

DISTRIBUTION AND NATURAL HISTORY OF THE HYLID FROG  
*HYLA XERA* IN THE TEHUACAN-CUICATLAN VALLEY, MEXICO, WITH A  
DESCRIPTION OF THE TADPOLE

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**ABSTRACT**—We describe the tadpole of the recently described hylid frog *Hyla xera* and report information regarding the distribution and natural history of this species endemic to the Tehuacán-Cuicatlan Valley in Oaxaca and Puebla, Mexico. This species was previously known only from the type locality near Zapotitlán Salinas, Puebla, south of Tehuacan, Puebla. With our work, its range is now extended, adding 6 localities in Puebla and 4 in Oaxaca. Adults take refuge in arboreal bromeliads and breed in streams in the rainy season from May to August.

**RESUMEN**—Describimos el renacuajo del anuro recientemente descrito *Hyla xera*, y aportamos información sobre la distribución e historia natural de este hílido endémico del Valle de Tehuacán-Cuicatlan en Oaxaca y en Puebla, México. Esta especie era conocida únicamente de la localidad tipo cerca de Zapotitlán Salinas, Puebla, al sur de Tehuacán, Puebla. A partir de este trabajo se amplía el conocimiento sobre la distribución de esta especie, adicionando 6 localidades para el estado de Puebla y 4 para Oaxaca. Los adultos se refugian dentro de las bromelias y su reproducción se lleva a cabo en arroyos durante la temporada de lluvias de mayo a agosto.

The tadpoles of many anuran species are undescribed (Mendelson et al., 1999), particularly those known from only a few adult specimens. Likewise, the natural history, biology, and ecology of the majority of these species have received little attention. In light of recent declines of amphibian populations, obtaining knowledge of habitats and breeding sites is critical.

The *Hyla sumichrasti* group (sensu Duellman, 1970) is endemic to Mexico and comprises 4 species: *H. sumichrasti*, *H. smaragdina*, *H. chimalapa*, and *H. xera* (Mendelson and Campbell, 1994; Duellman, 2001). The tadpoles of *H. smaragdina* and *H. sumichrasti* were described by Duellman (1970), whereas those of *H. chimalapa* and *H. xera* are unknown.

During fieldwork conducted from 1996 to 2001 in the Tehuacán-Cuicatlan Valley in southern Puebla and northern Oaxaca, we obtained adults and tadpoles of *Hyla xera* in different developmental stages at several localities. Herein, we describe the tadpole and provide information about the distribution and

natural history of this hylid endemic to the Tehuacán-Cuicatlan Valley.

The description is based on 6 series containing a total of 45 tadpoles in developmental stages 26 through 41 (Gosner, 1960) collected from 27 to 29 October 1996. Tadpoles were collected at elevations of 1,485 to 1,905 m in streams and associated pools flowing through either arid tropical scrub or tropical deciduous forest. Tadpoles were fixed in 10% formalin, and all were deposited in the Colección Herpetológica de la Escuela de Biología de la Universidad Autónoma de Puebla (EBUAP). Measurements were taken with a dial caliper (0.1 mm) under a stereoscopic microscope. Terminology is that of Altig and McDiarmid (1999). Information regarding the natural history of the species was gathered from field observations. Appendix 1 lists all material examined and also material originally reported by Mendelson and Campbell (1994). In addition to material deposited at EBUAP, we also report on specimens deposited at Escuela Nacional de Ciencias Biológicas, Instituto Politécnico Na-

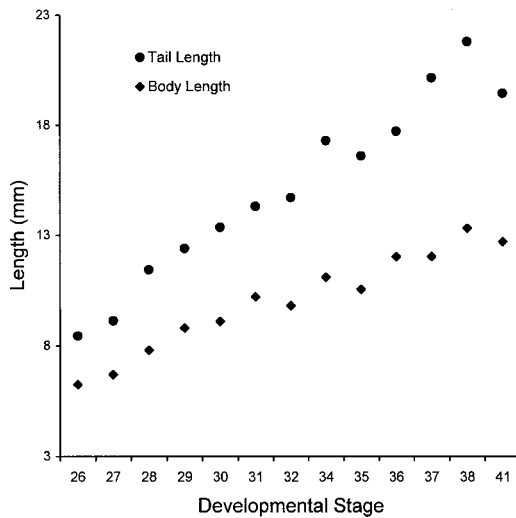


FIG. 1—Increases in body and tail lengths of tadpoles of *Hyla xera* during developmental stages 26–41 (Gosner, 1960).

cional (ENCB), the University of Texas at Arlington (UTA), and the University of Kansas (KU).

*Description of the Tadpole*—Relative increases of the body and tail lengths of 45 tadpoles in developmental stages 26 through 41 are shown in Fig. 1; body and tail proportions remain relatively constant through development. The following description is based on a single tadpole in Stage 37 (EBUAP-632) from Los Reyes Metzontla, Puebla. Measurements (mm): total length 36.4; body length 14.7; tail length 21.7; body width 8.4; body height 6.3; eye diameter 1.9; interorbital distance 2.9; internarial distance 1.8; naris–eye distance 1.4; snout–naris distance 3.4; snout–spiracle 8.5; snout–eye distance 5.7; oral disc width 7.6.

Body ovoid in dorsal view (Fig. 2); in lateral view higher anteriorly than posteriorly; snout widely rounded in dorsal and lateral view; nostrils small, rounded, directed dorsally, located near the eye about one-third of distance between eyes and tip of snout; internarial distance less than interocular distance; eyes moderately large, situated and directed dorsolaterally; tip of tail rounded; dorsal fin slightly higher than ventral fin; caudal musculature robust, highest at base, gradually tapering to pointed tip; spiracle sinistral, short, opening near mid-body slightly below midline; cloacal tube long and dextral.

Oral disc large, completely bordered with single row of numerous marginal papillae; upper marginal papillae smaller, blunter than larger, conical lower papillae; single row of submarginal papillae anterior to A-1, larger and less numerous than row of submarginal papillae posterior to P-7; lateral submarginal papillae present, large. Labial tooth row formula 3(3)/7 (several tadpoles in stages 27 through 29 with labial tooth formula 3(3)/6); P-4, P-5, P-6 discontinuous laterally; P-7 discontinuous throughout length. Size of teeth in row A-1 smaller than teeth in A-2 and A-3; size of teeth in P-4, P-5, P-6, and P-7 smaller than in P-1, P-2 and P-3. Labial tooth row A-2 slightly longer than A-1; gap in A-3 present, narrow. Upper jaw sheath moderately wide, finely serrate, lateral processes tapering abruptly posterolaterally; lower jaw sheath about equal in width to upper sheath, finely serrate; shallowly V-shaped (Fig. 2).

In preservative, dorsum dark gray; venter transparent; gut visible ventrally and laterally. Caudal musculature pale gray with small, bronze flecks; caudal fins translucent with faint bronze blotches.

Comparisons with the illustrations and descriptions presented by Duellman (1970, 2001) indicated that the tadpole of *H. xera* differs from that of *H. sumichrasti* by having a single row of marginal papillae (double in *H. sumichrasti*) and lateral submarginal papillae that are more numerous and larger in size. The tadpole of *H. xera* differs from that of *H. smaragdina* by having a smaller oral disc (immense in *H. smaragdina*), by having a single row of marginal papillae (double in *H. smaragdina*), by having lateral submarginal papillae (absent in *H. smaragdina*), and by having larger eyes.

*Distribution*—The 4 species in the *Hyla sumichrasti* group are endemic to western and southeastern Mexico: *H. sumichrasti* in the Sierra Madre del Sur of Guerrero, east and west of the Isthmus of Tehuantepec in Oaxaca, and in western Chiapas; *H. smaragdina* in the Sierra Madre Occidental, Sierra de Coalcomán and the Volcanic Range from southern Sinaloa, Jalisco, Morelos, and Puebla; *H. chimalapa* only on the Pacific versant of the Sierra Madre of southeastern Oaxaca and adjacent Chiapas; *H. xera* in the Zapotitlán Valley, Puebla (Webb, 1982; Mendelson and Campbell, 1994; Duellman, 2001).

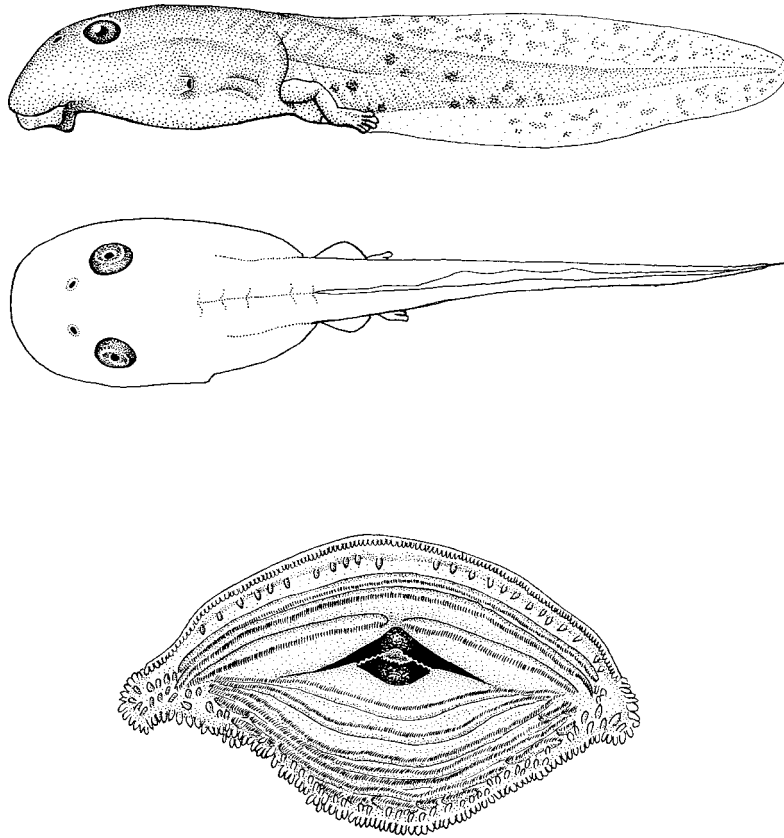


FIG. 2—Lateral and dorsal views (upper image) and mouthparts (lower image) of the tadpole of *Hyla xera*, Stage 37 (Gosner, 1960; EBUAP 632; total length 36.4 mm; mouth width ca. 6.7 mm).

At the time of its description (Mendelson and Campbell, 1994), *H. xera* was known only from the type locality (5.6 km SSW Zapotitlán Salinas, Puebla). A specimen originally referred to *H. chimalapa* (KU 179072) from 6.5 km NNE of Niltpec (NNE of Huajuapán de León, Oaxaca) has now been identified as *H. xera*. During our fieldwork, we discovered several new localities (Appendix I) for *H. xera* in the Tehuacán-Cuicatlán Valley (Fig. 3).

*Natural History*—The Tehuacán-Cuicatlán Valley is generally dominated by arid and semi-arid vegetation, including arid tropical scrub, thorn forest, and tropical deciduous forest (Fig. 4). Oak and pine-oak forests occur at higher elevations. Cloud forest occurs nearby in the Sierra de Juárez. Most of the range of *H. xera* is included in the arid and semi-arid vegetation, although we have found this species in a pine-oak forest 6.5 km W of Concep-

ción Pápalo, Oaxaca. The known elevational range of this species is 1,440 to 2,020 m.

In the Tehuacán-Cuicatlán Valley, evaporation exceeds rainfall, and no permanent streams exist. Annual rainfall is less than 150 mm and occurs mostly from May to September. Although there are important drainages in the valley (e.g., Río Grande), there are also streams 10 to 40 cm in depth with rocky or muddy substrates. Tadpoles and adults of *H. xera* are common in such streams. At Zapotitlán Salinas, we observed temporal partitioning of the Río Zapotitlán by various species of anurans. During the rainy season (May through September), adults of *Hyla xera* are common along this river. Other anurans, such as *Bufo occidentalis* and *Rana spectabilis*, are found from November to January. Recently metamorphosed individuals of *B. occidentalis* and *R. spectabilis* are present in February and March. An-

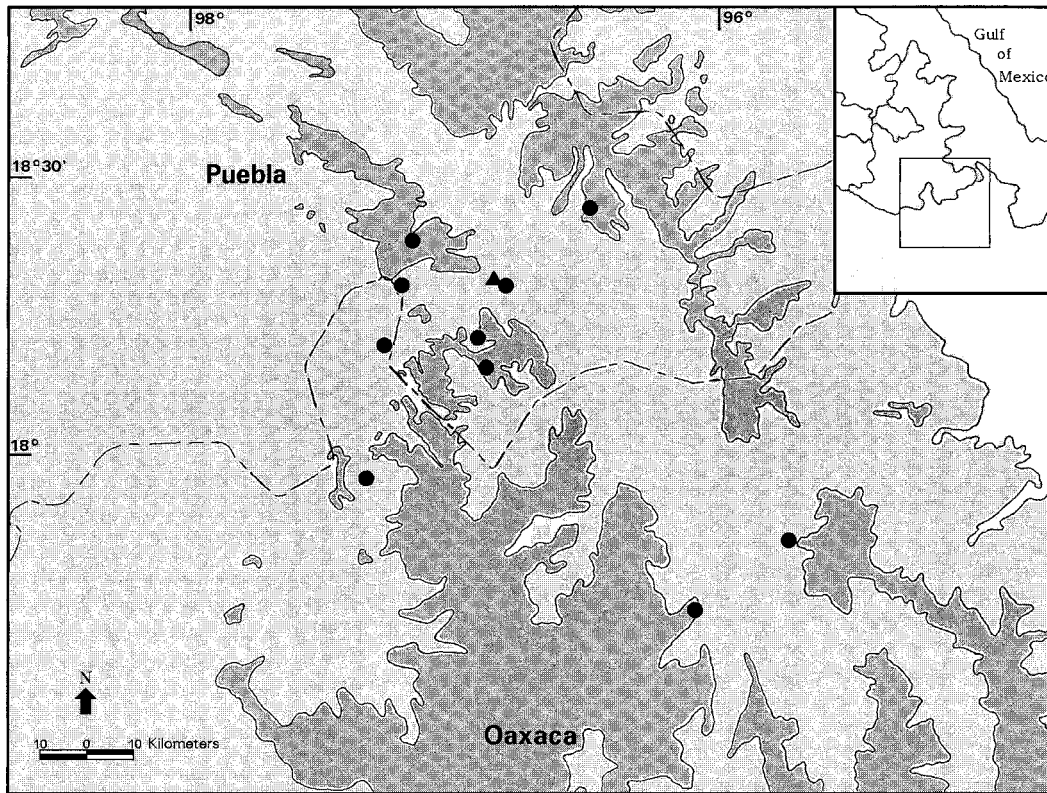


FIG. 3—Geographic distribution of *Hyla xera* from Tehuacán-Cuicatlán Valley. Closed circles represent the localities reported in this work, and the triangle indicates the type locality. Dark gray represents elevations above 2,000 m.

other anuran found in Zapotitlán Salinas is *Spea multiplicata*, but it has not been seen along the Río Zapotitlán; it reproduces mostly in temporary ponds near the Jardín Botánico, roadside ditches, and in the town of Zapotitlán Salinas during the rainy season. Anurans such as *Eleutherodactylus nitidus* and *E. augusti* also occur in the area, but these species have direct development.

The vegetation around Santa María Texcatitlán, Oaxaca, is tropical deciduous forest, with oak forest in the higher areas. Near this town, we found *H. xera*, *H. miotympanum*, *H. bistincta*, and *Rana zweifeli* at night in July 2001 in a lotic stream running through groves of fruit trees.

Like other members of the *H. sumichrasti* group, adults of *H. xera* were found on leaves or in the central axils of arboreal bromeliads (*Tillandsia*). These bromeliads were found on a variety of trees at the different localities. At

San Esteban Necoxcalco, bromeliads were found on *Pistacea mexicana* (Anacardeaceae; Fig. 4); at Concepción Pápalo, they were found on pine trees (*Pinus*); and at Caltepec, they were found on *Schinus mole* (pirul) and on cacti of the genus *Polaskia*. At San Juan Raya, bromeliads were found on *Beaurcaena gracilis* (Liliaceae; elephant foot or sotolín), where they were collected about 2 to 3 m above the ground. At San Esteban Necoxcalco and Santiago Chazumba, we sometimes found up to 10 specimens in a single bromeliad. At Los Reyes Metzontla, several individuals were found inside bromeliads located 1 to 2 km from the nearest stream; thus, they must move long distances to reach the streams to breed. Mendelson and Campbell (1994) reported frogs at Zapotitlán Salinas hidden streamside under rocks in daylight in June; at this locality we found individuals only at night along the stream. In

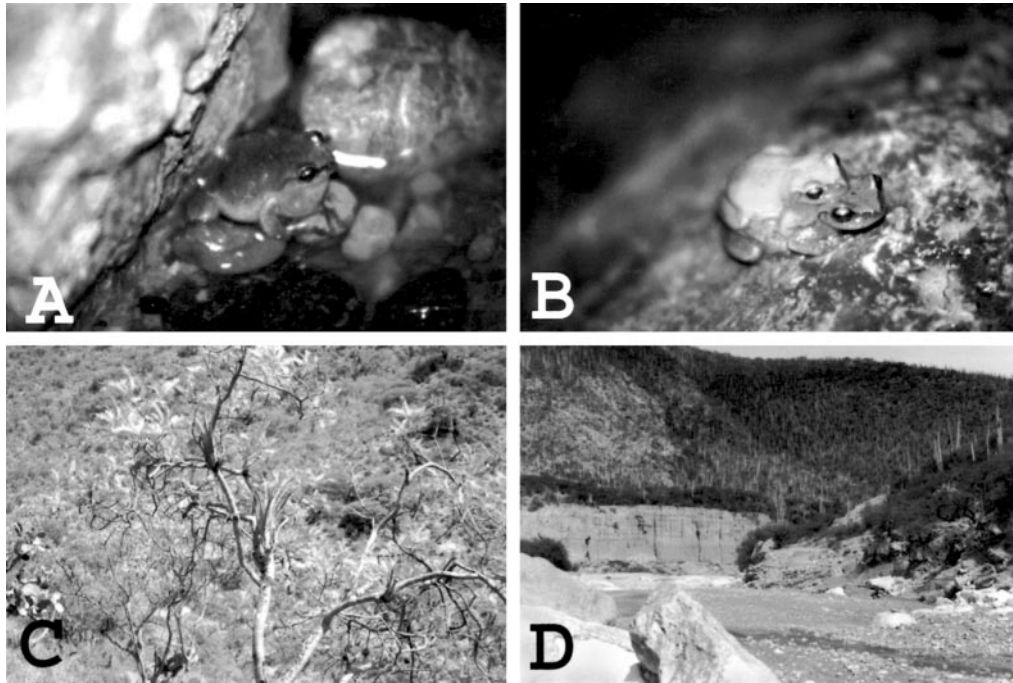


FIG. 4—A) adult male calling along the Río Zapotitlán. B) axillary amplexus of *H. xera* along the Río Zapotitlán. C) microhabitat of *H. xera* at San Esteban Necoxcalco (bromeliad [*Tillandsia*] on tree [*Pistacea mexicana*]). D) Río Zapotitlán, habitat of *H. xera* at Zapotitlán Salinas (type locality).

the few bromeliads present, we found only gekkonid lizards (*Phyllodactylus bordai*).

*Hyla xera* breeds during the rainy season; males called along the Río Zapotitlán after 2000 h from June to August. Males called from rocks along the stream, extending their single yellowish vocal sac (Fig. 4); at San Esteban Necoxcalco, males called from the axils of the bromeliads at dusk (about 1900 h). The advertisement call consists of a series of 3 or 4 quickly repeated notes.

As in other species of the genus, amplexus in *H. xera* is axillary (Fig. 4). Males are smaller than females: 12 males with nuptial excrescences had snout-vent lengths of 26.2 to 28.9 mm (mean = 27.0); 5 females (3 with well developed eggs) had snout-vent lengths of 29 to 35 mm (mean = 31.2). We did not observe oviposition in this species, but a female (SVL 35 mm) collected in July contained eggs arranged in 5 clusters on the left side ( $n = 185$ ) and 4 clusters on the right side ( $n = 181$ ).

Tadpoles were found in streams and associated pools in January, May, August, October, and November. On 26 January 1997, a single

tadpole of *H. xera* was found in a group of tadpoles of *Bufo occidentalis* in the Río Zapotitlán. Tadpoles of *H. xera* and *H. arenicolor* in different stages of development were found together in another stream 6 km south of Zapotitlán Salinas in October and November.

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- zontla (EBUAP 638–40, 644); 1 km W Los Reyes Metzontla (EBUAP 645); 1.8 km N Los Reyes Metzontla (EBUAP 633); Santa Ana Teloxtoc (EBUAP 642); 1.5 km SW San Esteban Necoxcalco (EBUAP 634); 1 km E San Esteban Necoxcalco (EBUAP 637); 2 km E San Esteban Necoxcalco (EBUAP 704); 1 km W San Esteban Necoxcalco (EBUAP 705); 0.4 km NW San Juan Raya (EBUAP 1121); stream in San Juan Raya (EBUAP 1122–24); 21.3 km S, 5.2 km W Tehuacán (ENCB 11584–85); 14 km SW Tehuacán (ENCB 6120); 1 km SE Caltepec (EBUAP 1171–72); 3.5 km SE Caltepec (EBUAP 1173). OAXACA: 3 km NE Santiago Chazumba (EBUAP 1125–32); 6 km W Concepción Pápalo (EBUAP 1150); 6.5 km W Concepción Pápalo (EBUAP 1151–56); 400 m SW Santa María Texcatitlán (EBUAP 2047–50); 6.5 km (by road) NE Santiago Niltepec (KU 179072).

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APPENDIX 1—Known localities for *Hyla xera*.

Adults. MEXICO: PUEBLA: 5.6 km SSW Zapotitlán Salinas (UTA 13387 [holotype], 13381–86, 13388 [paratopotypes]); Río Zapotitlán (EBUAP 627, 635–36, 641, 643, 646); 2 km E Los Reyes Metzontla (EBUAP 638–40, 644); 1 km W Los Reyes Metzontla (EBUAP 645); 1.8 km N Los Reyes Metzontla (EBUAP 633); Santa Ana Teloxtoc (EBUAP 642); 1.5 km SW San Esteban Necoxcalco (EBUAP 634); 1 km E San Esteban Necoxcalco (EBUAP 637); 2 km E San Esteban Necoxcalco (EBUAP 704); 1 km W San Esteban Necoxcalco (EBUAP 705); 0.4 km NW San Juan Raya (EBUAP 1121); stream in San Juan Raya (EBUAP 1122–24); 21.3 km S, 5.2 km W Tehuacán (ENCB 11584–85); 14 km SW Tehuacán (ENCB 6120); 1 km SE Caltepec (EBUAP 1171–72); 3.5 km SE Caltepec (EBUAP 1173). OAXACA: 3 km NE Santiago Chazumba (EBUAP 1125–32); 6 km W Concepción Pápalo (EBUAP 1150); 6.5 km W Concepción Pápalo (EBUAP 1151–56); 400 m SW Santa María Texcatitlán (EBUAP 2047–50); 6.5 km (by road) NE Santiago Niltepec (KU 179072).

Tadpoles. MEXICO: PUEBLA: Los Reyes Metzontla, Municipality of Zapotitlán Salinas, Puebla: 1 km W Los Reyes Metzontla (18°13'8"N, 97°29'3"W), EBUAP-631 ( $n = 11$  tadpoles); 1 km E Los Reyes Metzontla (18°13'3"N, 97°28'5"W), EBUAP-632 ( $n = 5$  tadpoles); 1.8 km N Los Reyes Metzontla (18°14'3"N, 97°29'0"W), EBUAP-628 ( $n = 6$  tadpoles); 1 km E Jardín Botánico de Zapotitlán Salinas (18°19'8"N, 97°26'13"W), EBUAP-1115 ( $n = 1$  tadpole); 1.5 km E San Esteban Necoxcalco (18°28'0"N, 97°16'13"W), EBUAP-629 ( $n = 7$  tadpoles); 2 km W San Esteban Necoxcalco (18°28'3"N, 97°18'8"W), EBUAP-630 ( $n = 15$  tadpoles); 6 km S Zapotitlán Salinas (uncatalogued tadpoles).