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New Species of the *Plectrohyla bistincta* Group (Hylidae: Hylinae: Hylini) from Oaxaca, Mexico

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ABSTRACT.—A new species of *Plectrohyla* is described from the Sierra de Miahuatlán in southern Oaxaca, Mexico. It is known from a single adult female obtained from pine-oak forest at 2550 m. The new species is similar to *Plectrohyla cembra* in size, habitus, and in having a partially concealed tympanum but differs most notably in aspects of color pattern, hand morphology, head shape, and palatine features.

RESUMEN.—Se describe una nueva especie de *Plectrohyla* de la Sierra de Miahuatlán al sur de Oaxaca, México. Se conoce de una sola hembra adulta que fue capturada en un bosque de pino y encino a 2550 metros de elevación. La nueva especie es similar a *Plectrohyla cembra* en tamaño, habito, y en tener el tímpano parcialmente escondido, pero difiere notablemente en aspectos de patrón de coloración, morfología de la mano, forma de la cabeza, y características del paladar.

As currently understood, the genus *Plectrohyla* comprises two sister clades: the *Plectrohyla bistincta* group with 22 species distributed in the Mexican highlands west of the Isthmus of Tehuantepec, and the *Plectrohyla guatemalensis* group with 18 species collectively occupying the uplands of Nuclear Central America (Faivovitch et al., 2005). Many members of the *P. bistincta* group seem to be restricted to single mountain ranges or drainages, and several are known from very few specimens. Despite the dearth of available material and the apparent difficulty in obtaining additional specimens, new species of the *P. bistincta* group continue to be described (e.g., Ustach et al., 2000; Canseco-Márquez et al., 2002; Meik et al., 2005). Although sufficient data

are lacking, the majority of species are likely critically endangered (see Lips et al., 2004).

Plectrohyla cembra was described by Caldwell (1974) on the basis of a single adult male specimen and a series of associated tadpoles collected north of Candelaria Loxicha in the Sierra Madre del Sur of Oaxaca in 1969. New material representing *Plectrohyla cembra* had not been secured for nearly three decades following its description. Recently, Mendelson and Canseco-Márquez (2002) reported an additional adult male specimen that was accessioned but had remained unidentified for many years, in the collections of the Museo de Zoología, Facultad de Ciencias (MZFC), Universidad Autónoma de México. This specimen was collected in 1993 from the Mixteca Alta region of Oaxaca, approximately 172 km (airline) northwest of the type locality.

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While sorting material obtained during recent collecting excursions into Oaxaca, we examined a specimen of *Plectrohyla* that is phenotypically similar to *P. cembra* and *Plectrohyla sabrina*. Because the new specimen was obtained from the same mountain range as the holotype of *P. cembra*, we initially believed that we had found the first known adult female specimen of that species. However, after examination of comparative material (including the holotype of *P. cembra*), we determined that the new specimen cannot be allocated to *P. cembra* or to any other hylid frog known from Mexico. Based on its distinctive morphology and color pattern, we describe this unique specimen as a new species.

MATERIALS AND METHODS

Terminology and measurements follow Duellman (2001); measurements were rounded to the nearest 0.1 mm; those ≥ 10 mm were made using a digital caliper; those < 10 mm were made using a dissecting microscope equipped with an ocular micrometer. Sex was determined by the presence of nuptial excrescences or by dissection. Webbing formulae follow Myers and Duellman (1982). Snout-vent length is abbreviated SVL throughout. Information on color in life was taken from a color transparency. We examined material from the herpetology collections at the University of Texas at Arlington (UTA), the University of Kansas (KU), and from the MZFC. A list of specimens examined is provided in Appendix 1.

DESCRIPTION OF NEW SPECIES

Plectrohyla miahuatlanensis sp. nov.

Figures 1–2

Holotype.—MZFC 17864 (original field number JAC 21228), an adult female collected north of Candelaria Loxicha, 2550 m (16°12.844'N, 96°31.938'W), Sierra de Miahuatlán, Oaxaca, Mexico; obtained on 23 September 2001 by Peter Heimes, Eric N. Smith, and Adrian Nieto Montes de Oca.

Diagnosis.—*Plectrohyla miahuatlanensis* is a medium-sized treefrog of the *P. bincta* group (sensu Toal and Mendelson, 1995; Faivovitch et al., 2005). The new species can be readily distinguished from all other Mexican hylids by its distinctive coloration: *Plectrohyla miahuatlanensis* possesses a dark green dorsum, dark brown hidden surfaces, yellow flanks, a dark brown canthal mask and lateral reticulations, and a yellow stripe separating the dorsal from the ventral coloration on the limbs and above

the cloaca. *Plectrohyla miahuatlanensis* is superficially most similar to other moderate- to medium-sized species of the *P. bincta* group, particularly *P. cembra*, *Plectrohyla charadricola*, *Plectrohyla chryses*, *Plectrohyla mykter*, and *Plectrohyla sabrina*. Of these species, only *P. cembra* shares with *P. miahuatlanensis* the character state of having an indistinct tympanum partially obscured by undifferentiated skin. The new species can be distinguished from *P. cembra* by the following combination of characters (condition for *P. cembra* in parentheses): snout truncate (snout round) in profile; brown canthal and postorbital stripe present (absent); flank yellow with brown reticulations (flank green with brown reticulations); disc on third finger approximately twice width of tympanum (disc on third finger slightly wider than tympanum); choanae small and separated by eight times choanal width (choanae large and separated by approximately 3.5 times choanal width); hand with distinctly longer, more gracile fingers. In addition, *P. miahuatlanensis* has slightly more webbing on the foot (webbing formula I1–2III1/4–2III1–21/3IV21/3–11/4V in *P. miahuatlanensis* vs. I11/2–2II11/3–21/2III2–3IV3–11/2V in *P. cembra*).

Plectrohyla miahuatlanensis also closely resembles *P. sabrina*, particularly in head shape and color pattern but can be distinguished from the latter species by the following combination of characters (condition for *P. sabrina* in parentheses): tarsal fold present (absent); tympanum partially obscured by undifferentiated skin (tympanum absent); body relatively robust (body slender); skin weakly glandular (skin smooth), flank yellow with brown reticulations (flank solid brown or brown with white mottling); choanae small and widely separated (choanae large and narrowly separated).

Description of Holotype.—Adult female; head same width as body, slightly wider than long; head length 31% SVL; head width 34% SVL; snout anteroventrally inclined and truncate (nearly bluntly rounded) in profile, acutely rounded in dorsal view, rostral keel not evident; canthus rostralis distinct, rounded; loreal region concave; lips moderately thick, not flared; nostrils slightly protuberant, crescent-shaped, directed anterolaterally; internarial region rounded. Top of head flat; diameter of eye 27% head width. Supratympanic fold moderately heavy, extending posteriorly from edge of orbit, curving only slightly downward to a point above insertion of forelimb; fold covering upper portion of tympanum; tympanum higher than long, partially concealed by undifferentiated skin, annulus indistinct; diameter of tympanum 35% diameter of eye.



FIG. 1. Female holotype of *Plectrohyla miahuatlanensis* sp. nov. in life (MZFC 17864). Photo by P. Heimes.

Weak axillary membrane present; row of low tubercles present on ventrolateral surface of forearm; transverse dermal fold on wrist; fingers long, slender, without lateral fringe, bearing large ovoid discs slightly wider than long; width of disc on third finger nearly twice the diameter of tympanum. Subarticular tubercles on Fingers I–III round, nearly flat, approximately one fourth to one third diameter of discs on respective digits; subarticular tubercles on Finger IV round, elevated, approximately two thirds diameter of disc; supernumerary tubercles low, diffuse; palmar tubercle low, weakly defined; prepollical tubercle moderately short, elongate. Webbing on hands vestigial. Hind limbs moderately slender; tibia length 53% SVL; foot length; 49% SVL; tibiotarsal articulation extending to anterior edge of orbit; heels of adpressed limbs overlap by about 30% length of shank; tarsal fold distinct, extending entire length of tarsus; inner metatarsal tubercle moderately small, flat, ovoid; outer metatarsal tubercle subconical, barely evident. Toes long, slender, with narrow lateral fringe, bearing discs slightly smaller than those on fingers; subarticular tubercles large, some round and moderately flat, others subconical; supernumerary tubercles small, indistinct, in single row on proximal segment of each digit; webbing formula: I1–2III11/4–2III1–21/3IV21/3–11/4V.

Cloacal opening directed posteriorly at upper level of thighs; cloacal sheath short. Skin on all dorsal surfaces moderately thick, weakly glandular; skin on throat, chest, abdomen, and posteroventral surface of thighs granular; other

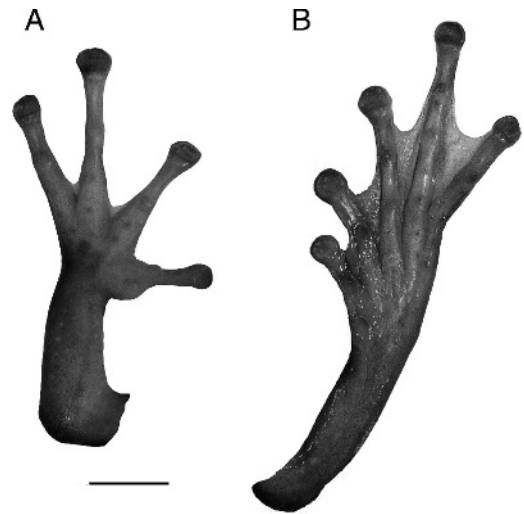


FIG. 2. Ventral surface of right hand (A) and left foot (B) of *Plectrohyla miahuatlanensis* (holotype, MZFC 17864). Line represents 5 mm.

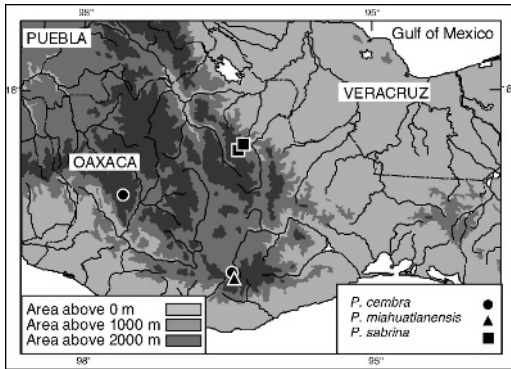


FIG. 3. Map of Oaxaca, Mexico, and portions of surrounding states depicting the type locality of *Plectrohyla miahuatlanensis* sp. nov. and known localities for *Plectrohyla cembra* and *Plectrohyla sabrina*.

ventral surfaces smooth. Tongue round, shallowly notched anteriorly and posteriorly; barely free behind. Vomerine dentigerous processes transverse, narrowly separated medially, each bearing four ventrally projecting teeth; choanae guttiform, directed posterolaterally, widely separated.

Measurements of Holotype.—Measurements in millimeters. SVL = 42.5; tibia length = 22.5; foot length = 20.8; head length = 13.0; head width = 14.6; tympanum diameter = 1.4; eye diameter = 4.0; eye–nostril distance = 3.4.

Color in Life.—Dorsal surfaces of body, head, and limbs dark green with faint brown mottling, flanks lemon yellow, periphery of throat, ventral and posterior surfaces of limbs dark brown; dark brown lateral stripe extending from intermaxillary symphysis through canthus, orbit, and supratympanic fold onto flanks, expanding on lateral surfaces to form reticulations; dark brown labial stripe present, continuous with lateral stripe at intermaxillary symphysis and near point of insertion of the forelimb; ventral coloration of limbs demarcated from dorsal green coloration by a thin broken yellow stripe; yellow stripes on posterior surfaces of hind limbs merge above cloaca to form a bar.

Color in Preservative.—Dorsum uniform dark glaucous, flanks greenish-grey with cream reticulations, broken line on limbs and above cloaca light grey, venter and hidden surfaces of limbs off-white; canthal and postorbital stripe barely evident, white cloacal bar distinct.

Etymology.—The species name is in reference to the Sierra de Miahuatlán, where the first and only known specimen of the new species was found.

Distribution and Habitat.—The holotype was encountered in late afternoon, inactive between the leaves of an arboreal bromeliad. The habitat at the type locality consisted of mesic pine-oak forest. Although the area was covered with relatively intact forest during 2001, many slopes of the Sierra de Miahuatlán have been cleared, or partially cleared, for agricultural purposes. Other amphibians collected at the type locality at the time the only known specimen of *P. miahuatlanensis* was secured include *Eleutherodactylus mexicanus*, *Bolitoglossa oaxacensis*, and a series of hyline frogs of the *Exerodonta sumichrasti* group.

DISCUSSION

The type locality of *P. miahuatlanensis* is situated in the Sierra de Miahuatlán, an east-west trending spur of the main escarpment of the Sierra Madre del Sur of Oaxaca (Fig. 3). Natural vegetation on the higher slopes consists primarily of dry to mesic oak and pine-oak forests. Despite the existence of several notable collections from the Sierra Madre del Sur of Oaxaca, the cordillera remains relatively poorly known herpetologically. This is likely because of the vast spatial extent, broken topography, and limited access that characterize these highlands. With the description of *P. miahuatlanensis*, five species of the *P. bistincta* group have been reported from the Sierra Madre in southern Oaxaca, making this region an important center of diversity for the group. Two species (*P. labedactyla* and *P. cembra*) are collectively known from only three specimens; *P. crassa* occurs in the Sierra Mixe and Sierra Juárez; and *P. pentheter* is known from multiple disjunct sites from central Guerrero through Oaxaca. The latter two species show some level of interpopulational variation, and may represent species complexes.

Although we have been able to obtain only a single specimen of the new species, we contend that our decision to describe it at this point is not premature. The important differences distinguishing *P. miahuatlanensis* from other *Plectrohyla* are based on characters that usually exhibit little intraspecific variation and have previously been shown to be of taxonomic utility in this group. In addition, the unique combination of characters distinguishing this species from the sympatric and superficially similar *P. cembra* is a suite of both color pattern and anatomical differences. To assume that the new specimen represents the otherwise unknown female of *P. cembra* would require a degree of sexual dimorphism unprecedented in the *P. bistincta* group (see also Mendelson and Toal, 1996). Among species of the *P. bistincta*

group where both males and females are known, sexual dimorphism is limited to size (females are usually larger than males) and sometimes to secondary sexual characters (e.g., nuptial excrescences in breeding males). Although additional material for the assessment of variation and sexual dimorphism in the new species would be ideal, many species of the *P. bistincta* group are known from very few specimens, and it is possible that many years will pass before new material becomes available.

Based on morphological characters Duellman and Campbell (1992) concluded that *Plectrohyla* (sensu stricto) was likely sister to members of the former *Hyla bistincta* group; however, they were unable to identify synapomorphies unambiguously supporting the *bistincta* group as a clade (see Toal and Mendelson, 1995). Recently, Faivovitch et al. (2005) performed a rigorous phylogenetic analysis of the Hylidae using morphology and multiple nuclear and mitochondrial genes. They recovered a sister-group relationship between *Plectrohyla* and members of the former *H. bistincta* group + additional species from the former *Hyla miotympanum* and *Hyla pictipes* groups. Faivovitch et al. (2005) assigned the name *Plectrohyla* to both clades recognizing that their limited sampling did not allow an adequate test of the intrarelationships of these groups. With the addition of *P. miahuatlanensis*, the genus now contains 41 recognized species that occupy disjunct highland regions both east and west of the Isthmus of Tehuantepec; the content and collective distribution of this clade make it a fascinating candidate for evolutionary analysis. A detailed study of interspecific relationships within *Plectrohyla* would almost certainly provide a major contribution to Middle American biogeography.

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APPENDIX 1

Specimens Examined

Plectrohyla celata: MEX: OAXACA: Sierra de Juárez, 1.1 km north of Cerro Pelón, UTA A-5060. *Plectrohyla cembra*: MEX: OAXACA: Campamento Río Molino, 33.8 km (by road) north of Candelaria Loxicha, KU 137035 (holotype); Sierra de Yucuyacua, 7.5 km southeast of Llano de Guadalupe, MZFC13382. *Plectrohyla chryses*: MEX: GUERRERO: Sierra Madre del Sur, 11.4 km west of Puerto del Gallo, UTA A-

56437–38, 56440. *Plectrohyla cyanomma*: MEX: OAXACA: Sierra de Juarez, 1.2 km north of crest of Cerro Pelón, UTA A-5731, 5735. *Plectrohyla mykter*: MEX: GUERRERO: Sierra Madre del Sur, 0.8 km southwest of Omilteme, UTA A-4108–11. *Plectrohyla psarosema*: MEX: OAXACA: Sierra Mixes, 5.8 km (by road) west of Totontepec, UTA A-5782 (holotype), UTA A-5771, 5776, 5783 (paratypes). *Plectrohyla sabrina*: MEX: OAXACA: Sierra de Juárez, 11.1 km south of Vista Hermosa, UTA A-52810 (paratype).