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

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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 in 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.

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 *Chiropteronotriton*. 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 *Chiropteronotriton* 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. *Chiropteronotriton arboresus* 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 *Chiropteronotriton* 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:

*Chiropteronotriton 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

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**Figure 1. Chiropteronotriton 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 *Chiropteronotriton 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
Table 1. Selected characters of species of Chiropterotriton (Caudata: Plethodontidae) from the Sierra Madre Oriental of Tamaulipas, Mexico

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Distribution (state and elevation)</th>
<th>SL (mm)</th>
<th>Habitus</th>
<th>PW/HL</th>
<th>Nares</th>
<th>Limbs, foot, and webbing</th>
<th>Mental gland</th>
<th>Teeth</th>
<th>Males</th>
<th>females</th>
<th>Adpressed Limbs (costal interspaces)</th>
<th>MPM Teeth</th>
<th>PM Taxon Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>C. arboreus</td>
<td>North-central Hidalgo, 1532–2042 m</td>
<td>30–40</td>
<td>Small, slender, head, body, tail slender, tail attenuate</td>
<td>0.05–0.06</td>
<td>Small, directed anterolaterally</td>
<td>Limbs short, foot small with extensive webbing, moderately large</td>
<td>Small, directed anterolaterally</td>
<td>0.11</td>
<td>12.0</td>
<td>40–50</td>
<td>0.39–0.42</td>
<td>0.06–0.07</td>
<td>0.29–0.36</td>
</tr>
<tr>
<td>C. cracens</td>
<td>Northeastern Querétaro, 1300–1810 m</td>
<td>30–35</td>
<td>Small, slender, head, body, tail slender, tail attenuate</td>
<td>0.05–0.06</td>
<td>Small, directed anterolaterally</td>
<td>Limbs short, foot small with extensive webbing, moderately large</td>
<td>Small, directed anterolaterally</td>
<td>0.11</td>
<td>12.0</td>
<td>40–50</td>
<td>0.39–0.42</td>
<td>0.06–0.07</td>
<td>0.29–0.36</td>
</tr>
<tr>
<td>C. dimidiatus</td>
<td>South-central Tamaulipas, 870–1290 m</td>
<td>30–35</td>
<td>Small, slender, head, body, tail slender, tail attenuate</td>
<td>0.05–0.06</td>
<td>Small, directed anterolaterally</td>
<td>Limbs short, foot small with extensive webbing, moderately large</td>
<td>Small, directed anterolaterally</td>
<td>0.11</td>
<td>12.0</td>
<td>40–50</td>
<td>0.39–0.42</td>
<td>0.06–0.07</td>
<td>0.29–0.36</td>
</tr>
<tr>
<td>C. orculus</td>
<td>Northern Hidalgo, 1240–3660 m</td>
<td>35–40</td>
<td>Small, slender, head, body, tail slender, tail attenuate</td>
<td>0.05–0.06</td>
<td>Small, directed anterolaterally</td>
<td>Limbs short, foot small with extensive webbing, moderately large</td>
<td>Small, directed anterolaterally</td>
<td>0.11</td>
<td>12.0</td>
<td>40–50</td>
<td>0.39–0.42</td>
<td>0.06–0.07</td>
<td>0.29–0.36</td>
</tr>
<tr>
<td>C. priscus</td>
<td>East-central Hidalgo, 1300–1810 m</td>
<td>30–35</td>
<td>Small, slender, head, body, tail slender, tail attenuate</td>
<td>0.05–0.06</td>
<td>Small, directed anterolaterally</td>
<td>Limbs short, foot small with extensive webbing, moderately large</td>
<td>Small, directed anterolaterally</td>
<td>0.11</td>
<td>12.0</td>
<td>40–50</td>
<td>0.39–0.42</td>
<td>0.06–0.07</td>
<td>0.29–0.36</td>
</tr>
</tbody>
</table>

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.
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 unicupsid, 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/HW 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 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 Miquihuanuana, 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. 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 mossaueri* 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**


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 chiroperterus. 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 Farias, Rancho del Cielo, 1,067 m, FMNH 105351, 105372, 105374–76-paratypes; trail Rancho del Cielo Agua de los Indios, UMMZ 105352-paratype; E of Gómez Farias, 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 Toxlacuaya, 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 Farias, 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 88998, 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 Tanguistengo, FMNH 112777, 112837, 114841; 8.0–9.6 km S Zacualtipan, FMNH 112841, 126773, 126872.