REDISCOVERY OF *HYLA PICTIPES* COPE, WITH DESCRIPTION OF A NEW MONTANE STREAM *HYLA* FROM COSTA RICA

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In 1957 during my first field work in Costa Rica, I collected two distinctive species of stream-breeding hylids, from the Cordillera Central, that did not agree with any of the specimens available to Taylor (1952, 1954, 1958) for his review. In subsequent years, workers from the University of Southern California and I accumulated additional material of these forms from the Costa Rican ranges. One species appears to represent *Hyla pictipes* Cope, originally described in 1875 and not rediscovered since. The second form proves to be an undescribed species related to *H. pictipes*.

The series referred to *Hyla pictipes* is from the slopes of the volcans: Poás, Barba, Irazú and Turrialba in the Cordillera Central and from the north and south slopes of the Cerro de la Muerte, Cordillera de Talamanca. All specimens were taken in the immediate vicinity of torrential streams at altitudes between 6500 to 8200 feet (1980 to 2500 meters). In life there was marked color variation in these frogs. Some were deep black in dorsal ground color, others dull green and a few chocolate brown. The color differences are not geographically constant nor do they correlate with differences in structural characters. On Volcán Poás and Volcán Barba two or more color variants were collected together. A number of specimens kept alive did not exhibit any ability to change individual ground color under different circumstances.

Hyla pictipes Cope, 1875

Figures 1, 2 and 3A

Hyla punctariola pictipes Cope, 1875: (Costa Rica: Provincia de Limón: Pico Blanco, in error for Cerro Utyum, 5000-7000 feet).

Hyla punctariola moesta Cope, 1875.

Hyla punctariola monticola Cope, 1875.

Diagnosis: Distinguished from other montane stream hylas by the following combination of characters: Small tympanum with heavy fold over it; dark groin with yellow spots; fingers ¼ webbed, toes 5/6 webbed; a series of white tubercles on forearm and foot. It is easily separated from its close relatives *H. rivularis* and *H. debilis* in

lacking the acute snout shape and from *H. tica* by having tympanum less than 20% of head length. *H. pictipes* might possibly be confused with *H. pseudopuma* which occurs at high elevations but is not a stream breeding frog. It is easily separated from this species in having less webbing on the hand and foot and a much smaller tympanum.

General Description: CRE 274: Adult male with snout-vent length 39.0 mm., head length 11.0 mm., head width 12.6 mm., interorbital

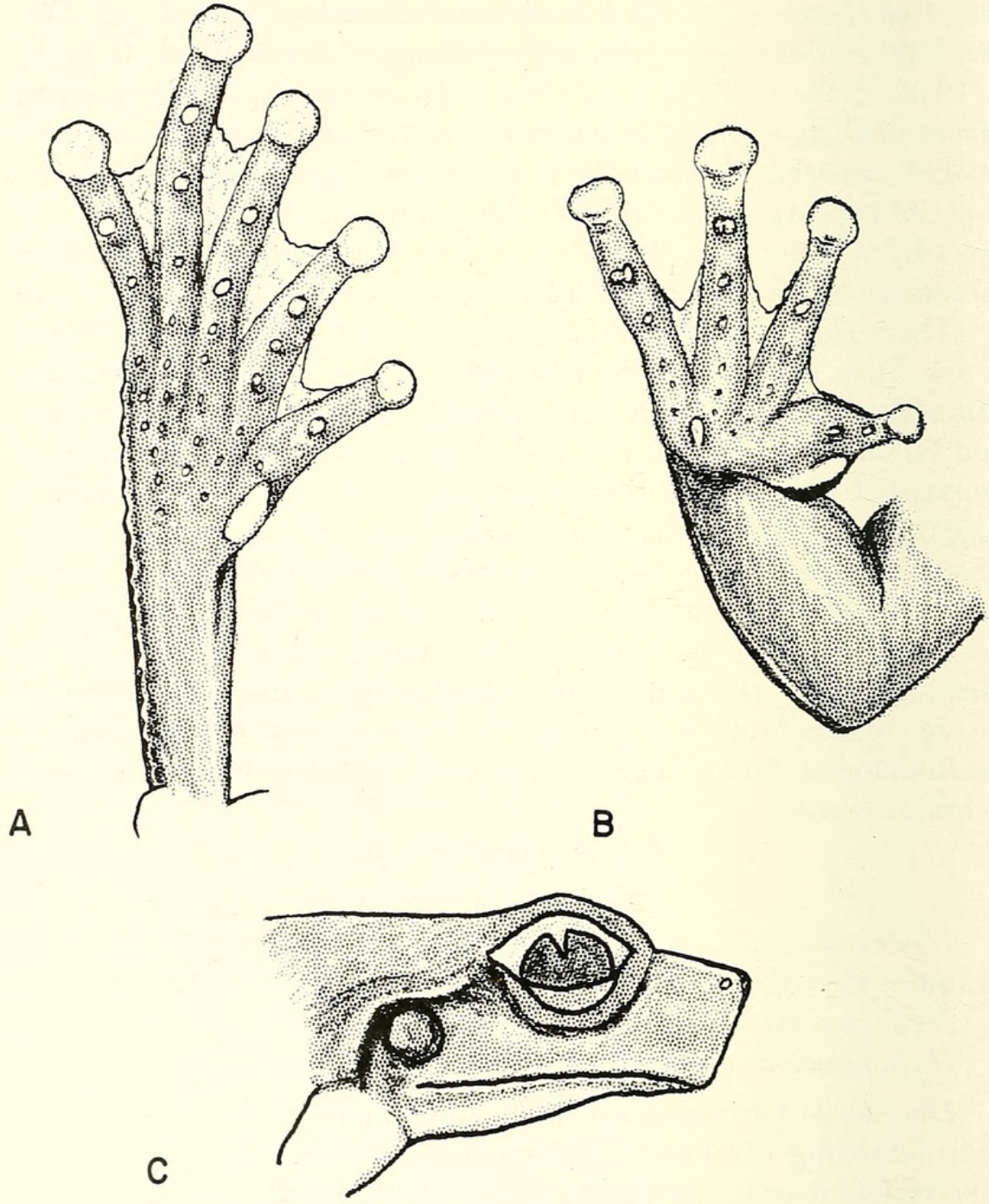

Figure 1. Hyla pictipes. A. Ventral view of foot. B. Ventral view of hand of male. C. Lateral view of head.

distance 4.0 mm., internarial distance 3.3 mm., width of eyelid 3.3 mm., tympanum 1.7 mm. Snout blunt, nostril equidistant between eye and snout, canthus distinct, loreal region concave, nostrils slightly protuberant; a heavy fold extending from eye over tympanum to shoulder (Fig. 1C). No external vocal sac but vocal slits present. Length of forearm 19.4 mm., a series of white tubercles on ventrolateral edge of forearm extending onto outer finger; thumb greatly enlarged and covered with black horny excrescences; vestige of web between thumb and first finger, other fingers ¼ webbed; distal subarticular tubercle divided on outer finger, many supernumerary tubercles on fingers and palm of hand, inner palmar tubercle oval, outer palmar tubercle tripartite, discs of outer fingers larger than tympanum (Fig. 1B). Heel reaches to nostril when leg is extended forward; foot webbed about 5/6, no inner tarsal fold, ridge consisting of tubercles extending from heel to outer toe (Fig. 1A). Scattered tubercles below vent.

A radiograph of this frog reveals the absence of the quadratojugal

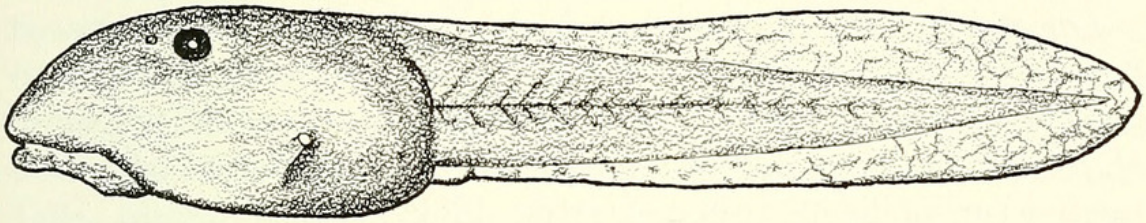

Figure 2. Lateral view of tadpole of *Hyla pictipes.*

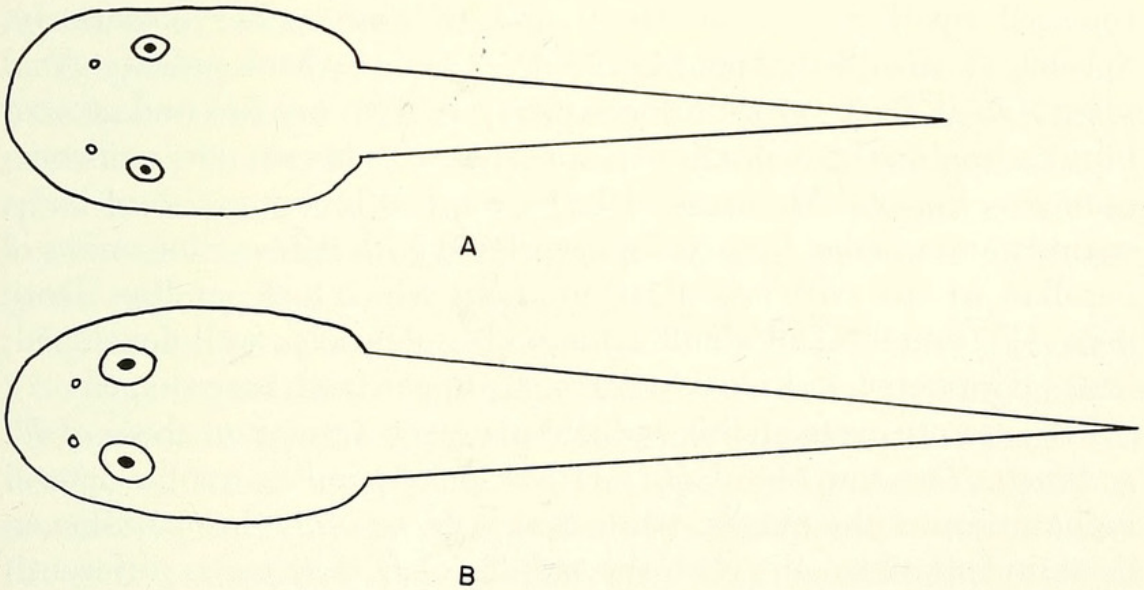

Figure 3. Diagrammatic dorsal views of the tadpoles of *Hyla pictipes* (A), and *Hyla rivularis* (B), with proportions based on the same body length.

bone as do radiographs of specimens from other localities. A cleared and stained specimen (CRE 6198) has a very much reduced quadratojugal.

Coloration: In life, back mottled black and gray, sides and groin black with few yellow spots; feet and rear of tibia and femur black with few yellow spots. Throat almost entirely mottled with dark, belly almost entirely black, cheeks gray. The extremes of color variation are represented by the above description and a female from Volcán Turrialba with the following color in life: Back uniform green, throat and venter bright yellow, sides mottled yellow and dark brown; yellow spots on front and rear of femur, shank, foot and arm. Many specimens are mottled dorsally with gray and black with the groin and rear of thigh black with yellow spots. The belly is light with variable amounts of dark mottling. The area below the eye is often green. The most consistent color character is the dark groin and femur with the light yellow spots. A light ridge on the arm and foot is present although variable in extent. White tubercles below the vent are always present.

Larvae: Tadpoles were collected along with adult *H. pictipes* at Rancho Redondo and Volcán Barba. None could be reared to metamorphosis but it is extremely likely that they represent the tadpole of *H. pictipes*. In general, they resemble the tadpoles of *H. rivularis* but the two can be distinguished (Starrett, 1960).

Description of Tadpole: (CRE 528 and CRE 6194) Maximum total length, 36.2 mm.; body depressed, tail about 1.6 of body length; tail fin low, not extending onto body, tail musculature not extending to rounded tip. Eyes dorsal, small and situated rather posteriorly. Spiracle sinistral with opening about 9/13 of way back on body. Anal tube dextral. Body color uniformly dark brown; tail fins and musculature also dark brown, tail fins speckled with brown dots and reticulations (Fig. 2). Mouth very large, ventral, about width of body, entirely surrounded by wide lips bordered with three or four rows of papillae. Mouth with lateral indentations which lack papillae. Tooth rows $\frac{2}{3}$, complete, all about same width; denticles well developed; beaks pigmented and weakly serrated; upper beak bow-shaped.

The mouth parts of this tadpole are very similar to those of *H. rivularis*. The tadpole of *H. pictipes* lacks papillae on the lateral indentations of the mouth, while that of *H. rivularis* has papillae on these indentations. In color, the tadpole of *H. pictipes* is differentiated by the uniformly brown body and tail. A comparison with *H. rivularis* shows that those of *H. pictipes* have relatively shorter tails, smaller eyes and the width of the tail is less at the base, making a

sharp demarcation between body and tail and less tapering in dorsal profile. Figure 3 compares the two tadpoles diagrammatically.

Remarks: In 1875 Cope described three frogs, *Hyla punctariola pictipes*, *H. p. moesta*, *H. p. monticola* from Pico Blanco, 5000 to 7000 feet, in Costa Rica. Although named as subspecies of *Hyla punctariola* Peters, Dunn (1940) has subsequently shown this species to be an *Eleutherodactylus*. Cope considered the three hylids as subspecies although he mentioned the possibility of their being three distinct species. His descriptions were brief and the differences mentioned were in color pattern. The color pattern of *H. p. moesta* "Above brownish-black, sides and femora, except above and below, deep black. Some white spots on sides behind axillae, and some small yellow ones near groin. A few minute white points on front and back of femur, and upper surfaces of feet. Otherwise the limbs and hands, except the thumb, are black. Lower surfaces thickly black spotted except on breast and tibia, where the white predominates," is very similar to that of frogs reported here from both the Cordilleras de Talamanca and Central. The color pattern described for *H. p. pictipes* is very similar to that of the frogs collected in Irazú, Poás and Barba. The color pattern of *H. p. monticola* is somewhat different. Cope describes a series of brown spots on the back forming transverse bars. The USNM types of these frogs, examined by me in December, 1961, were in poor condition. *H. p. moesta* (USNM 30660) is dried up and shriveled. From radiographs and examination of the specimen it appears there is no quadratojugal. The snout shape, amount of webbing and large pre-pollex are all similar to these characters in my series of Costa Rican frogs.

The syntypes of *H. p. pictipes* (USNM 30652 and 30631) are soft. The foot webbing is like that in the recent series. Both have a large pre-pollex. Traces of color pattern can be discerned. The typical light spots in the groin and on the rear of the femur are present as well as a white line on the tarsus. The quadratojugal appears to be absent in the radiographs.

The holotype of *H. p. monticola* (USNM 30661) is very shriveled. The webbing on the foot is similar to the other Cope types and probably no quadratojugal is present. It seems apparent that Cope was dealing with one variable species. The types of *H. p. moesta* and *H. p. pictipes* seem definitely conspecific with the recent series of Costa Rican frogs described above. The type of *H. p. monticola* is referred to the same form. The few anatomical characters visible apply, but the color pattern as described by Cope is different from available fresh material. This may not be significant because there is such

variation in color pattern in the species. Taylor (1958) described a frog that fits Cope's color pattern description of *H. p. monticola*. An examination of that specimen (KU 36764) reveals that it is *Smilisca sordida* Peters (includes *Smilisca gabbi* Cope, 1875). The transverse bars are not uncommon in other specimens of *S. sordida* from Costa Rica.

It seems best to use the name *Hyla pictipes* for these montane frogs because the types of *H. pictipes* are in fairly good condition and more characteristics of the species can be seen. I hereby designate USNM 30652 as the lectotype of *Hyla pictipes* Cope.

The specimens of this frog which were collected at dusk or after dark were found either sitting partially submerged on rocks in the streams or on leaves of relatively low plants close by the water; those taken during the day were all in wet situations; either on rocks or sticks in the streams or on rocks along the water's edge which were constantly showered with spray. Males were heard calling only for a short time starting at dusk, and the individuals which were located by call were all sitting partially submerged in moving water. The call of *H. pictipes* is a rather weak, low and somewhat drawn out

Figure 4. Distribution of *Hyla pictipes* and *Hyla tica*.

single "brraw," with long intervals of silence between calls. Calling males were usually difficult to locate because of the ventriloquistic nature of the call, emphasized by the preference of the frogs for calling sites which were located beneath fallen tree trunks or in other similarly concealed locations.

The distribution in Costa Rica is shown (Fig. 4).

The new form also occurs along fast-moving streams in the central and Talamanca ranges in Costa Rica, but at lower elevations, 3700 to 5400 feet (1130 to 1650 m.), than *H. pictipes*. Because the new form is from Costa Rica and since the local name used for inhabitants of that country is "tico," the new form will be called

Hyla tica, new species

Figure 5

Holotype: UMMZ 122482 from a stream, 4500 feet, on Volcán Turrialba, Cartago Province, Costa Rica; collected on July 25, 1957 by Andrew and Priscilla Starrett and Thomas M. Uzzell, Jr.

Paratypes: 36 specimens from various localities. (Table 1)

Diagnosis: A moderately small hyla (male 29 to 34 mm., female 34 to 38 mm.) with short legs, heel when extended forward reaching to eye. No distinct inner tarsal fold, outer tarsal fold consisting of series of tubercles. Fingers about ⅓ webbed, toes about 4/5 webbed. Snout short and rounded; diameter of eye larger than distance from eye to nostril. Diameter of tympanum about ½ that of eye.

Color tan with brown and black splotches on back, groin and rear of thigh yellow, dark bars on dorsal area of femur, belly granular with scattered black dots. Back with scattered pustules.

This frog can be distinguished from other Costa Rican hylids by the following combination of characters: rounded not sharply projecting snout; fingers about ⅓ webbed, toes about 4/5 webbed, tympanum about ½ eye, dark bars on femur, belly light with dark flecks, eyes not red.

Description of Holotype: Adult male with snout-vent length 30.5 mm.; length of head from angle of jaw 9.0 mm.; head width 9.3 mm., interorbital distance 3.5 mm.; internarial distance 3.1 mm., width of eyelid 2.0 mm., diameter of tympanum 1.9 mm. Snout rounded in profile, nostril closer to eye than to middle of upper lip, canthus rounded, loreal region sloping, a slightly concave area around nostrils; a fold extending from eye over tympanum. Vocal sac median, external.

Vestige of web between thumb and first finger, outer fingers about ⅓ webbed, distal subarticular tubercle divided on all fingers, a

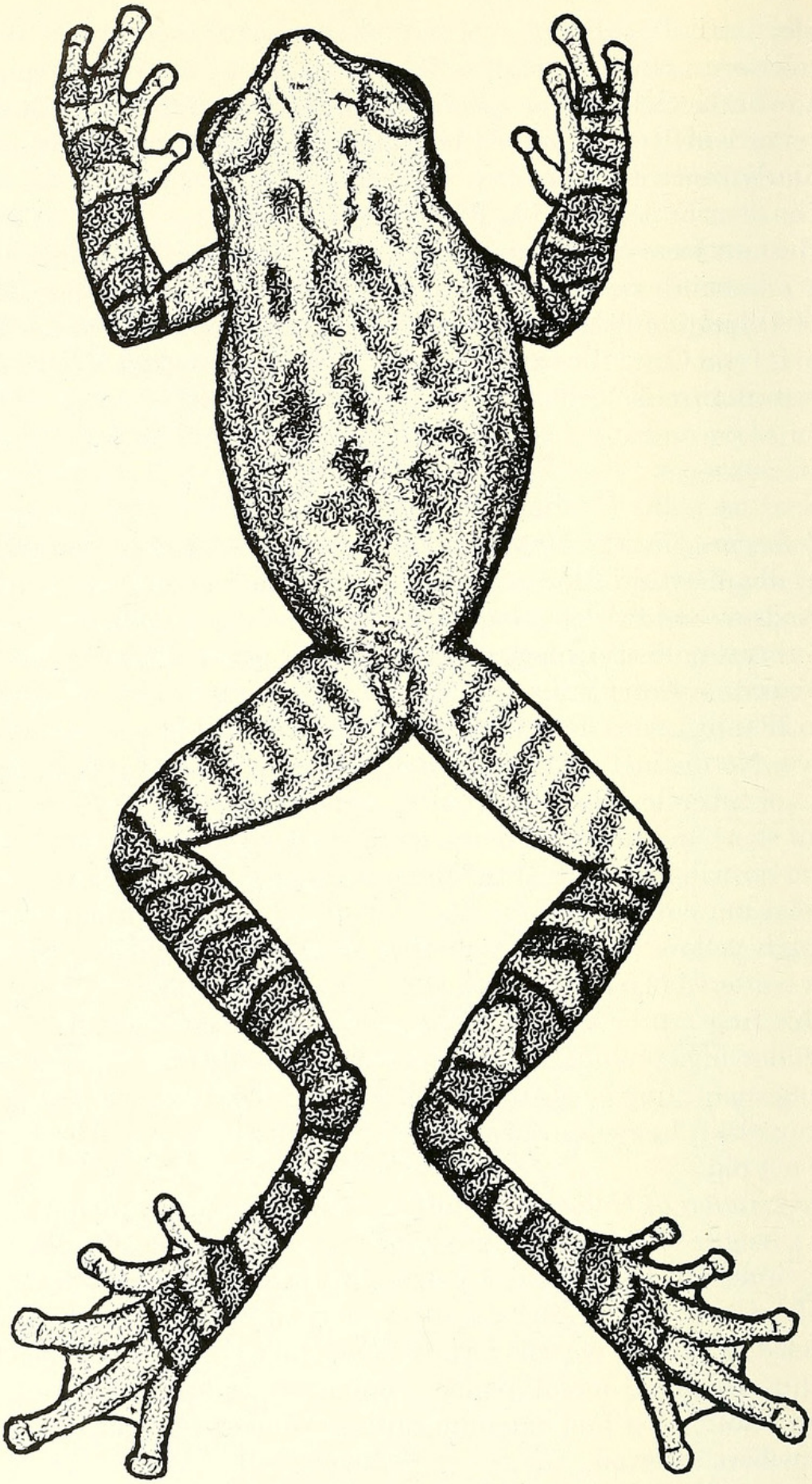

Figure 5. Dorsal view of *Hyla tica*, new species.

rounded palmar tubercle at base of thumb, outer palmar tubercle bifid, disc of 3 outer fingers slightly smaller than tympanum. Length of forearm 14.7 mm., a series of white tubercles on ventro-lateral edge of forearm, thumb slightly swollen and finely shagreened.

Length of femur 14.7 mm., tibia 17.0 mm., foot 23.0 mm. No inner tarsal fold, a few small white tubercles on outer tarsal edge. An oval inner metatarsal tubercle and a very small round outer tubercle. Many supernumerary subarticular tubercles, distal divided on outer toes. Discs about same size as those of fingers. Foot about 4/5 webbed.

Anus with small anal flap, white tubercles present below opening; vomerine teeth present 5-5, larger than choanae, extending beyond posterior edge of choanae. Tongue rounded, not notched posteriorly. Belly granular; back and legs covered with pustules.

Coloration: When collected, frogs appeared very dark in contrast with other hylas in same region. Back appeared warty with pustules. Dark brown above with slight bronze and greenish tints; brown spots on sides, brown bars on thigh. Yellow in groin and on rear of thigh; few black flecks on venter. Eye color grayish brown.

Color in alcohol: Back and head bronze with dark brown spots and reticulations; dorsal part of femur tan with indistinct dark bars; rear of thigh brown and white; tibia brown with darker brown bars, few white pustules on foot; white mottling on upper lip; chin and belly cream, white with dark flecks on lower lip; scattered black spots on belly; sides brown with white reticulations; anterior femur flesh color; arm tan with a dark bar extending onto two outer fingers (Fig. 5).

The amount of dark mottling on the back is variable; it is absent in some specimens and one female has a dark hourglass marking extending from the eyes to the middle of the back. The dark bars on the thigh are prominent on some specimens and rather obscure on others. Most specimens have dark flecks on the belly. A dark area often extends from the rear of thighs onto the ventral part of the thighs. This dark area is dotted with white tubercles. The chin is white anteriorly with a few dark flecks.

Remarks: Variation in measurements are summarized in Table 2. The vomerine teeth are absent on the right side in one female. The choanae are slightly larger than the vomerine teeth in all the paratypes.

The frogs on Volcán Turrialba were collected during a light rain in a mixed chorus with *Hyla rivularis*. They were calling from the vegetation above a small rocky stream. The call of the male was a

TABLE 1. Locality data for paratypes of *Hyla tica* sp. n.

Museum No.	No. of Specimens	Date	Elevation (feet)	Province	Locality
UMMZ 118474 (CD 7612-7617)	4	July 25, 1957	4500	Cartago	Type locality
UMMZ 118475	1		5000	Heredia	San José de la Montaña
UMMZ 118476	1		4500	Alajuela	E slope Volcán Poás, 13.3 mi. N Vara Blanca
CRE 7017	10	Sept. 27, 1963	3900-4000	Cartago	Tapantí, along Río Quiri
CRE 7095	1	Dec. 19, 1963	4300-4600	Cartago	1 km. N Tapantí
CRE 7037	1	Oct. 16, 1963	4500	Puntarenas	0.5 mi. W Monteverde, tributary to Río Guacimal
CRE 7043	4	Oct. 19, 1963	4700-4900	Puntarenas	0.5 mi. NE Monteverde
CRE 7211	1		4800	Puntarenas	0.5 mi. NE Monteverde
CRE 7048	8	Oct. 30-31, 1963	3700-3900	San José	0.25 mi., above and 0.5 mi. below junction of Río Claro and Río La Hondura
CRE 7062	1	Nov. 29, 1963	4700	San José	1 km. S San Cristóbal Sur in Río Tarrazú
CRE 7157	1	Feb. 20, 1964	4200	Alajuela	1 mi. S Zapote on Zarcero-Quesada rd.
CRE 7056	4	Nov. 20, 1963	5400	Cartago	Río Playas where it crosses Pacayas-Santa Cruz rd.

TABLE 2. Measurements of *Hyla pictipes* and *H. tica* sp. n.

Species	No. of Specimens	Sex	Snout-Vent Length/Head Length (Mean)	Snout-Vent Length/Leg Length (Mean)	Head Width/ Head Length (Mean)	Tympanum/ Head Length (Mean)	Snout-Vent Length (Mean)	Snout-Vent Length (Range)
H. tica	28	♂	3.3	.61	1.00	.23	31.1	29.0–34.0
H. tica	9	♀	3.4	.62	1.00	.21	35.8	34.3–37.6
H. pictipes	35	♂	3.2	.61	1.02	.15	34.2	30.9–39.9
H. pictipes	17	♀	3.4	.61	1.06	.15	39.1	33.4–45.0

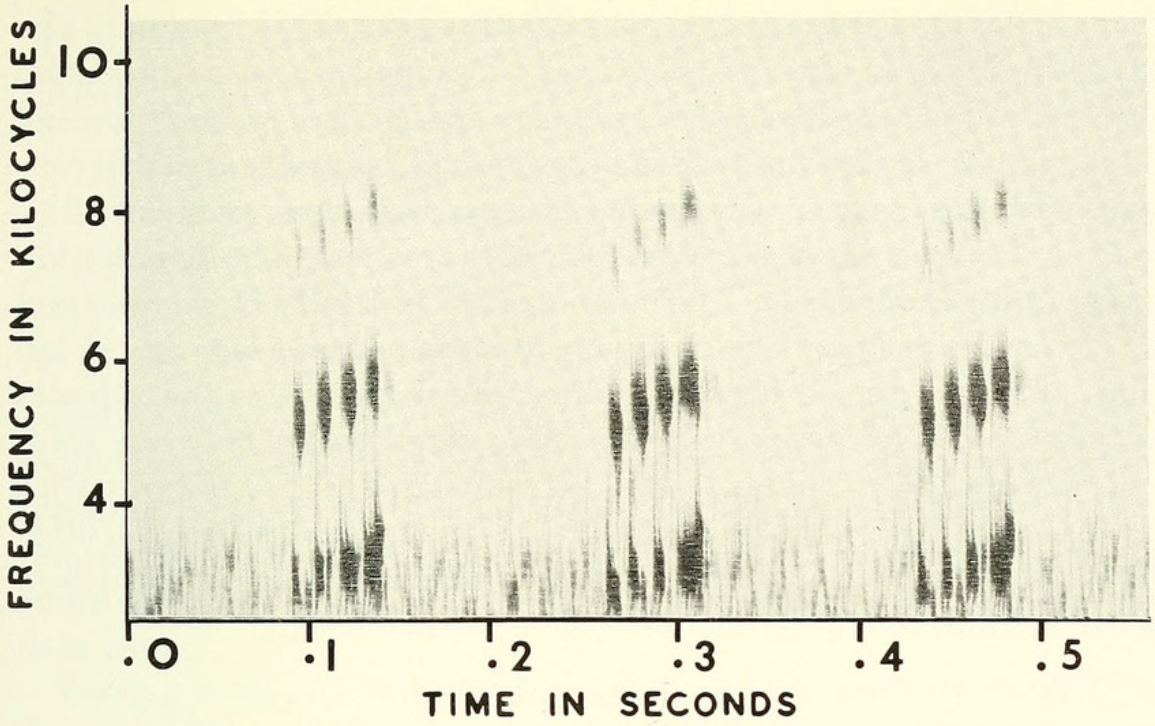

Figure 6. Sound spectrograph of *Hyla tica*, new species.

weak repeated sequence of three notes, each one consisting of a short series of crepitations lower in pitch than the continuous cricket-like call of *H. rivularis*. William E. Duellman made a sound-spectrograph of this species (KU 65132) at Río Maria-Aguilar, 3 kilometers west of Cariblanco, Alajuela Province; April 18, 1961 (Fig. 6). The call consists of 3 notes, each note having 4 pulses. The pulse rate is 80 pulses per second. The duration of the call for the 3 notes is 0.4 seconds. The first pulse has a fundamental frequency of 2600 cycles per second, the dominant frequency of 5000 c.p.s. and the third harmonic of 6200 c.p.s. The fourth pulse has a fundamental of 3100 c.p.s., dominant 5600 c.p.s. and third harmonic 7100 c.p.s.

The females contained large (2 mm.) unpigmented eggs suggesting the possibility of the eggs being deposited in streams under rocks.

Hyla tica can readily be distinguished from *Hyla debilis* and *H. rivularis* by the round instead of sloping snout and more webbing on the hands and feet. However, this frog appears to be related to a group of stream breeding tree frogs which includes *Hyla rivularis*, *H. debilis*, *H. pictipes* and possibly the red-eyed hylas, *H. uranochroa*, *H. rufioculis* and *H. legleri*. Two cleared and stained specimens of *H. tica*, UMMZ 118474 (CD 7615) and CRE 7017, and radiographs of other *H. tica* reveal the presence of a slightly reduced quadratojugal bone. The bone is slender and does not quite reach the maxilla. The quadratojugal is even more reduced in *H. rivularis* and *H. debilis*, occurring as a tiny bone at the base of the squamosal. This

bone is either very small or completely absent in *H. pictipes*. The quadratojugal in the red-eyed frog, *H. rufioculis*, is reduced and similar to the condition in *H. rivularis* and *H. debilis*. In *H. uranochroa* and *H. legleri* the quadratojugal is not reduced and makes contact with the maxilla. This group of frogs lives near small streams, and as far as is known they are stream breeders. The females lay large unpigmented eggs. The tadpoles of *H. rivularis*, *H. pictipes* and *H. uranochroa* have large sucking mouthparts and low dorsal tail fins, and are adapted for stream life. The similarity in the tadpoles is more evidence supporting the close relationship between *Hyla pictipes* and *Hyla rivularis*. The distribution of *H. tica* in Costa Rica is shown in Figure 4. The altitudinal distribution of *H. tica* (3700 to 5400 feet) overlaps that of *H. rivularis* (4125 to 6800 feet) which in turn overlaps that of *H. pictipes* (6500 to 8200 feet).

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