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THE TADPOLE OF *HYLA ROBERTSORUM*, WITH  
COMMENTS ON THE AFFINITIES OF THE SPECIES

BY GEORGE B. RABB AND JAMES E. MOSIMANN

ON August 16, 1952, in the course of field work in the state of Hidalgo, Mexico, we collected tadpoles of a hylid frog in El Chico Parque Nacional northeast of Pachuca. In view of their striking similarity to the streamlined tadpoles of the genus *Plectrohyla* (Hartweg and Orton, 1941; Stuart, 1942), their description seems warranted.

From the accounts of Taylor (1940) and Taylor and Smith (1945), it is highly probable that the type locality of *Hyla robertsorum* is the same as or very near our collecting site. Here a narrow stream runs through an open sheep-grazed meadow bordered by fir forest at an elevation of 2700 meters. The width of the stream in many places was such as to permit us to step from one bank to the other. Its bottom was of diverse character, muddy, sandy, and in places rocky. Along the rockier parts a shrubby mat-form of *Cupressus* grew on the banks and extended over the flowing water. Three adult and two immature individuals of *Hyla robertsorum* were collected, and other adults seen. All sought safety in the stream when approached, and none was seen farther from the water than the stream banks. These observations are generally in accord with those of Taylor and of Taylor and Smith. These writers reported large series of *H. robertsorum* collected from the axils of plants bordering the stream in the cold of early morning, and at warmer temperatures, the behavior noted above. We saw some ranid tadpoles and numerous ones of a hylid frog, presumably *H. robertsorum*, in the quieter parts of the rushing stream. Seventeen of the latter were collected.

DESCRIPTION OF TADPOLES (Fig. 1).—Body slightly depressed and elongate. Maximum body width a little greater than one-half of body length (from snout to ventral end of body). Body width measured at level of nostrils slightly greater than three-quarters of the maximum

body width. This feature, together with the moderately truncate snout, gives a very distinctive oblong appearance to the body when viewed dorsally. Eyes small, dorsolateral in position and directed upward. Minimum interorbital width slightly greater than width of anterior dorsal musculature. Nostrils small, opening anterolaterally. Internarial width about the same as interorbital width in larger tadpoles, less in smaller tadpoles. Internarial width less than width of lips.

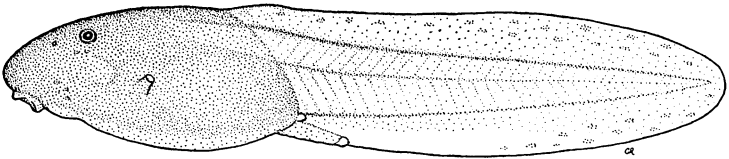


FIG. 1. Lateral view of the tadpole of *Hyla robertsoni*.

Tail fin about one and a half times as long as body, slightly more than twice as long as deep, tapering very gradually to a rounded tip. Tail musculature not quite reaching tip. Tail fin not extending onto body. Belly wall thin with no muscular modifications, although ventrolateral muscles present. Lateral line system well defined. Spiracle sinistral, about equidistant from end of snout and ventral end of body. Vent dextral, the cloacal tube extending along ventral part of tail fin for a distance equal to about one-quarter of body length.

Body color in formalin uniform dark gray, lightening somewhat on venter. Superficial melanophores linear, deeper melanophores rounded. Tail fin light, translucent, darker above than below musculature. Tail musculature generally light, its dorsal border heavily pigmented. Scattered dark patches of rounded melanophores on tail fin.

Lips moderately wide, thin, entirely bordered by small papillae, which usually form two irregular rows on lower lip and on central part of upper lip and are arranged as a single row elsewhere. A single row of larger papillae between upper lip and outer anterior tooth row, and a similar row between lower lip and outer posterior tooth row. Laterally, these rows give way to patches of about 20 somewhat smaller and more rounded papillae (Fig. 2).

Tooth rows  $2/3$ . Anterior rows nearly equal in length, about twice as long as anterior beak, lateral end of inner anterior row closer to edge of lip than to edge of anterior beak. Inner anterior row interrupted medially by a distinct rounded notch. Posterior tooth rows very slightly shorter than anterior rows. Inner posterior row noticeably

TABLE I  
Measurements and Ratios of Tadpoles of Four Hylid Species

Measurements (in mm.)	<i>H. robertsororum</i> (2)		<i>P. cotzicensis</i> (2)		<i>P. guatemalensis</i> (2)		<i>H. bistincta</i> (1)
Total length . . . . .	47.7	47.0	45.0	43.5	43.2	45.5	47.3
Body length . . . . .	18.8	18.8	18.0	18.0	15.8	15.8	16.5
Tail length . . . . .	28.9	28.2	27.0	25.5	27.4	29.7	30.8
Maximum body width . . . . .	10.2	9.9	11.0	10.2	10.5	10.8	9.0
Narial body width . . . . .	7.8	7.8	7.5	7.5	7.5	6.8	6.0
Tail height . . . . .	9.3	9.0	8.3	8.3	9.8	9.5	8.6
Interorbital distance . . . . .	4.5	4.2	4.5	3.9	4.2	3.9	3.0
Internarial distance . . . . .	3.8	3.8	4.5	4.1	4.4	4.2	4.1
Cloacal tube length . . . . .	4.5	4.5	3.0	3.0	2.3	2.3	3.0
Ratios (per cent)							
Body length/Total length. . . . .	39.4	40.0	40.0	41.4	36.5	34.7	34.9
Max. width/Body length . . . . .	54.3	52.7	61.1	56.7	66.5	68.4	54.5
Tail height/Tail length . . . . .	32.2	31.9	30.7	32.5	35.8	32.0	27.9
Cloacal tube/Body length . . . . .	23.9	23.9	16.7	16.7	14.6	14.6	18.8
Narial width/Max. width . . . . .	76.5	78.7	68.2	73.5	71.4	63.0	67.7

turning outward laterally. Teeth of all rows of about equal length, and diminishing in size laterally on all rows. Horny beaks well developed, anterior one moderately arched, posterior one deeply indented, giving it a rounded V-shape. Serrations of beaks peglike, usually slightly larger in posterior beak, but not strong in either.

Table I gives measurements made with an ocular micrometer of typical tadpoles of four species. All tadpoles were at approximately the same stage, with hind leg buds just beginning to appear externally.

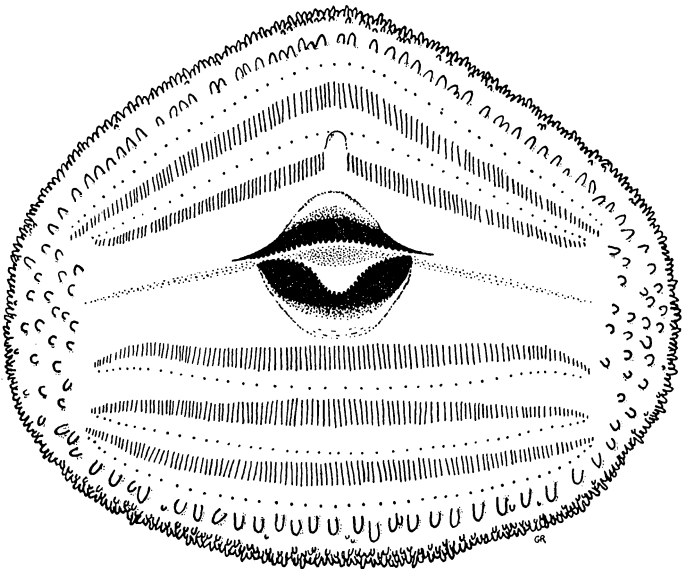


FIG. 2. Mouthparts of the tadpole of *Hyla robertsorum*.  
(Somewhat diagrammatic)

The foregoing description was mainly based on tadpoles at this stage in order to make it comparable with the descriptions of *Plectrohyla* tadpoles by Hartweg and Orton and by Stuart. The illustrations likewise are in nearly the same style used in their papers. The terminology used above follows Stuart (1942).

REMARKS.—Taylor (1940) records *Hyla lafrentzi*, *Hyla eximia*, and a frog of the *Rana pipiens* complex from the type locality of *H. robertsorum*. Two tadpoles referable to *Rana pipiens* were secured by us in collecting the hylid tadpoles described above. Our tadpoles are very different from a series of pond-type tadpoles of *H. eximia* collected by Richard Etheridge near Huachinango, Puebla. The tadpoles of *H.*

*eximia* differ from ours in lacking a complete fringe of papillae along the upper lip and large papillae between the edge of the lips and tooth rows, in having more pigment on the tail fin, in having the tail fin well elevated just posterior to the body, with a pointed rather than a rounded tip. The tadpoles of *Hyla lafrentzi* are not available to us, but in view of the similarities of adult *H. eximia* and *H. lafrentzi* (Taylor, 1939), it is unlikely that our tadpoles represent this species. There

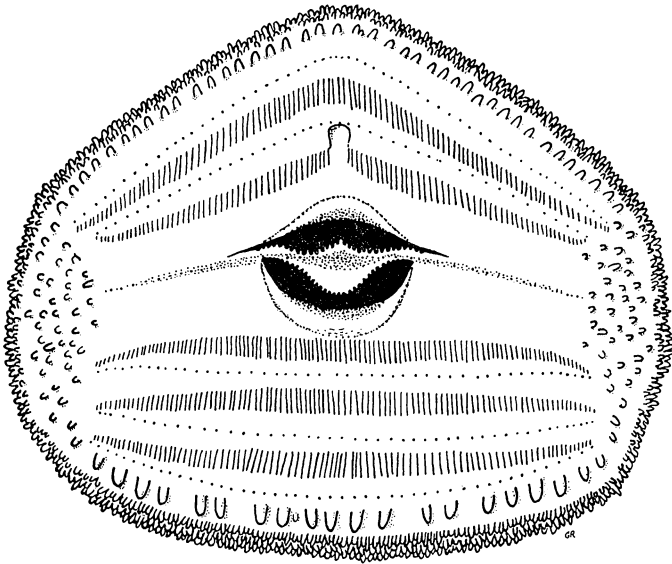


FIG. 3. Mouthparts of the tadpole of *Hyla bistincta*.  
(Somewhat diagrammatic)

remains, of course, a possibility that an unrecorded stream-breeding species of *Hyla* or perhaps of *Plectrohyla* occurs at the type locality of *H. robertsororum*.

RELATIONSHIPS.—In body form and proportions, and even in the delineation of the lateral line system, the tadpoles here referred to *Hyla robertsororum* very closely resemble specimens identified as *Plectrohyla cotzicensis* by Stuart (1951). In mouthparts arrangement they are closest to tadpoles designated by Stuart as *Plectrohyla guatemalensis*. The mouthparts of *P. cotzicensis* tadpoles are quite different, lacking lateral patches of papillae, having shorter posterior tooth rows, and having sharply pointed, not peglike, serrations on the beaks. The tadpoles of *P. guatemalensis* differ from those of *Hyla robertsororum* chiefly

in having a relatively chunky body with a conically tapering snout rather than a long body with a truncate snout. The latter have a longer cloacal tube than any of the species they were compared with (Table I) and apparently are darker in pigmentation, though color differences are difficult to ascertain from specimens preserved in various ways.

We have examined the series of incompletely described tadpoles tentatively referred to *Hyla bistincta* by Shannon (1951). They are generally similar to the tadpoles of *H. robertsororum*, but are more like those of *P. guatemalensis* in body form. We are fairly confident that the identification of this series as *Hyla bistincta* is correct, since the partly transformed specimens show no sign of the pollex becoming externally partially separable from the first finger, as it does in *P. guatemalensis* at this stage. The terminal phalange in the pollex in these specimens of *H. bistincta* is cartilaginous, while comparable individuals of *P. guatemalensis* have this element developed as a relatively bony, outwardly directed spine. The mouthparts of the three species are very similar. The main differences may be seen in Figures 2 (*H. robertsororum*) and 3 (*H. bistincta*) and the figure in Stuart's paper (1942) of *Plectrohyla* Form X, which is probably the same as *P. guatemalensis* according to Stuart, *in litt*. The differences are tabularly arranged here:

Part	<i>P. guatemalensis</i>	<i>H. bistincta</i>	<i>H. robertsororum</i>
Fringing papillae, upper lip .....	Double row	Double row	Double row medially
Fringing papillae, lower lip .....	Double row	Triple row	Double row
Lateral papillae .....	Few	Many	Intermediate
Anterior beak curve .....	Even	Indented	Even
Nonfringing papillae, lower lip .....	Large, intermediate	Large, few	Moderate size, many

This should be considered only a general, tentative guide since we know little about the constancy of these characters, particularly in *H. bistincta* tadpoles, of which there were only three in this series young enough to be compared with the other species. The lateral papillae, the posterior tooth rows being of almost equal length, the double row of fringing papillae, and the peglike serrations of the beaks distinguish these three species from *Plectrohyla* tadpole "forms" B, Y, Z (and/or *P. cotzicensis*), and A (probably *P. matudai*, according to Taylor, 1942a).

The 2/3 tooth row formula, the circumoral fringing papillae, and the presence of at least some large papillae between the fringing papillae and the tooth rows suffice to separate the tadpoles of *H. bistincta* and *H. robertsorum* and those of *Plectrohyla* from other known Mexican hylid tadpoles.

Because of the similarity of the tadpoles of *Hyla robertsorum* and *Plectrohyla* we examined the adult characters of this species with reference to its generic allocation. Adults of *robertsorum* have a thick glandular skin, an indistinct tympanum, a supratympanic fold, patches of small horny spine-like excrescences on the thumb swelling and first and second fingers in breeding males, no external vocal sac in males, fingers practically free of web, a moderate anal flap, no quadratojugal bone, and a large free terminal phalange in the pollex which does not pierce the skin and which is not indicated externally by any separation of the thumb from the skin of the first finger, the thumb appearing instead as a large swelling alongside the first finger, as is common in many hylids. Dorsal ground color in adults is olive brown to gray, usually with dark brown mottling; immature individuals are usually bright green in life. In respect to these characters, *robertsorum* may be distinguished from *Plectrohyla*, as presently known, only by the terminal pollex bone, which in *Plectrohyla* is ordinarily shaped as a spine outwardly directed; externally the skin covering the spine is partly separated from the first finger (at least in adult males).

*H. robertsorum* is included in the "*Hyla bistincta* group" by Smith and Taylor (1948). The four specimens examined of another species of this group, *H. pachyderma*, agree in all of the characteristics listed above for *H. robertsorum*. Correspondent agreement is found in the descriptions and comparisons of *H. robustofemora*, *H. robertsorum*, and *H. pachyderma* of Taylor (1940, 1942b). In the seven specimens of *H. bistincta* examined, a quadratojugal is lacking, but the skin appears thinner, the vocal sacs are developed externally in males, the tympanum is relatively distinct, and the anal flap is more developed than in *H. robertsorum*. Two other forms, *H. dalquesti* and *H. cyclomaculata*, related to *H. bistincta* according to Taylor (1948, 1949), agree with *H. bistincta* in at least the two last-mentioned characters, but differ from all of the above species by having the fingers partly webbed. We do not know the condition of the quadratojugal in these two species. The status of *Cauphias crassum* Brocchi, which was placed in the *H. bistincta* group by Smith and Taylor (1948) and has been considered as a *Plectrohyla* by Hartweg (1941) and by Stuart (1942), is uncertain.

CONCLUSIONS.—From the foregoing it may be seen that the adult characters of *H. robertsororum* indicate that it is morphologically intermediate between *Plectrohyla* and *Hyla bistincta*. The close similarity of *H. pachyderma* and *H. robustofemora* to *H. robertsororum* indicates that they also occupy such a position. The tadpoles of *H. pachyderma* and *H. robustofemora* are unknown, but as described above, those of *H. bistincta*, *H. robertsororum*, and some species of *Plectrohyla* are very similar, a condition we believe due to closeness of relationship rather than to convergence in stream adaptations. It is not within the scope of this paper to discuss more critically the present placement of forms within the genus *Plectrohyla* and the "*Hyla bistincta* group." Future research may show the desirability of recognizing some part of the latter group as a genus close to *Plectrohyla* or of including some or all of its forms in *Plectrohyla*.

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SPECIMENS EXAMINED.—Tadpoles: *Hyla bistincta*, USNM 123690 and 123694 (6), San Lucas Camotlán, Oaxaca, Mexico; *H. eximia*, UMMZ 103307 (35), 3.5 mi. west of Huachinango, Puebla, Mex.; *H. robertsororum*, UMMZ 106443 (17), El Chico Parque Nacional, northeast of Pachuca, Hidalgo, Mex.; *Plectrohyla cotzicensis*, UMMZ 100518 (4) and 100519 (9), Maria Tucum, Totonicapán, Guatemala; *P. guatemalensis*, UMMZ 90219 (13), Finca Chichen, Alta Verapaz, Guat.; UMMZ 98337 (20), 2 km. west of Panajachel, Solola, Guat.; UMMZ 98338 (6), Tacana, San Marcos, Guat.; *Rana pipiens*, UMMZ 106442 (2), El Chico Parque Nacional, Hidalgo, Mex.

Others: *H. bistincta*, UMMZ 94238–40, Los Conejos, 4 mi. west-southwest of Uruapan, Michoacán, Mex.; UMMZ 102076, 15 mi. southeast of Autlan, Jalisco, Mex.; UMMZ 102075, Cerro San Andres, 11 mi. westnorthwest of Ciudad Hidalgo, Michoacán, Mex.; UMMZ 85452–53, Uruapan, Michoacán, Mex.; *H. pachyderma*, USNM 115026–29, Pan de Olla, Veracruz, Mex.; *H. robertsororum*, UMMZ 92462 and 106401 (5), USNM 114762–85, El Chico Parque Nacional, Hidalgo, Mex.; UMMZ 106432 (6) and S-1558, 10 mi. north of Agua Blanca, Hidalgo, Mex.; *Plectrohyla cotzicensis*, UMMZ 95902–08, 2 km. northwest of Ixchiguan, San Marcos, Guat.; *P. guatemalensis*, UMMZ 95910, Momostenango, Totonicapán, Guat.; *P. sagorum*, UMMZ S-836, Mount Ovando, Soconusco, Chiapas, Mex.



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