns (Dalquest 1948). It usually hunts in irregular circles (Hall 1946), foraging from 1 m above the ground to treetop height, pursuing aerial insects (Fenton et al. 1980).

Western small-footed bats are early flyers, emerging soon after sunset (Fenton et al. 1980; Whitaker et al. 1981). Activity peaks in British Columbia occur at 2200–2300 h and 0100–0200 h (Woodsworth 1981). Frequently, *M. ciliolabrum* is caught foraging over natural water courses and man-made water holes (Anderson and Jones 1971; Chung-MacCoubrey 1996; Hardy 1941; Pierson et al. 1996), and will dip to the water surface, apparently drinking (Larrison and Johnson 1981). Individuals commonly feed along the margin of trees (Fenton et al. 1980). *M. californicus* may be more aggressive than *M. ciliolabrum*, but no aggressive interactions between the 2 species have been observed (Bogan 1974; Woodsworth 1981). In areas where *M. ciliolabrum* and *M. californicus* are sympatric, the bats spatially partition their foraging areas (Woodsworth 1981). *M. ciliolabrum* forages along rocky bluffs, whereas *M. californicus* forages over water. When not in association with *M. californicus*, *M. ciliolabrum* also will forage over water, at heights of 3–5 m. Individuals follow a predictable foraging beat, repeatedly patrolling an area of the shoreline (Woodsworth 1981).

Echolocation calls of *M. ciliolabrum* vary geographically (Thomas et al. 1987). Calls from Arizona are short and frequency-modulated, with the peak frequency at 44 kHz (sweep range, 55–41 kHz—Fenton and Bell 1981). The call has no harmonics and its duration is 5 ms. In Washington, echolocation calls have a broader sweep (>60–40 kHz), and shorter duration (1–3 ms—Tho-

mas et al. 1987). Calls from Wyoming had a maximum frequency of 62.4 kHz, a minimum frequency of 40.3 kHz, and a duration of 3.5 ms, whereas those from New Mexico had maximum and minimum frequencies of 61.1 and 39.2 kHz, respectively, and were 3.9 ms long (O'Farrell et al. 1999).

GENETICS. The 44 chromosomes of *M. ciliolabrum* include 4 pairs of metacentric and 17 pairs of acrocentric chromosomes (Baker and Patton 1967). The X and Y chromosomes are submetacentric (Baker and Patton 1967). The fundamental number (FN) = 50, whereas FN = 52 for *M. leibii* (Bickham et al. 1986). Specimens from the alleged zone of intergradation between *M. leibii* and *M. ciliolabrum* in Oklahoma did not show any evidence of morphological intermediacy (van Zyll de Jong 1984). Electrophoretic divergence between *M. leibii* in Ontario and *M. ciliolabrum* in British Columbia was much greater than the divergence between subspecies, and similar to the divergence between monotypic species of Chiroptera (Herd 1987). Based on intercentroid distances, western small-footed bats are more closely related to *M. californicus* than to *M. leibii* (van Zyll de Jong 1984).

CONSERVATION STATUS. *Myotis ciliolabrum* is on the Blue List in Alberta (Alberta Wildlife Management Division 1996) and British Columbia (Cannings et al. 1999), indicating it is at risk or vulnerable. In the United States, *M. ciliolabrum* was a Federal Category 2 candidate species (Fish and Wildlife Service 1994). Such species are of concern, but with insufficient information on population numbers to add them to the endangered species list.

REMARKS. The nomenclatorial history of this species is complex. Miller and Allen (1928) argued that the specific epithet *subulatus* had been applied incorrectly by many authors to the "common long-eared Myotis," now *M. septentrionalis*. They based this on the fact that the type locality for *Vespertilio subulatus* is outside the range of *M. septentrionalis*, and that the original description more accurately fits what is now referred to as *M. ciliolabrum*. Glass and Baker (1965, 1968) argued that *subulatus* actually applied to *M. yumanensis* and should be suppressed. Thus, *Myotis leibii* was applied to both the eastern small-footed myotis and the western small-footed myotis, although Hall (1981) disagreed with Glass and Baker (1965, 1968). Finally, van Zyll de Jong (1984) demonstrated that *M. ciliolabrum* is as distinct from *M. leibii* as either is from *M. californicus*, the other member of the *leibii* group.

The translation of *ciliolabrum* is "whiskered lip," from the Latin *cilium* meaning eyelid, and *labrum* meaning lip (van Zyll de Jong 1985).

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