

## New Species of *Pseudoeurycea* (Caudata: Plethodontidae) from the Mountains of the Mixteca Region of Oaxaca, Mexico

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**ABSTRACT.**—A new terrestrial species of *Pseudoeurycea* is described from the mountains of the Mixteca region of Oaxaca. Compared with other members of the genus, the new species is relatively slender and short-legged. The background color of the dorsum of this species is dark gray with reddish-brown spots. The Mixteca region of Oaxaca has long been poorly explored biologically, and the knowledge of the distribution of its salamanders is scarce. Herein, we present new information regarding salamanders species in this region.

**RESUMEN.**—Se describe una nueva especie de salamandra terrestre del género *Pseudoeurycea* de las montañas de la Mixteca de Oaxaca. Comparada con los otros miembros del género, la nueva especie es relativamente delgada y con extremidades cortas. La coloración dorsal de esta especie es gris oscuro con manchas café rojizas. La región Mixteca de Oaxaca ha sido poco explorada biológicamente, y el conocimiento que se tiene sobre la distribución de salamandras es escaso. En este trabajo presentamos información sobre algunas salamandras que habitan en esta región.

The tropical plethodontid salamander genus *Pseudoeurycea* contains 39 species and ranges from western Tamaulipas (Atlantic Versant) and eastern Sonora (Pacific Versant), Mexico, southward to Guatemala. Species diversity is high in Mexico, with only a few species present in Guatemala. Many species show localized distributions, some of them restricted to particular mountainous ranges, and endemism is high in some regions. A recent molecular phylogenetic study on *Pseudoeurycea* indicates the genus is not monophyletic with respect to mt DNA haplotypes, showing paraphyly with respect to *Lineatriton* (Parra-Olea, 2002).

The state of Oaxaca (Mexico) is rich in salamander species (35), with the greatest diversity (31.4%) represented by species of *Pseudoeurycea*. In Oaxaca, many species are poorly known, and some of them have been collected once (e.g., *Pseudoeurycea aquatica*, *Pseudoeurycea anitae*, and *Pseudoeurycea praecellens*). After years of surveys and fieldwork, new species of salamanders from northern Oaxaca are being described regularly (e.g., Hanken and Wake, 1994; Wake and Campbell, 2001; Canseco-Márquez and Parra-Olea, 2003; Parra Olea et al., 2004), and several others remain to be described (G. Parra-Olea, pers. comm.). Although only a few species of salamanders are known from the Pacific Slope of the Sierra Madre del Sur of

Oaxaca, this is an important mountain range where more new species are likely to be discovered (Parra-Olea et al., 2002). There are many regions of Oaxaca, such as the Mixteca Oaxaqueña in northwest Oaxaca, that remain relatively unexplored. Our knowledge of plethodontid distribution in this region is very poor, even though Webb and Baker (1969) explored the region sporadically and Casas-Andreu et al. (1996) summarized our knowledge of the Oaxacan herpetofauna.

### MATERIALS AND METHODS

The species description follows the format used by Lynch and Wake (1989) for other species in the genus *Pseudoeurycea* and includes the same characters and measurements. Measurements were made using digital calipers; measurements of feet, toes, and some head dimensions, as well as tooth counts, were taken under a stereoscopic microscope. All measurements are in millimeters. Standard length (SL) was measured from the tip of the snout to the posterior end of the vent. Color notes are based on living and preserved specimens.

### DESCRIPTION OF NEW SPECIES

While conducting fieldwork in the mountains of northwestern Oaxaca, we collected a series of nine salamanders of the genus *Pseudoeurycea* from the region known as Mixteca Alta. Subsequent

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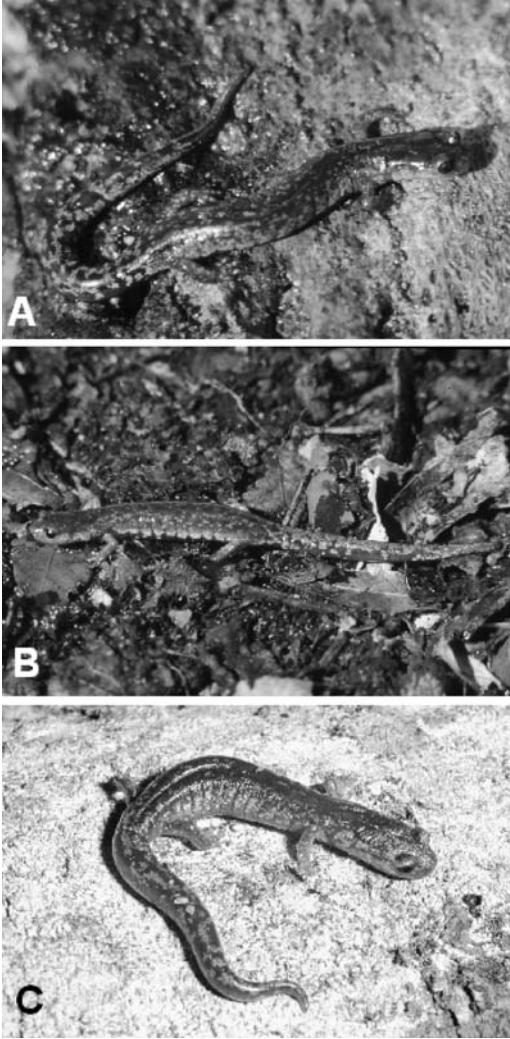


FIG. 1. Specimens in life of *Pseudoeurycea mixteca*. (A) Paratype MZFC 15291, from San Juan Bautista Coixtlahuaca. (B) Paratype MZFC 15293, collected at the type locality (San Pedro Jocotipac). (C) Paratype UTA A-56282, collected on Hwy San Andres Chichahuaxtla-Tlaxiaco, reproduced from UTA 23797 slide (E. N. Smith).

comparisons indicated that these salamanders represent an undescribed species, named here as

*Pseudoeurycea mixteca* sp. nov

Figure 1

*Holotype*.—MZFC 15293, Adult female collected 3 km south of San Pedro Jocotipac, Oaxaca, Mexico (N 17° 44.075', W 97° 05.320'), 2420 m; obtained by Jorge Salazar Arenas (JSA 236) in oak forest on 28 June 1999.

*Paratypes*.—Eight specimens. MZFC 15291, 6 km west of San Juan Bautista Coixtlahuaca,

Oaxaca (N 17° 41.622', W 97° 16.905'), 2335 m (L. Canseco-Márquez); MZFC 15292, 15294, 2 km south of San Pedro Jocotipac, Oaxaca (N 17° 45.005', W 97° 05.320'), 2230–2255 m (O. Robles-Romero and J. Salazar-Arenas); MZFC 15295–96, 5 km southwest of San Pedro Jocotipac, 2370–2415 m (L. E. Chong-Alcaraz and O. Robles-Romero); IBH 14193–94, Town of Tlaxiaco, Oaxaca, corner of Claudio Cruz and Isabela Católica (N 17° 16.1', W 97° 40.8'), 1985 m (G. Parra-Olea); UTA A-56282, Carretera San Andrés Chichahuaxtla-Tlaxiaco (approximately N 17° 10.90', W 97° 48.62' ), 2295 m (E. N. Smith and J. L. Camarillo-Rangel).

*Referred Specimens*.—MVZ 138910–21, Heroica Ciudad de Tlaxiaco; MVZ 164694, 27.8 km southeast (by road) of Heroica Ciudad de Tlaxiaco on road to San Miguel, elevation 2780 m; MVZ 164695–99, 29.5 km southeast (by road) of Heroica Ciudad de Tlaxiaco on road to San Miguel, elevation 3080 m.

*Diagnosis*.—In general proportions and color pattern, *P. mixteca* is most similar to *Pseudoeurycea altamontana*, which occurs at elevations above 3000 m along the Transverse Neovolcanic Belt (Lagos de Zempoala, Morelos, to the western slopes of Volcán Popocatepetl in the States of Puebla and Mexico). However, *P. mixteca* differs by having shorter limbs (adpressed limbs are separated by 3–3.5 costal folds in *P. mixteca* versus limbs contacting or overlapping in *P. altamontana*).

The new species can be distinguished from other Oaxacan species as follows: from *Pseudoeurycea saltator* in having a large size (maximum SL = 58.6 vs. 48 mm in *P. saltator*) and by having fewer maxillary plus premaxillary teeth (33–39 vs. 86 for *P. saltator*). Compared with *Pseudoeurycea bellii*, the new species is smaller (maximum SL 58.6 vs. 115 mm in *P. bellii*), and lacks a distinctive series of paired red spots on the dorsum (present in *P. bellii*). It differs from *P. aquatica*, *P. anitae*, *Pseudoeurycea aurantia*, *Pseudoeurycea juarezi*, and *Pseudoeurycea unguidentis*, by having shorter limbs (the adpressed limbs separated by 3–4 costal folds vs. limbs contacting or slightly overlapping in the other species). The new species differs from *Pseudoeurycea mystax* in the number of phalanges in the fifth toe (two phalanges vs. one phalange in *P. mystax*) and by lacking the distinctive nasolabial protuberances that are present in *P. mystax*; furthermore *P. mixteca* differs from *P. mystax* by having fewer maxillary plus premaxillary teeth (33–39 vs. 57–66 in *P. mystax*). The new species differs from *Pseudoeurycea conanti* in coloration (dorsum with irregular reddish brown spots in *P. mixteca* vs. uniformly black in *P. conanti*) and by having fewer maxillary plus premaxillary teeth (33–39 in *P. mixteca* vs. 46 in *P. conanti*). Compared with

*Pseudoeurycea smithi* the new species is smaller (maximum SL 58.6 mm vs. 88 mm) and differs in coloration (dorsum with irregular reddish-brown spots vs. dorsum uniformly dark brown in *P. smithi*). From *Pseudoeurycea werleri*, *P. mixteca* differs by having shorter limbs (adpressed limbs separated by 3–4 costal folds vs. separated by 1–2 in *P. werleri*) and by lacking of webbing on feet (present in *P. werleri*); additionally it can be distinguished of *P. werleri* in having a slender body (body stout in *P. werleri*) and in coloration (dorsum with irregular reddish brown spots vs. dorsum uniformly dark gray to black in *P. werleri*). The new species may be confused with *Pseudoeurycea cochranæ*, which is also found in the Mixteca Region (however, no specimens of *P. cochranæ* were collected in the same area where *P. mixteca* occurs), but it differs from *P. cochranæ* by having a relatively longer tail (72–102% vs. 70–80% SL in *P. cochranæ*) and relatively longer limbs (adpressed limbs separated by 3–4 costal folds vs. 1–2.5, rarely 3, *P. cochranæ*).

Recently Perez-Ramos and Saldaña de la Riva (2003) described *Pseudoeurycea amuzga* from Sierra de Malinaltepec, Guerrero, near the border with Oaxaca, and they state that this region represents the westernmost extension of the Mixteca Region. *Pseudoeurycea mixteca* is distinguished from *P. amuzga* in being larger (maximum SL = 58.6 vs. 48 mm in *P. amuzga*) and in coloration (dorsum with irregular reddish-brown spots vs. a dorsum uniformly dark gray in *P. amuzga*).

*Description.*—*Pseudoeurycea mixteca* is a medium-sized salamander; SL in the single male 55.8 and six adult females 40.5–58.6 (mean = 50.3). Head narrow (11–15% SL in male and females). Snout rounded in dorsal view, slightly more truncate in single male than in females, rounded in profile; eyes moderate in size, only slightly protuberant. Nostrils small, oval; nasolabial groove straight, reaching lip. Head slightly wider than neck, parotoid glands not evident. Costal folds 13, counting one each in the axilla and groin areas. Limbs relatively short, when are pressed to body, digits are separated by 3–4 costal folds. Fifth toe relatively well developed, smaller than fourth; digits well developed, moderately long and slender, with no appreciable basal webbing, without subterminal pads; digits in order of decreasing length: fingers 3-2-4-1, toes 3-4-2-5-1. Tail relatively short and slender, 72 to 102% (mean 88%) SL, slight constriction at the base of the tail, skin on dorsum of the tail slightly rugose; maxillary teeth 13, enlarged and slightly curved in the single male, 21–31 (mean = 27), enlarged and curved in females; premaxillary teeth 4 and enlarged in the single male, 6–11 (mean = 7.6) enlarged and slightly curved in females; vomerine teeth in long rows, 11 in the single male and 16–25 (mean = 19.2) in females.

*Coloration in Life.*—Dorsal background, including head, trunk, tail, and limbs dark brown; the dorsum and limbs irregularly marked with reddish-brown spots; density of spots greatest on dorsal surface of the tail, with only a few small marks occur on the head (Fig. 1); a fine dark line runs from posterior border of eye, extending over neck and downward nearly to gular fold; a cream stripe present on each costal fold between axilla and groin, forming a series of pale bands on lateral surface of body. Belly dark gray, with gular region being somewhat paler. Iris golden.

*Coloration in Alcohol.*—Dorsal background of head, trunk, limbs, and tail is dark gray; all irregular marks on the body are pale brown; the bands on the lateral surfaces are pale gray; the line on the lateral surface of head the is similar in shade to that of live specimens; the belly is pale gray.

*Measurements of the Holotype.*—Measurements in millimeters. Head width 7.3; head depth 3.8; eyelid length 2.6; eyelid width 2.0; anterior margin of orbit to snout 2.3; interorbital distance 1.7; distance between corners of eyes 5.4; snout to forelimb 15.3; nostrile diameter 0.2; distance between external nares 2.1; projection of snout beyond mandible 0.7; snout to gular fold 12; width across shoulders 6.9; snout to anterior angle of vent 50.1; snout to posterior anterior angle of vent 53.7; axilla to groin 31.1; tail length 49.5; tail depth at base 4.7; tail width at base 4.7; forelimb length 10.8; width of hand 3.5; hind-limb length 11.7; width of foot 4.3; length of longest (third) toe 1.9; length of fifth toe 0.2; Numbers of teeth: premaxillary 9; maxillary 14/12; vomerine 11/10.

*Variation.*—All paratypes agree with the holotype. We have only one male specimen; it has fewer premaxillary, maxillary, and vomerine teeth than do the females. The density of spots in the specimens from Tlaxiaco is greater on the dorsum of the head than are the spots on specimens from other localities, and the cream bands on the lateral surfaces of body are not evident.

*Distribution and Ecology.*—*Pseudoeurycea mixteca* is known from the Mixteca Alta region of northwestern Oaxaca (Fig. 2) and is currently known from four localities: San Pedro Jocotipac (type-locality), San Juan Bautista Coixtlahuaca, Tlaxiaco, and Hwy. San Andrés Chicahuatlaxiaco. Specimens have been collected in the months of January, June, July, and September between elevations of 1985 and 2420 m. Because a hiatus exists between the southernmost locality (Tlaxiaco) and the type-locality (Fig. 2), additional work is needed to establish the geographic distribution of this species.

This species is known from several microhabitats in oak forests and pine forest, the

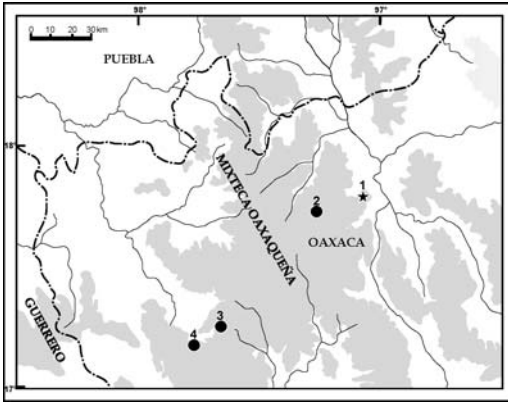


FIG. 2. Geographic distribution of *Pseudoeurycea mixteca* in northwestern Oaxaca. Star represents type locality and circles other locality records. Gray area represent elevations above 2000 m. (1) San Pedro Jocotipac, (2) San Juan Bautista Coixtlahuaca, (3) Tlaxiaco, (4) San Andrés Chicahuaxtla-Tlaxiaco.

majority in the former formation. One specimen was found in the base of dead agave, at the edge of an oak forest. Other specimens were found in the abundant leaf litter in an oak forest, whereas others were found under logs and in holes in tree trunks. The specimens obtained in Tlaxiaco were collected under bricks in the garden of a house (G. Parra-Olea, pers. comm.) and under the bark of a pine log (E. N. Smith, pers. comm.).

One specimen (MZFC 15292) had remnants of a small centipede and an adult staphylinid beetle in its mouth. This suggests that, like most salamanders, the diet includes small invertebrates.

One other species of salamander (an undescribed species of *Thorius*, G. Parra-Olea pers. comm.) is known to co-occur with *P. mixteca* at the northernmost localities. Other species of amphibians and reptiles associated with *P. mixteca* include: *Eleutherodactylus* (*Tomodactylus*) *nitidus*, *Abronia mixteca*, *Sceloporus formosus*, *S. mucronatus*, *Anolis quercorum*, *Eumeces brevirostris*, *Conopsis lineata*, *Salvadora intermedia*, *Tantilla flavilineata*, and *Thamnophis chrysocephalus*.

**Etymology.**—The specific epithet is derived from the area in which the new species lives, located at northwestern Oaxaca, and known as the Mixteca Alta.

**Discussion.**—The Mixteca Region is poorly known herpetologically, and only a few reports exist for the area. Recent explorations of this region have resulted in the discovery of new species (Canseco-Márquez et al. 2002; *Pseudoeurycea mixteca*). Some species endemic to Oaxaca have been described from this region (i.e., *Sceloporus subpictus*, *Abronia mixteca*, *Tantilla flavilineata*, *Anolis quercorum*), and Mendelson and Canseco-Márquez (2002) reported a second

specimen of *Hyla cembra* from this region. The Mixteca Region is covered by several vegetation types including pine forest, pine-oak forest, cloud forest, and oak forest, the latter habitat being abundant in the eastern Mixteca Region, where the majority specimens of *P. mixteca* were collected.

Wake et al. (1991) studied distributional patterns of salamanders along elevational transects in Oaxaca, but, nevertheless, the northwestern part of the state has been unexplored and distributional records of salamanders from that area are scarce. Only two species have been reported from the Mixteca: Papenfuss et al. (1983), Webb and Baker (1969), and Parra-Olea et al. (2002) reported *Bolitoglossa riletii* from secondary Tropical Semideciduous Forest near Putla de Guerrero between 700 and 1030 m, and Hanken (1983) reported *Thorius narisovalis* from 29.5 km northeast of Tlaxiaco, 3080 m; an undescribed species of *Thorius* also occurs at this latter locality (G. Parra-Olea, pers. comm.). Fieldwork in 1993 by the senior author in the pine-oak forests of the Sierra del Yucunino, resulted in discovery of some additional salamanders species this region. *Bolitoglossa riletii* (MZFC 13412–14) was found at Corral de Piedra, Santa Ana del Progreso, southwest of Tlaxiaco, between 1250 and 1265 m; *Pseudoeurycea bellii* (MZFC 13415) was found in the same locality at 1265 m; and juvenile specimens tentatively assigned to *P. cochranae* (MZFC 13410–11) and *Thorius narisovalis* (MZFC 13404–09) were collected between 1930 and 2925 m, at llano de Guadalupe, southwest of Tlaxiaco.

*Pseudoeurycea mixteca* was originally considered as *Pseudoeurycea* sp. nov. 2 by Parra-Olea (2002) and Parra-Olea and Wake (2001). Parra-Olea (2002) established three groups in the genus *Pseudoeurycea* based in mtDNA data. *Pseudoeurycea mixteca* (*Pseudoeurycea* sp. 2 in her analysis) is a member of the *Pseudoeurycea gadovii* group and is the sister taxon to the clade formed by *P. altamontana*, *Pseudoeurycea longicauda*, and *Pseudoeurycea robertsi*. None of these species occurs in Oaxaca.

A large sample deposited in the Museum of Vertebrate Zoology (MVZ 138910–21, 164694–99) listed as *Pseudoeurycea* sp. nov. Tlaxiaco are referred to *P. mixteca* based on molecular and phenotypic comparisons with our diagnosis (D. Wake, pers. comm.). The MVZ series does broaden the known elevational range for *P. mixteca* up to 3080 m. However those specimens were not examined as part of this study and, thus, have not been compared directly with our type series.

*Pseudoeurycea mixteca* is found within an area that has been cataloged by the Comisión

Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO) as of conservation priority (Arriaga et al., 2000). Even though some areas in the Mixteca still remain forested, destruction of habitat occurs at an accelerated pace and jeopardizes conservation of habitat.

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## APPENDIX 1

*Specimens Examined*

*Pseudoeurycea juarezi*: MEX: OAXACA., Brecha 60, Santiago Comaltepec: MZFC 4542, MZFC 04544; 3.1 mi. N of Cerro Pelón: MZFC 15272-73; Sierra Juarez, 27.5 km S Vista Hermosa, 2384 m: UTA 12879-80; Sierra Mixe, 12.4 km W Totontepec, 2524 m: UTA 12881; Sierra Juárez, 10.9 km WSW La Esperanza, on Mex Hwy. 175: UTA 17082; Sierra Juárez, 22.4 km WSW La Esperanza, approximately 0.8 km from Mex. Hwy 175, on road to Brecha Las Cascadas: UTA 17083-84; Sierra Juárez, Mex Hwy 175, km 107: UTA 28751.

*Pseudoeurycea cf. unguidentis*: MEX: OAXACA. Sierra Mixes, 13.6 mi (by road) northeast of Tamazulapan: UTA 5893.

*Pseudoeurycea mystax*: MEX: OAXACA: Sierra Juárez, Carr. Mitla-Totontepec MZFC: 5305-6.

*Pseudoeurycea smithi*: MEX: OAXACA. north Slope Sierra de Juarez, 1.1 km north crest of Cerro Pelon: UTA 5711; 1.8 km west of Llano de Las Flores: UTA 18526–57.

*Pseudoeurycea cochranae*: MEX: OAXACA. El Tejocote: UTA 6287, 17081; Llano de Guadalupe: MZFC 13410–11.

*Pseudoeurycea altamontana*: MEX: MORELOS. Lagunas Zempoala, 2835–3048 m: UTA 12865–66.