

A New Salamander of the Genus *Chiropterotriton* (Caudata: Plethodontidae) from the Sierra Madre Oriental of Tamaulipas, Mexico

Author(s): Jonathan A. Campbell, Jeffrey W. Streicher, Christian L. Cox, Edmund D. Brodie Jr.,

Source: South American Journal of Herpetology, 9(3):228-234. 2014.

Published By: Brazilian Society of Herpetology

DOI: <http://dx.doi.org/10.2994/SAJH-D-14-00042.1>

URL: <http://www.bioone.org/doi/full/10.2994/SAJH-D-14-00042.1>

BioOne (www.bioone.org) is a nonprofit, online aggregation of core research in the biological, ecological, and environmental sciences. BioOne provides a sustainable online platform for over 170 journals and books published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Web site, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/page/terms_of_use.

Usage of BioOne content is strictly limited to personal, educational, and non-commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

A New Salamander of the Genus *Chiropterotriton* (Caudata: Plethodontidae) from the Sierra Madre Oriental of Tamaulipas, Mexico

Jonathan A. Campbell^{1,*}, Jeffrey W. Streicher^{1,2}, Christian L. Cox^{1,3}, Edmund D. Brodie, Jr.⁴

¹ Department of Biology, University of Texas at Arlington, Arlington, Texas 76019, USA.

² Current address: Department of Ecology and Evolutionary Biology, University of Arizona, Tucson, Arizona 85721, USA.

³ Current address: Department of Biology, University of Virginia, Charlottesville, Virginia 22904, USA.

⁴ Department of Biology, Utah State University, Logan, Utah 84322, USA.

* Corresponding author. Email: campbell@uta.edu

Abstract. A new salamander of the genus *Chiropterotriton* is described from the Sierra Madre Oriental in southwestern Tamaulipas, Mexico. This genus is widespread in the Sierra Madre Oriental, its range extending from Tamaulipas to northern Oaxaca, and it occurs into central Mexico along the mountains associated with the Transverse Volcanic Axis. The species described herein is one of the northernmost species. Previously a few species of *Chiropterotriton* have been reported from the mountains of Tamaulipas and adjacent Nuevo León, but this new salamander is easily distinguished by its enlarged nares. It also differs from all congeners by a combination of characters including size, limb length, hand and foot morphology, color pattern, and dental morphology.

Keywords. Amphibia; New species; Systematics; Taxonomy.

Resumen. Se describe una nueva especie de salamandra del género *Chiropterotriton* de la Sierra Madre Oriental del suroccidente de Tamaulipas, México. Este género es de amplia distribución en la Sierra Madre Occidental, habitando desde Tamaulipas hasta el norte de Oaxaca, y hacia el centro de México a través de las montañas asociadas al eje transversal volcánico. La especie que se describe acá es una de las especies distribuidas más al norte. Unas pocas especies del género *Chiropterotriton* han sido reportadas de la montañas de Tamaulipas adyacentes a Nuevo León, pero esta nueva salamandra es fácilmente diferenciable por sus narinas agrandadas. También se deferenencia de las otras especies del género por la combinación de caracteres que incluye tamaño, longitud de extremidades, morfología de pies and manos, patron de colocación y morfología dental.

INTRODUCTION

The Mexican herpetofauna remains poorly known and novel taxa continue to be encountered on almost every serious field trip (e.g., Campbell and Flores-Villela, 2008; Campbell et al., 2009; Bryson et al., 2014). This is especially true with amphibians, particularly tropical plethodontid salamanders, which are secretive and do not reveal their presence by larval stages in aquatic environments. Until fairly recently, *Chiropterotriton* was considered to range from Mexico to Costa Rica (Wake and Lynch, 1976), but subsequent morphological and molecular evidence revealed that this grouping was non-monophyletic (Wake and Elias, 1983; García-Paris and Wake, 2000; Wiens et al., 2007). Consequently, revisionary work restricted *Chiropterotriton* to localities west of the Isthmus of Tehuantepec, making the genus an endemic component of the Mexican herpetofauna occurring mostly in mountainous regions of the Sierra Madre Oriental. With a few exceptions, including the populations in the highlands skirting the southern Mexican Plateau, it is restricted to east of the Continental Divide. The systematics of *Chiropterotriton* remain in disarray with boundaries among the 12 described species poorly defined and with a large number

of populations representing undescribed species (Darda, 1994; Parra-Olea, 2003). The most recently described species in the genus was published by Rabb (1965).

The amount of sexual dimorphism among species of *Chiropterotriton* varies considerably, but in general males are smaller (standard length) than females, have more truncate snouts (as opposed to broadly rounded) as viewed in dorsal aspect, better developed cirri, fewer teeth in the premaxillary-maxillary series, and relatively longer adpressed limbs. The mental gland is not evident in males of some species, but is moderately to strongly developed in others.

MATERIALS AND METHODS

We used standard morphological characters of salamanders to compare a species of *Chiropterotriton* discovered in the Sierra Madre Oriental with its congeners, most of which occur well to the south. Measurements were made to the nearest 0.1 mm using an ocular micrometer for measurements less than 10 mm and a Vernier caliper or metric ruler for measurements exceeding this length. Measurements were taken to the nearest mm for standard length, tail length, and total length. Abbreviations are: SL,

standard length; TL, tail length; HW, head width; HL, head length from tip of snout to midventral gular fold); MW, manus width; PW, pes width; EN, eye–nostril distance; NN, internarial distance; EE, interocular distance across top of head; VT, total number of vomerine teeth; and PM, total number of premaxillary-maxillary teeth. As noted by Rabb (1958), the number of costal grooves is of little help in distinguishing species of *Chiropterotriton*. The number reported in the literature varies from 11–13, but all species appear to have an equal number, which is 13 if the ill-defined to virtually absent grooves in the axillary and inguinal regions are included. Webbing on the hind feet was scored as modest, moderate, or extensive. Most species of *Chiropterotriton* have a modest amount of webbing that extends onto the penultimate phalanx or the base of the ultimate phalanx of most digits and only to the penultimate phalanx of the fourth toe. *Chiropterotriton arboreus* has a moderate amount of webbing that extends well onto the ultimate phalanx of most digits, and *C. magnipes* has extensive webbing that extends the length of the phalanges. Coloration in life is taken from digital images taken immediately after collection and field notes. The general format of our description follows Adler (1996) and Campbell et al. (2010). Museum acronyms follow Sabaj Pérez (2010). Specimens examined for comparison are listed in the Appendix.

RESULTS

During the summer of 2009 a field party discovered an undescribed member of this genus in the northern portion of the Sierra Madre Oriental in southwestern Tamaulipas. Several species of *Chiropterotriton* have been reported from this state but occur to the east at lower elevations, and another congener is known to the north in the state of Nuevo León at high elevations in the Cerro Potosí region. This new species is one of the more distinctive members of this somewhat mundane clade, for which we propose the name:

Chiropterotriton miquihuanus sp. nov.

Miquihuanan Splayfoot Salamander—Tlaconete de Patas Ensanchadas de Miquihuana (Figs. 1, 2, 3)

Holotype

UTA A-59225 (field no. JAC 29731), an adult male, along road from La Peña to Las Joyas (about 11.5 km airline NNE from the town of Miquihuana), 3,081 m (23.66501 N, 99.71404 W), on 7 June 2009 by a field party consisting of J.W. Streicher, C.L. Cox, C.M. Sheehy III, and Ruben U. Tovar.

Paratopotypes

UTA A-59198–224, 59226–249, all with collection data similar to holotype.

Definition and diagnosis

The size and shape of the nares of this species distinguish it from all congeners. Its huge oval nares are



Figure 1. *Chiropterotriton miquihuanus* sp. nov., paratopotypes. (A) UTA A-59210, female, 33 mm standard length (SL), 62 mm total length, showing inconspicuous broad dorsal band. (B) UTA A-59237, female, 41 mm SL, 76 mm total length, showing essentially uniform coloration.

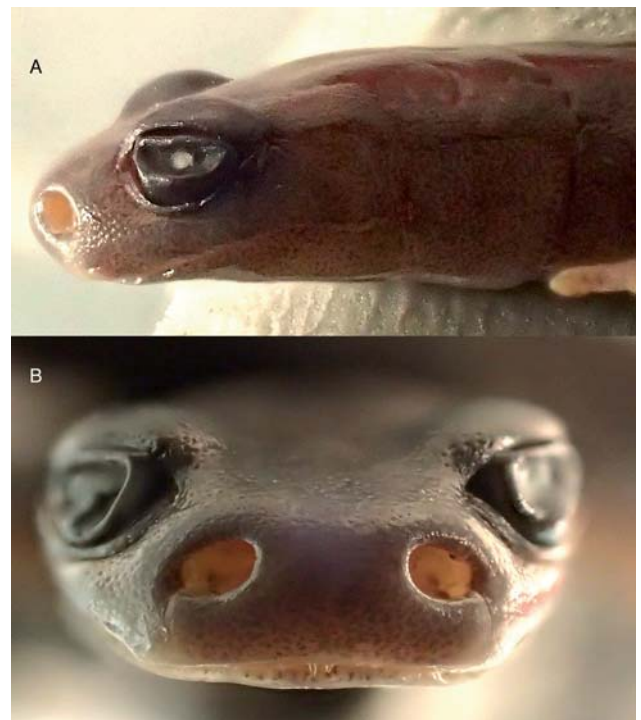


Figure 2. Lateral (A) and frontal (B) aspects of head showing enlarged nares in *Chiropterotriton miquihuanus* sp. nov., UTA A-59225, holotype, head length 7.2 mm, internarial distance 2.0 mm from center of nares.

about equal in size to the horizontal distance across the pupil (Fig. 2). The only other species of *Chiropterotriton* in which adults have enlarged nares are *C. dimidiatus* and *C. mosaueri*, in which the nares are subcircular and about 50% of the horizontal distance across the pupil. In most other species of *Chiropterotriton* the nares are small narrow slits, crescents, or ovals, oriented approximately

horizontally or slanting diagonally posteriorly. *Chiropterotriton chiroptera* has small, subcircular nares.

In *Chiropterotriton miquihuanus* adult males are 33–37 mm SL and adult females are 31–41 mm SL; the head is slightly wider than the neck and the body and tail are moderately robust; the limbs are short with 1.5–3.0 costal interspaces between adpressed limbs in males and 3.0–4.5 in females; PW relatively small (0.06–0.08 of SL, 0.29–0.44 of HL); amount of webbing modest (Fig. 3); mental gland usually not apparent, inconspicuous and whitish in a few individuals; PM teeth 23–28 in males, 38–41 in females.

Chiropterotriton chondrostega (22–31 mm SL), *C. cracens* (24–31 mm SL), and *C. dimidiatus* (22–27 mm SL) are considerably smaller, whereas *C. lavae* (36 to > 50 mm SL), *C. magnipes* (40–60 mm SL), and *C. priscus* (37–50 mm SL) are larger species. *Chiropterotriton arboreus*, *C. chiropterus*, *C. chondrostega*, *C. cracens*, *C. magnipes*, and *C. mosaueri* have slender bodies with attenuate tails. The amount of webbing is moderate–extensive in *C. arboreus*, *C. magnipes*, and *C. mosaueri*. The PW is larger in *C. chiropterus* (0.09–0.10 SL, 0.41–0.50 HL), *C. magnipes* (0.11–0.12 SL, 0.47–0.53 HL), and *C. multidentatus* (0.08–0.10 SL, 0.37–0.52 HL), and smaller in *C. dimidiatus* (0.05 SL, 0.28 HL). The limbs are longer as evinced by adpressed limbs and the number of costal interspaces in *C. arboreus* (-1.0 to -1.5 males, 1.0 to -0.5 females), *C. chiropterus* (1.0 to -0.5 males, 0.5–1.5 females), *C. lavae* (about 1.0), *C. magnipes* (-2.0 to -2.5 males), and *C. mosaueri* (-2.0 males), and shorter in *C. dimidiatus* (3.5 males, 4.0–5.0 females). The mental gland is well developed in adult males of *C. arboreus*, *C. dimidiatus*, *C. mosaueri*, and *C. multidentatus*, but not apparent or inconspicuous in other species including *C. miquihuanus*. The number of PM teeth is usually higher in *C. cracens*, females of *C. lavae*, *C. magnipes*, males of *C. mosaueri*, *C. multidentatus*, *C. priscus*, females of *C. terrestris*, and lower in males of *C. chiropterus*, *C. dimidiatus*, *C. lavae*, and *C. orculus* (Table 1).

It should be noted that diagnostic characters cannot be extracted from some of the literature. For example, Taylor (1939) combined at least three species of *Chiropterotriton* in his analysis of *C. chiropterus*, and references to *C. multidentatus* are almost always a composite of several species.

Description of holotype

A large, mature male based on the development of the testes and cirri, but no mental gland apparent; testes and associated ducts are heavily pigmented with black; general habitus of body and tail moderately robust; head only slightly wider than neck; conspicuous subocular groove extending from level of anterior corner of eye to beneath posterior corner of eye, but not reaching lower edge of lip; in dorsal aspect snout rounded posterior to

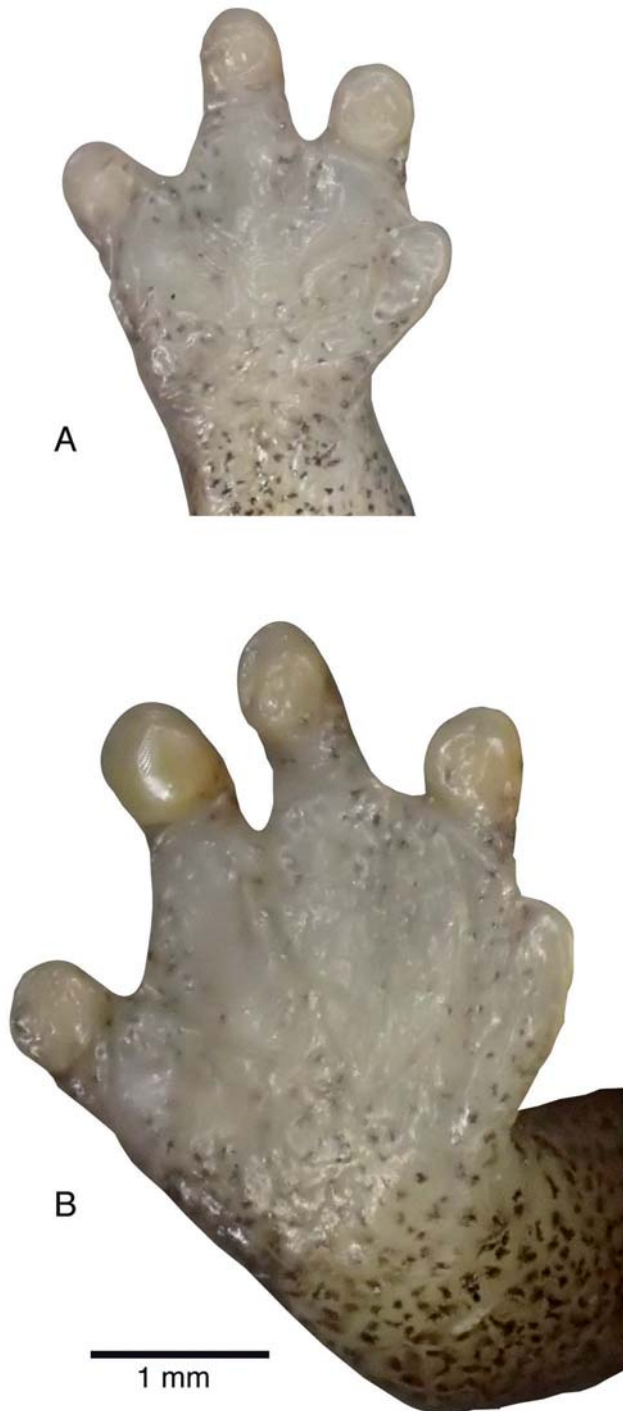


Figure 3. Right manus (A) and right pes (B) of *Chiropterotriton miquihuanus* sp. nov., holotype, UTA A-59225, male, 37 mm standard length.

Table 1. Selected characters of *Chiropterotriton* (adults only). Data taken from Taylor (1939, 1940, 1941, 1942), Rabb (1956, 1958, 1965), Woodall (1941) and specimens examined herein. We have taken a somewhat conservative approach to distribution (i.e., we have not followed distribution maps of the IUCN Red List of Threatened Species [Parra-Olea et al., 2008], because many of the isolated populations indicated therein represent undescribed species). Distances between adpressed limbs indicated to nearest 0.5 costal interspace; gaps between adpressed limbs indicated by positive number, overlap of limbs indicated with negative numbers. *C. multidentatus* as treated here probably represents a composite of species; Rabb (1958) reports a Tamaulipan specimen from 457 m, but the identification of this individual needs to be confirmed and this figure not used here as lower limit of distribution. Abbreviations: HL = head length; PM = premaxillary-maxillary teeth; PW = pes width; SL = standard length; TL = tail length.

Taxon	Distribution (state and elevation)	SL (mm)	Habitus (head, body, tail)	TL/SL	Nares	Limbs, foot, and webbing	PW/SL PW/HL	Adpressed Limbs (costal interspaces)	Mental gland	PM teeth
<i>C. arboreus</i>	East-central Hidalgo	Maximum 38	Head wider than neck; body slender, tail attenuate	Tail longer than body	Small, directed laterally	Limbs long, feet relatively large with moderate webbing		Males 1.0 to -1.5; females 1.0 to -0.5	Well-developed	Males 25–40; females 34–62
<i>C. chiropterus</i>	West-central Veracruz	Males 32–36; females 34–38	Head distinctly wider than neck, body slender, tail attenuate	1.03–1.37	Small, directed laterally	Moderate in size, modest webbing	0.09–0.10 0.41–0.50	Males 1.0 to -0.5; females 0.5 to 1.5	Not apparent	Males about 12 (none posteriorly)
<i>C. chondrostega</i>	Northwestern Hidalgo and adjacent Querétaro, 1524–2042 m	Males 22–30; females 25–31	Small, slender, tail attenuate		Small	Small, modest webbing		Males 2.0–3.0; females 3.0–4.0		Males 23–38; females 38–49
<i>C. cracens</i>	South-central Tamaulipas, 914–1890 m	Males 24–31; females 24–31	Head slightly wider than neck, body slender, tail moderately attenuate	0.93–1.37	Small, directed anteriorly	Limbs short, feet Limbs short, feet small with modest webbing	0.06–0.07 0.26–0.39	Males 0.5–2.0; females 2.5–3.5	Not apparent	Males 33–58; females 40–66
<i>C. dimidiatus</i>	Southeastern Hidalgo, 3033 m	Males 22–27; females 23–29	Head slightly wider than neck, body and tail moderately robust	0.77–0.80	Large, sub-circular, directed forward, about 50% of horizontal distance across pupil	Small, modest webbing	0.05 0.28	Males about 3.5; females 4.0–5.0	Well-developed	Males 7–18; females 32–48
<i>C. larvae</i>	West-central Veracruz	Males 36–50; females probably larger	Head wider than neck, body and tail moderately robust	0.69–1.23	Small, directed laterally	Limbs moderately long, feet medium-sized with modest webbing	0.06–0.08 0.30–0.47	Males overlap by 1.0	Not prominent, poorly developed	Males 6–10; females 50–56
<i>C. magnipes</i>	Northeastern Querétaro, 1300–1810 m	Males 40–53; females 51–60	Head distinctly wider than neck, body slender, tail attenuate	1.02–1.24	Small, directed anterolaterally	Long limbs, huge feet with extensive webbing	0.11–0.12 0.47–0.53	Males -2.0 to -2.5	Not apparent	Males average 79
<i>C. miquihuanus</i>	Southwestern Tamaulipas, 3081 m	Males 33–37; females 31–41	Head slightly wider than neck, body and tail moderately robust	0.78–1.12	Large, ovoid, directed anterolaterally, about as large as diameter across pupil	Limbs short, feet small with modest webbing	0.06–0.08 0.29–0.44	Males 1.5–3.0; females 3.0–4.5	Usually not apparent, rarely whitish and inconspicuous	Males 23–28; females 38–41
<i>C. mosaueri</i>	Northwestern Hidalgo	Males 39–46	Slender, tail attenuate and longer than body	Tail longer than body	Large, ca. 50% diameter of pupil	Large with moderate webbing		Males -2.0	Well-developed	Males 56–69
<i>C. multidentatus</i>	South-central San Luis Potosí to southeastern Hidalgo, 1070–2440 m	Males 32–44; females 32–46	Head slightly wider than neck, body and tail moderately attenuate	0.91–1.23	Small, directed laterally	Medium-sized with modest webbing	0.08–0.10 0.37–0.52	Males 1.0 to -1.5; females 0.5–2.0	Well-developed	Males 25–54; females 39–85
<i>C. orculus</i>	Northern Morelos to northern Puebla	Males 30–35; females 30–40	Head not or scarcely wider than neck, body and tail moderately robust	0.70–1.03	Small, directed anterolaterally	Limbs short, feet small with modest webbing	0.07–0.08 0.27–0.42	Males 1.5–2.0; females 2.5–3.5	Well-developed	Males 14–18; females 33–40
<i>C. prisca</i>	Central Nuevo León, 2440–3660 m	Males 37–50; females 42–50	Head not or scarcely wider than neck, body stout, tail robust	0.81–1.09	Small, directed anterolaterally	Limbs short, feet small with modest webbing	0.07–0.09 0.32–0.45	Males 2.0–3.0; females 3.0–3.5	Well-developed	Males 33–42; females 42–53
<i>C. terrestris</i>	East-central Hidalgo	Males 23–37; females 25–35	Head scarcely wider than neck, body and tail robust	0.90–1.07	Small, directed anterolaterally	Limbs short, feet small with modest webbing	0.6–0.8 0.34–0.42	Males about 2.5; females 3.0	Poorly developed	Males 19–32; females 41–57

level of nares, truncate between nares; nares very large and oval in shape, directed anterolaterally; cirri moderately well developed; sinusoidal nasolabial groove extending from posterior edge of naris, downward and then posteriorly to edge of lip; costal grooves 11, 13 if poorly developed axillary and inguinal grooves included; cloacal papillae lining anterior of vent; no conspicuous basal constriction of tail; limbs relatively short, adpressed limbs separated by 3.0 costal folds; manus and pes relatively small, first finger and first toe completely included in web; webbing between Fingers II–IV and Toes II–III and IV–V extending to base of ultimate phalanx, webbing between Toes III–IV extending only onto antepenultimate ultimate phalanx; terminal pads present on all digits, but less developed on first digits of manus and pes; SL 37 mm; snout to arm insertion 10.7 mm; total length 72 mm; TL 35 and 95% of SL, roughly quadrangular in cross section; tail base depth 3.0 mm; tail base width 2.8 mm; axilla to groin 17.9 mm; HL 7.2 mm; HW 5.5 mm; projection of snout beyond lower jaw 0.6 mm; horizontal distance across eye 2.1 mm; EN (anterior edge of eye to center of naris) 1.1 mm; NN (to center of naris) 2.0 mm; EE (anterior edges of eye) 2.8 mm; antibrachium and manus 5.0 mm; shank and pes 5.5 mm; MW 2.2 mm; PW 3.0 mm; vent length 3.0 mm; vomerine teeth arranged in two slightly curved rows with 4/4 teeth; PM 23; and premaxillary teeth unicuspid, slightly enlarged over more posterior teeth, slightly darkened, and projecting slightly forward.

Color in preservative (alcohol after formalin).

Dorsum of head, torso, and tail dark gray, with melanophores less dense on flanks, venter of body, and tail, but nevertheless these regions dark. Costal grooves narrowly edged with black. Chin and throat pale with scattered tiny melanophores. Ventral surfaces of limbs and palmar and plantar surfaces paler than dorsal surfaces.

Variation

Adult males 33–37 mm SL, 63–71 mm total length, TL/SL 79–106%; adult females 31–41 mm SL, 57–77 mm total length, TL/SL 78–112%; many of the females containing large eggs close to maturity; limbs longer in males, adpressed limbs separated by 1.5–3.0 costal interspaces, in females separated by 3.0–4.5 costal interspaces; PW/SL 0.06–0.08; PW/HL 0.29–0.44; PM teeth 23–28 in males, 38–41 in females. The premaxillary teeth in adult females hook posteriorly in contrast to projecting slightly forward in males.

Color in life. Generally a very dark little salamander that may be uniformly dark gray to black on dorsal and lateral surfaces and only slightly paler on ventral surfaces. Some individuals have fine rust-colored, burgundy, or pale ash-gray specks or fine mottling on the dorsum



Figure 4. Type-locality of *Chiropterotriton miquihuanus* sp. nov., southwestern Tamaulipas, Mexico, above 3,000 m.

which extends from the snout or the neck onto the base of or throughout most of the tail as a broad dorsal band; this band is usually not conspicuously set off from adjacent coloration, but some individuals have pale lateral borders of the dorsal band, clearly demarcating it. The dorsal band can extend onto the rostrum, covering the eyelids and snout above the canthus. The dorsal surfaces of the forelimbs are dark gray, sometimes with a slight burgundy tinge; the hind limbs are darker gray. The chin and throat are whitish with intense gray mottling or stippling.

Etymology

The specific name is taken from the name *Miquihuana*, a municipality in southwestern Tamaulipas from which the new species was taken.

Distribution and habitat

This species is known only from southwestern Tamaulipas from the vicinity of the type locality at elevations over 3,000 m (Fig. 4). This region is in the pine-oak zone (Rzedowski, 1986) with boreal forest on the higher peaks (Leopold, 1950). The type-series were all taken on the ground under logs and rocks in habitat consisting mostly of pine with scattered oak, agave, and yucca.

DISCUSSION

The genus *Chiropterotriton*, endemic to Mexico, is the most poorly known group of salamanders in that country. Darda (1994) suggested that there were at least 22 species, most of which were, and remain, undescribed two decades later, despite the great amount of morphological diversity within the genus. Parra-Olea (2003) provided further evidence of this undescribed diversity using mitochondrial DNA to report variation consistent with at least

seven undescribed species; these species currently remain undescribed. Within the last decade, various additional populations representing undescribed species have been discovered. Species of the genus can be adapted to terrestrial, arboreal, and cavernicolous habits. The type-locality of *C. miquihuanus* near Nevada Joyas Miquihuana regularly receives snow accumulation from December–March, suggesting that *C. miquihuanus* and *C. priscus* on Cerro Potosí possibly have greater cold-tolerance capabilities than most of their congeners to the south.

Species of *Chiropterotriton* are often allopatric from congeners, but in some instances several species may occur sympatrically. In such cases, distinctly different morphotypes occur, usually with one small and one larger morphotype occurring sympatrically and one of these adapted to more arboreal habitats. For example, in southeastern Hidalgo the diminutive *C. dimidiatus* is sympatric with the larger *C. multidentatus* and in east-central Hidalgo *C. arboreus* is sympatric with *C. terrestris* (Rabb, 1958).

Previously, several species of *Chiropterotriton* were known from Tamaulipas, but these occurred at relatively low elevations along the eastern portion of the Sierra Madre Oriental. Some 150 km to the northwest, *C. priscus* inhabits the highlands in the Cerro Potosí region at elevations of 2440–3660 m. The discovery of *C. miquihuanus* at high elevations in southwestern Tamaulipas helps fill in the wide hiatus previously known for members of *Chiropterotriton*. It appears that *C. miquihuanus* might be sympatric with another cavernicolous species of *Chiropterotriton*. We have seen photographs of what appear to be *C. miquihuanus* and a sympatric pale pinkish tan, moderate-sized species that may represent a high-elevation population of *C. multidentatus* or a currently undescribed species. These were found under surface debris and on wet walls of caves, respectively, near the village of Dulces Nombres in the General Zaragoza region of southeastern Nuevo León less than 50 km from the type-locality of *C. miquihuanus*.

Taylor (1944) and Rabb (1956) noted that the young of *Chiropterotriton* possess greatly enlarged nares. This characteristic persists in the adults of *C. miquihuanus*, along with several other features that are probably paedomorphic. Rabb (1958) suggested that the large nares, foot structure, and the relatively short tail in adult *C. dimidiatus* also represent paedomorphic features. *Chiropterotriton miquihuanus* shares these features. A relatively dark coloration is characteristic of young *Chiropterotriton* and some *Pseudoeurycea* and the retention of a dark pattern in adult *C. miquihuanus* may be also regarded as paedomorphic. *Chiropterotriton mosaueri* and *C. dimidiatus* are the only congeners that share the feature of enlarged nares in adults with *C. miquihuanus*, but we refrain from interpreting this similarity as evidence of phylogenetic relatedness because paedomorphic features are well known to have evolved independently in many salamander lineages (Alberch et al., 1979).

ACKNOWLEDGMENTS

We thank C.M. Sheehy III and R.U. Tovar for participating in the fieldwork in Tamaulipas during the Summer of 2009 that led to the discovery of this new species. We are particularly indebted to the following curators and their institutions for the loan of comparative material: C. Raxworthy and D. Kizirian (AMNH), A. Resetar (FMNH), G. Schneider and R. Nussbaum (UMMZ). T. Hibbitts kindly shared his images of salamanders from southeastern Nuevo León. This paper is based on work supported by the National Science Foundation (grant no DEB 0613802) to J. Campbell and carried out under The University of Texas–Arlington IACUC no. A07.027. Collecting permits were issued by the Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT).

REFERENCES

- Adler K. 1996.** The salamanders of Guerrero, Mexico, with descriptions of five new species of *Pseudoeurycea* (Caudata Plethodontidae). *Occasional Papers of the Natural History Museum, University of Kansas* 177: 1–28.
- Alberch P., Gould S.J., Oster G.F., Wake D.B. 1979.** Size and shape in ontogeny and phylogeny. *Paleobiology* 5: 296–317.
- Bryson R.W., Linkem C.W., Dorcas M.E., Lathrop A., Jones J.M., Alvarado-Díaz J., Grünwald C.I., Murphy R.W. 2014.** Multilocus species delimitation in the *Crotalus triseriatus* species group (Serpentes: Viperidae: Crotalinae), with the description of two new species. *Zootaxa* 3826: 475–496. doi:10.11646/zootaxa/3826.3.3
- Campbell J.A., Flores-Villela O. 2008.** A new long-tailed rattlesnake (Viperidae) from Guerrero, Mexico. *Herpetologica* 64: 246–257. doi:10.1655/07-054.1
- Campbell J.A., Blancas-Hernández J., Smith E.N. 2009.** A new species of stream-breeding treefrog of the genus *Charadrahyla* (Hylidae) from the Sierra Madre del Sur of Guerrero, Mexico. *Copeia* 2009: 287–295. doi:10.1643/CH-08-143
- Campbell J.A., Smith E.N., Streicher J., Acevedo M.E., Brodie E.D. Jr. 2010.** New salamanders (Caudata: Plethodontidae) from Guatemala, with miscellaneous notes on known species. *Miscellaneous Publications, Museum of Zoology, University of Michigan* 200: 1–60.
- Darda D.M. 1994.** Allozyme variation and morphological evolution among Mexican salamanders of the genus *Chiropterotriton* (Caudata: Plethodontidae). *Herpetologica* 50: 164–187.
- García-Paris M., Wake, D.B. 2000.** Molecular phylogenetic analysis of relationships of the tropical salamander genera *Oedipina* and *Nototriton*, with the descriptions of a new genus and three new species. *Copeia* 2000: 42–70. doi:10.1643/0045-8511(2000)2000[0042:MP AORO]2.0.CO;2
- Leopold A.S. 1950.** Vegetation zones of Mexico. *Ecology* 31: 507–518. doi:10.2307/1931569
- Parra-Olea G. 2003.** Phylogenetic relationships of the genus *Chiropterotriton* (Caudata: Plethodontidae) based on 16S ribosomal DNA. *Canadian Journal of Zoology* 81: 2048–2060. doi:10.1139/z03-155
- Parra-Olea G., Wake D., Raffaelli J. 2008.** *Chiropterotriton multidentatus*. The IUCN Red List of Threatened Species. Version 2014.3. Accessible at www.iucnredlist.org. Accessed: 24 November 2014.
- Rabb G.B. 1956.** A new plethodontid salamander from Nuevo León, Mexico. *Fieldiana Zoology* 39: 11–20.

- Rabb G.B. 1958.** On certain Mexican salamanders of the plethodontid genus *Chiropterotriton*. *Occasional Papers of the Museum of Zoology, University of Michigan* 587: 1–43.
- Rabb G.B. 1965.** A new salamander of the genus *Chiropterotriton* (Caudata: Plethodontidae) from Mexico. *Breviora* 235: 1–8.
- Rzedowski J. 1986.** Vegetación de México. Editorial Limusa, México. 432 pp.
- Taylor E.H. 1939** [1938]. Concerning Mexican salamanders. *The University of Kansas Science Bulletin* 25: 259–313.
- Taylor E.H. 1940.** New salamanders from Mexico with a discussion of certain known forms. *The University of Kansas Science Bulletin* 26: 407–439.
- Taylor E.H. 1941.** New plethodont salamanders from Mexico. *Herpetologica* 2: 57–65.
- Taylor E.H. 1942.** New Caudata and Salientia from Mexico. *The University of Kansas Science Bulletin* 28: 295–323.
- Taylor E.H. 1944.** The genera of plethodont salamanders in Mexico, Pt. I. *The University of Kansas Science Bulletin* 30: 189–232.
- Sabaj Pérez M.H. (Ed.). 2010.** Standard symbolic codes for institutional resource collections in herpetology and ichthyology: an online reference. Version 1.5 (4 Oct. 2010). www.asih.org/, American Society of Ichthyologists and Herpetologists, Washington, DC.
- Wake D.B., Lynch J.F. 1976.** The distribution, ecology and evolutionary history of plethodontid salamanders in tropical America. *Natural History Museum of Los Angeles County Science Bulletin* 25: 1–65.
- Wake D.B., Elias P. 1983.** New genera and a new species of Central American salamanders, with a review of the tropical genera (Amphibia, Caudata, Plethodontidae). *Contributions in Science, Los Angeles* 345: 1–19.
- Wiens J.J., Parra-Olea G., García-Paris M., Wake D.B. 2007.** Phylogenetic history underlies elevational patterns of biodiversity in tropical salamanders. *Proceedings of the Royal Society of London* 274: 919–928. doi:10.1098/rspb.2006.0301
- Woodall H.T. 1941.** A new Mexican salamander of the genus *Oedipus*. *Occasional Papers of the Museum of Zoology, University of Michigan* 444: 1–4.

APPENDIX

Specimens examined

All specimens are from Mexico. Museum acronyms follow Sabaj Pérez (2010).

Chiropterotriton arboreus. **HIDALGO:** 7.8 km SW Tlanchinol, 1,463 m, UTA A-34125.

Chiropterotriton chiropterus. **VERACRUZ:** Huatusco, UTA A-30299–304; 4.8 km SW La Joya, 22.4 km NW Jalapa, 2,347 m, FMNH 70246, 70249, 70252, 70267, 70269, 70289.

Chiropterotriton cracens. **TAMAULIPAS:** 8 km W Gómez Farías, Rancho del Cielo, 1,067 m, FMNH 73810–11; UMMZ 105351, 105372, 105374–76-paratypes; trail Rancho del Cielo Agua de los Indios, UMMZ 105352-paratype; E of Gómez Farías, La Joya de Salas trail, 1,372 m, UMMZ 111318.

Chiropterotriton dimidiatus. **HIDALGO:** La Estanzuela, UTA A-4116–18; probably Parque Nacional El Chico, FMNH 125691, 125694, 125696.

Chiropterotriton lavae. **VERACRUZ:** 3.2 km E Las Vigas, 2,316 m, AMNH 106541–43, 106547; 28.8 km W Jalapa, near Toluca, FMNH 123451, 123454, 123457; 16 km S Teziutlán, FMNH 179617, 179619; no locality data, FMNH 123455.

Chiropterotriton magnipes. **QUERETARO:** 3.2 km W El Madroño, Parada Santa María, 1,676 m, UTA A-12862–64.

Chiropterotriton cf. multidentatus. **HIDALGO:** Parque Nacional El Chico, 3,048 m, FMNH 125575, 125584, 125586, 125590; UTA A-42715–35. **TAMAULIPAS:** 8 km W Gómez Farías, Rancho del Cielo, 1,006–1,067 m, UMMZ 98973, 105343; 3.2 km NW San José, 1,554 m, UMMZ 111310; El Chihue, 17 km by road SE Revillagigedo, 1,890 m, UMMZ 111323–24; Ojitos Mine, 3.2 km W El Chihue, 2,621 m, UMMZ 111327).

Chiropterotriton orculus. **ZEMPOALA:** 2,865–2,926 m, UTA A-5256–59, 5261–64; **MORELOS:** Lagunas de Zempoala, 2,804–3,048 m, AMNH 88989, 88995, 106498, 106504, 106506–07; UTA A-12845–61.

Chiropterotriton priscus. **NUEVO LEON:** S slope Cerro Potosí, 3,140–3,505 m, UTA A-4198–202, 4718, 6596–605; 21.4 km NW 18 de Marzo or 37.1 km NW Galeana, on Cerro Potosí, AMNH 171745, 171748, 171751, 171754, 171781; near Galeana, Ojo de Agua, Cerro Potosí, 2,438 m, FMNH 30625; 14.6 km W 18 de Marzo on Cerro Potosí, FMNH 236031, 236033–34.

Chiropterotriton terrestris. **HIDALGO:** 6.4–16.0 km S Tianguistengo, FMNH 112777, 112837, 114841; 8.0–9.6 km S Zacualtipan, FMNH 112841, 126773, 126872.