The south-facing slopes of the Sierra Madre del Sur in Oaxaca, Mexico, remain mostly covered with pristine broad-leaf forest. This image shows the stream where adults and tadpoles of the hylid frog *Megastomatohyla pellita* were collected. Tadpoles were captured with a net during the day, whereas adults were encountered on rocks in the streambed at night. The locality is about 25 km north of the village of San Gabriel Mixtepec.

Mesoamerican Herpetology
www.mesoamericanherpetology.com
Eagle Mountain PUBLISHING, LC
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The tadpole of *Megastomatohyla pellita* (Duellman, 1968) (Amphibia: Anura: Hylidae)

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Abstract: We describe the larval stage of the Oaxacan Yellow Treefrog (*Megastomatohyla pellita*) based on five tadpoles collected from a mountain stream, 25 km N San Gabriel Mixtepec, elev. 1,490 m, Oaxaca, Mexico. The tadpole of this species is characterized by the presence of a large suctorial, posteriorly emarginated oral disc with 7(7)/10 keratodont rows, marginal papillae positioned in an alternating uniseriate row anteriorly and laterally, and in two alternating rows posteriorly (MPRF 1-2/1-2/2-3); a cloacal tube with a dextral opening; a low dorsal fin with a convex margin, and slightly higher than the body; a low ventral fin throughout its length, only slightly higher than the body; and the tip of tail rounded. We provide a coloration description in life.

Key words: Anuran larvae, *Batrachochytrium dendrobatidis*, Mexico, Oaxaca, rediscovery, Sierra Madre del Sur

Resumen: Se describe la etapa larval de la ranita *Megastomatohyla pellita*, basada en cinco renacuajos obtenidos en un arroyo de montaña, a 25 km al norte de San Gabriel Mixtepec, Oaxaca, México, elevación de 1,490 m. El renacuajo de esta especie se caracteriza por la presencia de un disco oral emarginado posteriormente con 7(7)/10 hileras de dientes, papilas marginales posicionadas en una hilera alternada anterior y lateralmente, y dos hileras alternadas posteriormente (fórmula de las hileras de papilas marginales, 1-2/1-2/2-3); tubo cloacal con una abertura dextral; aleta dorsal baja con un margen convexo, y ligeramente superior a la del cuerpo; aleta ventral baja en toda su longitud, sólo ligeramente más alta que el cuerpo; punta de la cola redondeada. Proporcionamos una descripción de la coloración en vida.

Palabras Claves: *Batrachochytrium dendrobatidis*, etapa larval, México, Oaxaca, redescubrimiento, Sierra Madre del Sur

Citation: Köhler, G., R. G. Trejo Pérez, L. Canseco-Márquez, F. Méndez de la Cruz, and A. Schulze. 2015. The tadpole of *Megastomatohyla pellita* (Duellman, 1968) (Amphibia: Anura: Hylidae). Mesoamerican Herpetology 2: 146–152.

Received: 2 April 2015; **Accepted:** 28 May 2015; **Published:** 18 June 2015.

INTRODUCTION

The Oaxacan Yellow Treefrog, *Megastomatohyla pellita*, was described by Duellman (1968; as *Hyla pellita*) on the basis of three specimens collected on 20 February 1966 from 33 km north of San Gabriel Mixtepec, Oaxaca, Mexico. These three specimens of the type series "were found on low vegetation in streams in cloud forest at night" (Duellman, 1968: 570). The species was placed in the genus *Megastomatohyla* by Faivovich et al. (2005) and has remained poorly known, as it has not been "recorded since the 1960s" (Stuart et al., 2008: 263). A description and illustration of its larva, therefore, is of particular importance because of the conservation status of this species, which has been classified by the IUCN as Critically Endangered (Santos-Barrera and Canseco-Márquez, 2004).

During fieldwork along the Pacific slopes of the Sierra Madre del Sur in the Mexican state of Oaxaca, GK and RGTP collected two adults and several tadpoles of this species in the vicinity of its type locality. Because the larval stage of *M. pellita* remains undescribed (Duellman, 1970, 2002), herein we provide a description of the tadpole of this endangered hylid.

MATERIALS AND METHODS

On 6 March 2013 we collected five tadpoles of *Megastomatohyla pellita* (SMF 99433, Gosner stages 26–30) from a mountain stream located 25 km N of San Gabriel Mixtepec (16.19313°, -97.09766°, elev. 1,490 m), Oaxaca, Mexico. Before the tadpoles were preserved, we cut the distal portion of the tail in one of the specimens (Gosner stage 27) and preserved it in 98% non-denaturated ethanol for DNA extraction. The tadpoles were preserved and maintained in 4% formalin, and deposited in the herpetological collection of the Senckenberg Research Institute Frankfurt, Germany. The identification of the tadpoles was verified by matching the CO1 barcodes with the respective barcodes of adult frogs (GenBank accession no. KR920741, KR920742, KR920743). We follow Köhler (2012) for the capitalized colors and color codes (the latter in parentheses), as well as for the terminology of markings used in the color descriptions. We follow Altig (1970) and McDiarmid and Altig (1999) for the terminology of tadpole morphology, except that we follow Dubois (1995) in using the term keratodonts instead of teeth. We use the abbreviations MPRF (marginal papillae row formula), LKRF (labial keratodont row formula), and *Bd* (*Batrachochytrium dendrobatidis*). We took the images of the detailed morphological characters with a Canon DSLR camera using a micro lens (Canon MP-E 65 mm), and formatted them with the image stacking software Helicon Focus 6.2.2. (Helicon Soft Ltd.).

RESULTS

The following measurements are based on two tadpoles (SMF 99433) at Gosner (1960) stages 28 and 30, respectively: total length = 38.23 mm + 38.45 mm; body length = 13.42 mm + 13.94 mm; tail length = 24.60 mm + 24.25 mm; maximum body height = 6.30 mm + 7.49 mm; maximum body width = 7.77 mm + 7.85 mm; internarial distance = 3.43 mm + 3.61 mm; interorbital distance = 3.85 mm + 4.17 mm; eye diameter = 1.95 mm + 2.22 mm; oral disc width = 6.33 mm + 6.80 mm; snout-nostril distance = 2.12 mm + 2.58 mm; snout-spiracle distance = 9.29 mm + 9.49 mm; maximum tail height = 9.87 mm + 10.08 mm; maximum dorsal fin height = 2.62 mm + 2.33 mm; maximum ventral fin height = 1.96 mm + 1.98 mm; maximum tail muscle height = 4.45 mm + 4.86 mm; maximum tail muscle width = 4.17 mm + 4.38 mm; body length relative to total length = 35.1% + 36.3%; and eye diameter relative to body length = 4.4% + 5.3%.

***External morphology*:** The body is globular, compressed in lateral view and ovoid in dorsal view (Fig. 1). The snout is oval in dorsal view, and tapering in lateral view. The oral disc is prominent, situated and directed almost ventrally, and emarginated posteriorly. The oral disc is bordered by marginal papillae without gaps, in an alternating uniseriate row anteriorly and laterally, and with two alternating rows posteriorly; the inner papillae are larger and triangular in shape, and the outer papillae are conical and long (MPRF 1-2/1-2/2-3). Submarginal papillae are present, grouped laterally and on the lower labium, near the lateral ends of the lower labium; the submarginal papillae are triangular and long. The jaw sheaths are slightly serrated, with the upper one arc-shaped and the lower one widely V-shaped. LKRF 7(7)/10. Keratodont rows A-1 to A-3 are fragmented and respectively shorter than A-4 to A-7, with the latter containing significantly larger keratodonts and A-7 with a clear median gap. Rows P-1 to P-6 are nearly the same length, rows P-1 to P-3 contain significantly larger keratodonts, which decrease in size in rows P-4 to P-10, and rows P-9 and P-10 are shorter and fragmented (Fig. 2). The eyes are small, and positioned and directed laterally. The nostrils are positioned dorsolaterally and directed anterodorsally, are ovoid in shape and slightly elevated, and form a small torus but without an operculum. The spiracle is low and in a sinistral position, with the opening directed posterolaterally, and ends in a free tube that is less wide than its base. The cloacal tube is situated medially, is longer than wide with a tapered shape, and is attached to the ventral fin, with a dextral opening.

The low dorsal fin rises slightly before the border between the body and tail and has a convex margin, and is slightly higher than the body height. The ventral fin is low throughout its length, lower than the dorsal fin, and only slightly extends beyond the body. Myotomes of tail musculature are visible throughout its length. The tip of the tail is rounded, and slightly directed downward. The lateral line system (*sensu* Lannoo, 1999) is not visible.

Fig. 1. Preserved tadpole of *Megastomatohyla pellita* (SMF 99433; Gosner stage 28). (A) lateral view; (B) dorsal view; and (C) ventral view. Scale bars = 5 mm.

Fig. 2. Oral disc of a preserved tadpole of *Megastomatohyla pellita* (SMF 99433; Gosner stage 28). Scale bar = 1 mm.

The coloration in life is as follows (Fig 3 and 4): the dorsal and lateral surfaces of the body are Olive (126) with Vandyke Brown (281) and Raw Umber (22) blotches and mottling, and with Straw Yellow (53) and Clay Color (20) stipples; a Whitish Lime Green (111) blotch is present in the dorsolateral snout region; the posterior portion of the ventrolateral margin of the body is Sulphur Yellow (92); the spiracle is Brownish Olive (276), with Pale Sulphur Yellow (92) around the opening; the oral disc, in lateral view, is Olive Horn Color (16); the iris is Light Straw Yellow (95) with Sepia (279) suffusions at the edges; the tail musculature is Whitish Lime Green (111), with suffusions of Brownish Olive (276) pigment and a larger and a smaller Smoke White (261) blotch in the central lateral region; the upper and lower fins contain Glaucous (289) stipples and a fine Smoke Gray (267) reticulum of capillary-like lines; the posterior portion of the ventral surface of the body is Blue Black (187), with Sulphur White (96) blotches and stipples; the sinus hyobranchialis is Dark Bluish Purple (230); the oral disc is Sulphur White (96), grading into Pale Buff (1) on the posterior portion, and contains Jet Black (300) keratodont rows and jaw sheaths.

DISCUSSION

The description and illustration of the tadpole of *Megastomatohyla pellita* should facilitate the identification of this species during tadpole surveys along the Pacific slopes of the southern Sierra Madre del Sur in Mexico. The tadpoles of cloud forest stream breeding frogs need several months to complete development, and therefore can be more easily detected than their adult conspecifics. Whereas the adult frogs are nocturnal and their activity is affected by short-term climatic conditions (e.g., adult activity might be low during cold, dry, windy periods), the tadpoles are easily detected both at night and during the day, and are not affected by climatic fluctuations. Therefore, tadpole surveys are valuable tools for monitoring stream breeding montane frogs, and particularly suited for uncommon or rarely found species. Such surveys now are more important, as *Bd*-infection has been detected in syntopic species in this particular region (Lips et al., 2004; G. Köhler, unpublished) and tadpoles showing anomalies in the keratinized mouthparts are reliable indicators.

Fig. 3. Tadpole of *Megastomatohyla pellita* (SMF 99433) in life.

Fig. 4. Oral disc of *Megastomatohyla pellita* tadpole (SMF 99433) in life.

None of the tadpoles of the four species of the genus *Megastomatohyla* have been described in detail. Altig (1987) provided a key for the tadpoles of Mexico, and defined the following parameters for identifying "*Hyla mixomaculata* (*H. pellita*)": vent dextral; spiracle definitely sinistral; usually lotic habitat; lower labial tooth rows 9–11; gut coiled; collected near Huatusco and Coscomatepec, Veracruz. These traits do not represent a detailed morphological characterization of the *M. pellita* tadpole, but rather summarize the general features of typical stream-dwelling hylid tadpoles. Examples of this tadpole morphotype, with a large suctorial oral disc and numerous keratodont rows, also are found in other genera, e.g., in *Ptychohyla* and *Hyloscirtus* (Köhler, 2011). Tadpoles of other frog species recorded at the same locality along with *M. pellita* include those of *Lithobates sierramadrensis* (Taylor, 1939) and *Ptychohyla leonhardschultzei* (Ahl, 1934). Furthermore, we collected adults of *Exerodonta sumichrasti* at this site, but found no tadpoles. The sparse knowledge of the entire genus *Megastomatohyla,* and particularly of their larval stages, urgently requires more research to utilize the valuable tadpole data, especially for conservation efforts regarding a disease-based decline.

Acknowledgments.—We thank Claudia Koch and an anonymous reviewer for valuable comments. Collecting and exportation permits (FAUT 0074 and 2013-039) were issued by Martin Vargas Prieto, Secretaria del Medio Ambiente y Recursos Naturales, México D.F., Mexico.

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