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**SOME HYLID FROGS FROM THE
GUIANA HIGHLANDS, NORTHEASTERN SOUTH
AMERICA: NEW SPECIES, DISTRIBUTIONAL
RECORDS, AND A GENERIC REALLOCATION**

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ABSTRACT: Three new species of *Hyla* are named from the Guianan region of northeastern South America. *Hyla hadroceps*, a species of unknown relationships from southern Guyana, has a large, blunt head and tuberculate dorsal skin. *Hyla roraima*, a member of the *Hyla geographica* group, and *Hyla warreni*, a species of unknown relationships, occur on Mt. Roraima in western Guyana. *Hyla kanaima* Goin and Woodley, a member of the *Hyla geographica* group, is reported from Mt. Roraima and redescribed. *Hyla rodriguezii* Rivero is placed in the genus *Osteocephalus*.

KEY WORDS: *Hyla hadroceps*, *Hyla roraima*, *Hyla warreni*, new species; *Osteocephalus rodriguezii*; Guyana; Venezuela.

RESUMEN: Se denominan tres especies nuevas de *Hyla* de la región de las Guayanas en el noreste de Sudamérica. *Hyla hadroceps*, especie de relaciones desconocidas del sur de Guyana, tiene una cabeza grande y roma, y la piel del dorso con tubérculos. *Hyla roraima*, miembro del grupo *Hyla geographica*, e *Hyla warreni*, especie de relaciones desconocidas, ocurren en el Monte Roraima en Guyana occidental. Se reporta de Monte Roraima, Guyana, y redescrive a *Hyla kanaima* Goin and Woodley, miembro del grupo *Hyla geographica*. Se ubica a *Hyla rodriguezii* Rivero en el género *Osteocephalus*.

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Our independent field work in northeastern South America during the past two decades has resulted in the collection of numerous new species of hylid frogs. Study of our material and that in various museum collections has resulted in a revision of the genus *Stefania* (Duellman and Hoogmoed, 1984), definition of species in the *Hyla granosa* group (Hoogmoed, 1979a), and descriptions of three new species of *Ololygon* (Hoogmoed and Gorzula, 1979; Duellman, 1986). During our studies of other museum collections we discovered three unnamed species of *Hyla* not represented among specimens that we collected.

Herein we report on some hylids of the genera *Hyla* and *Osteocephalus* from the Guiana Highlands. This region encompasses the table mountains extending from Surinam southwestward to the southern part of the Territorio Federal de Amazonas in southern Venezuela. The area was described by Hoogmoed (1979b); localities mentioned in the text are shown in Figure 1.

We examined material in the British Museum (Natural History) (BM),

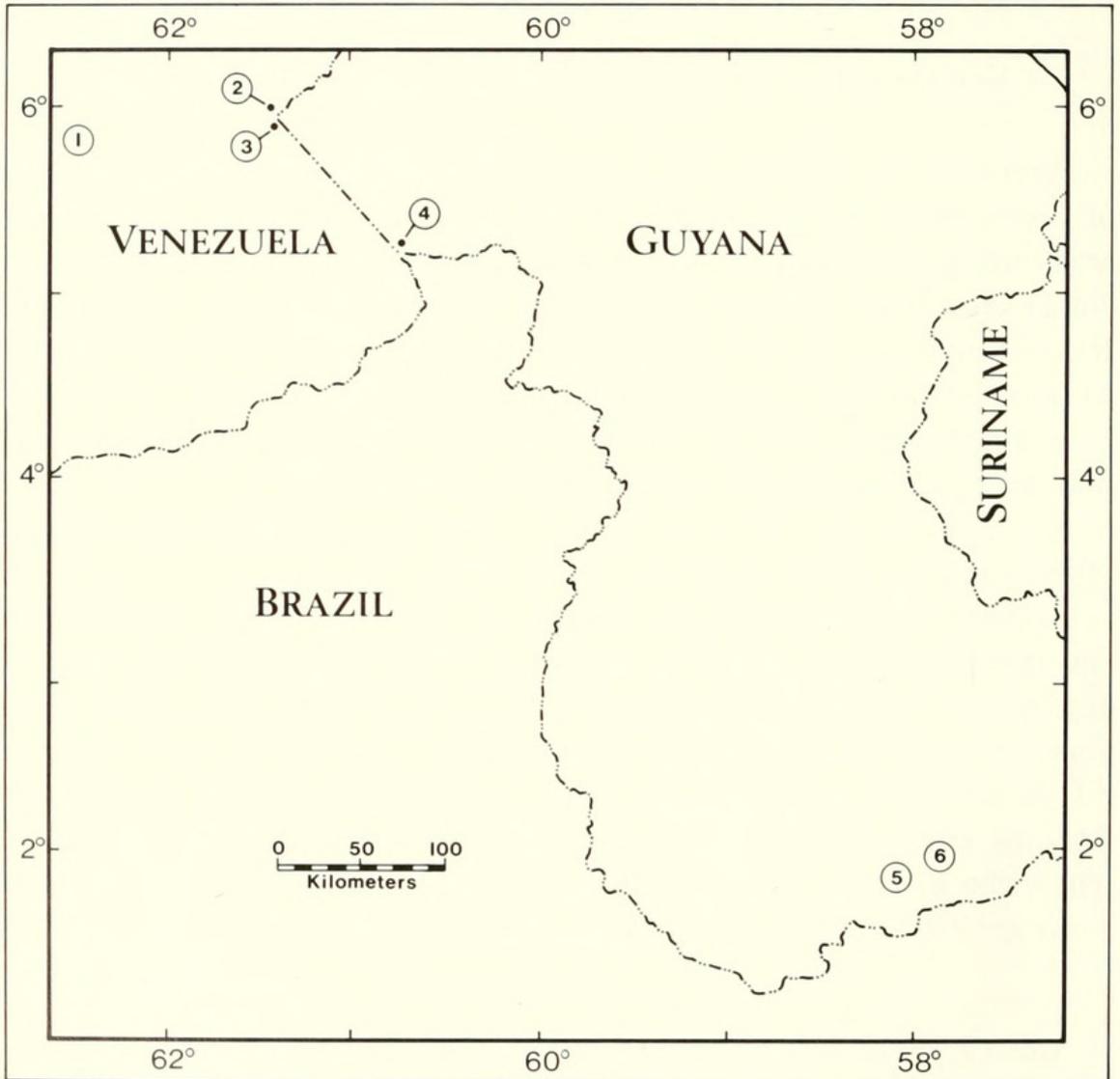


Fig. 1. Map of Guianan Region showing localities mentioned in text. 1 = Auyán-tepuí; 2 = Paso del Danto; 3 = Km 144; 4 = Northeastern slope of Mt. Roraima; 5 = Acarai Mountains; 6 = New River.

Museum of Comparative Zoology at Harvard University (MCZ), Museum of Natural History at The University of Kansas (KU), National Museum of Natural History (USNM), Nationaal Natuurhistorisch Museum (formerly Rijksmuseum van Natuurlijke Historie) (RMNH), the University of Guyana Department of Biology (UGDB), and the University of Puerto Rico at Mayagüez (UPR-M). Measurements and structural features follow Duellman (1970), except that webbing formula is that of Savage and Heyer (1967), as modified by Myers and Duellman (1982). Snout-vent length is abbreviated SVL.

HYLA LAURENTI, 1768

Nearly 300 species, most of which are placed in one of more than 40 phenetic groups, are recognized in the paraphyletic genus *Hyla*. Seven of these groups occur in the Guianan Region. These are: (1) *Hyla boans* group (Duellman, 1970), (2) *Hyla geographica* group (Duellman, 1973), (3) *Hyla granosa* group (Hoogmoed, 1979a), (4) *Hyla leucophyllata* group (Duellman, 1970), (5) *Hyla marmorata* group (Bokermann, 1964), (6) *Hyla microcephala* group (Duellman, 1970), and (7) *Hyla parviceps* group (Duellman and Crump, 1974).

Two of the three new species described herein cannot be relegated to any of these recognized species groups. The other new species is a member of the *Hyla geographica* group. For ease of comparison, comparable features are numbered sequentially in the diagnoses.

Hyla hadroiceps new species

Holotype.—KU 69720, an adult male, from area north of Acarai Mountains, west of New River (ca. 02°N, 58°W), Rupununi District, Guyana, obtained in January 1962 by William A. Bently.

Diagnosis.—The single male has a SVL of 53.9 mm and the following characteristics: (1) body robust; head blunt; (2) skin on dorsum bearing many large, round tubercles; skin of head not co-ossified with underlying dermal bones; (3) tympanum distinct; (4) fingers about two-thirds webbed; (5) toes nearly fully webbed; (6) fringes and calcars absent on limbs; (7) axillary membrane extending to midlength of upper arm; (8) dorsum brown with irregular darker brown markings; venter cream with brown flecks; (9) vomerine odontophores short, diagonal.

A subgular vocal sac immediately distinguishes *Hyla hadroiceps* from species of *Phrynohyas* and *Osteocephalus*, some of which it resembles superficially. The thick tubercular skin, large size, and absence of black and orange or yellow flash colors distinguish it from members of the *Hyla marmorata* group. The absence of dermal fringes on the limbs distinguishes *H. hadroiceps* from *H. tuberculosa*.

Description of holotype.—Adult male; body robust; head wider than long; snout short, distance from tip of snout to eye equal to length of eye, truncate in dorsal view and in profile, not projecting beyond margin of lip; canthus rostralis rounded, indistinct; loreal region concave, sloping steeply to rounded lip; nostril protuberant laterally; internarial area slightly depressed; top of head flat; interorbital distance slightly more than width of upper eyelid; tympanum distinct, round, its length 0.55 that of eye, separated from eye by distance about equal to length of tympanum; supratympanic fold weak, barely covering upper edge of tympanic annulus. Axillary membrane extending about one half length of upper arm; forearm robust, lacking ulnar fold; fingers short, bearing round discs; width of disc on Finger III slightly greater than diameter of tympanum; disc on Finger I noticeably smaller than others; dermal keel along outer edge of Finger IV; relative lengths of fingers $1 < 2 < 4 < 3$; subarticular tubercles distinct, moderately small, conical; distal tubercle on Finger IV weakly bifid; supernumerary tubercles small, round, present only on proximal segments; two palmar tubercles, round; thenar tubercle elongate; nuptial excrescence elliptical, unpigmented, present on dorsal surface of proximal part of Finger I; fingers about two-thirds webbed; webbing formula $\text{I}2^- - 2\frac{1}{2} \text{III}1\frac{1}{2} - 2\text{III}2^- - 1\frac{1}{2} \text{IV}$ (Fig. 2A). Hind limb moderately short, lacking folds on tarsus; inner metatarsal tubercle elongate, round in section, barely visible from above; outer metatarsal tubercle indistinct, round, low; toes short, bearing round discs slightly smaller than those on fingers; disc on Toe I much smaller than others; dermal keel along outer edge of Toe V; relative lengths of toes $1 < 2 < 5 < 3 < 4$; subarticular tubercles distinct, moderately small, subconical; supernumerary tubercles small, round,

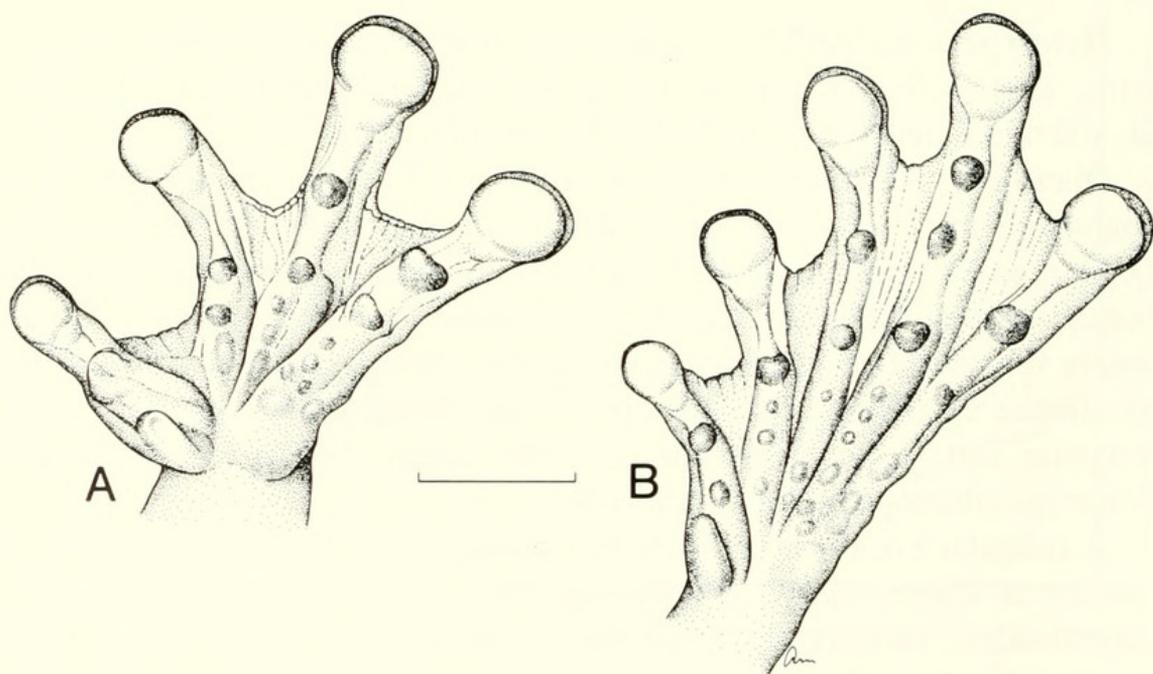


Fig. 2. Hand (A) and foot (B) of *Hyla hadroceps*, KU 69720. Line = 5 mm.

present only on proximal segments; toes extensively webbed; webbing formula $\text{II}-2\text{III}-2\text{III}1-2\text{IV}1\frac{1}{2}-1\text{V}$ (Fig. 2B). Skin on dorsal surfaces of head, body, shanks, and forearms with abutting, low, round tubercles; skin on flanks, chest, belly, and proximal ventral surfaces of thighs coarsely granular; skin on other surfaces smooth; anal sheath long; anal opening puckered, directed posteroventrally at upper level of thighs. Vomerine odontophores oblique, widely separated medially, diverging posteriorly just behind posterior margins of transversely ovoid choanae, bearing 6 and 7 teeth; tongue broadly cordiform, shallowly notched posteriorly, free posteriorly for about one-fourth of its length; vocal slit extending from midlateral base of tongue toward angle of jaw; vocal sac single, median, subgular with lateral extensions.

Color in preservative: Dorsum brown with irregular darker brown markings; limbs brown with broad, transverse brown marks—one each on forearm, wrist, and foot; two each on tibia, shank, and tarsus (Fig. 3). Flanks and anterior and posterior surfaces of thighs creamy tan with brown flecks; venter cream with brown flecks laterally on throat, over entire belly, and distally on thighs.

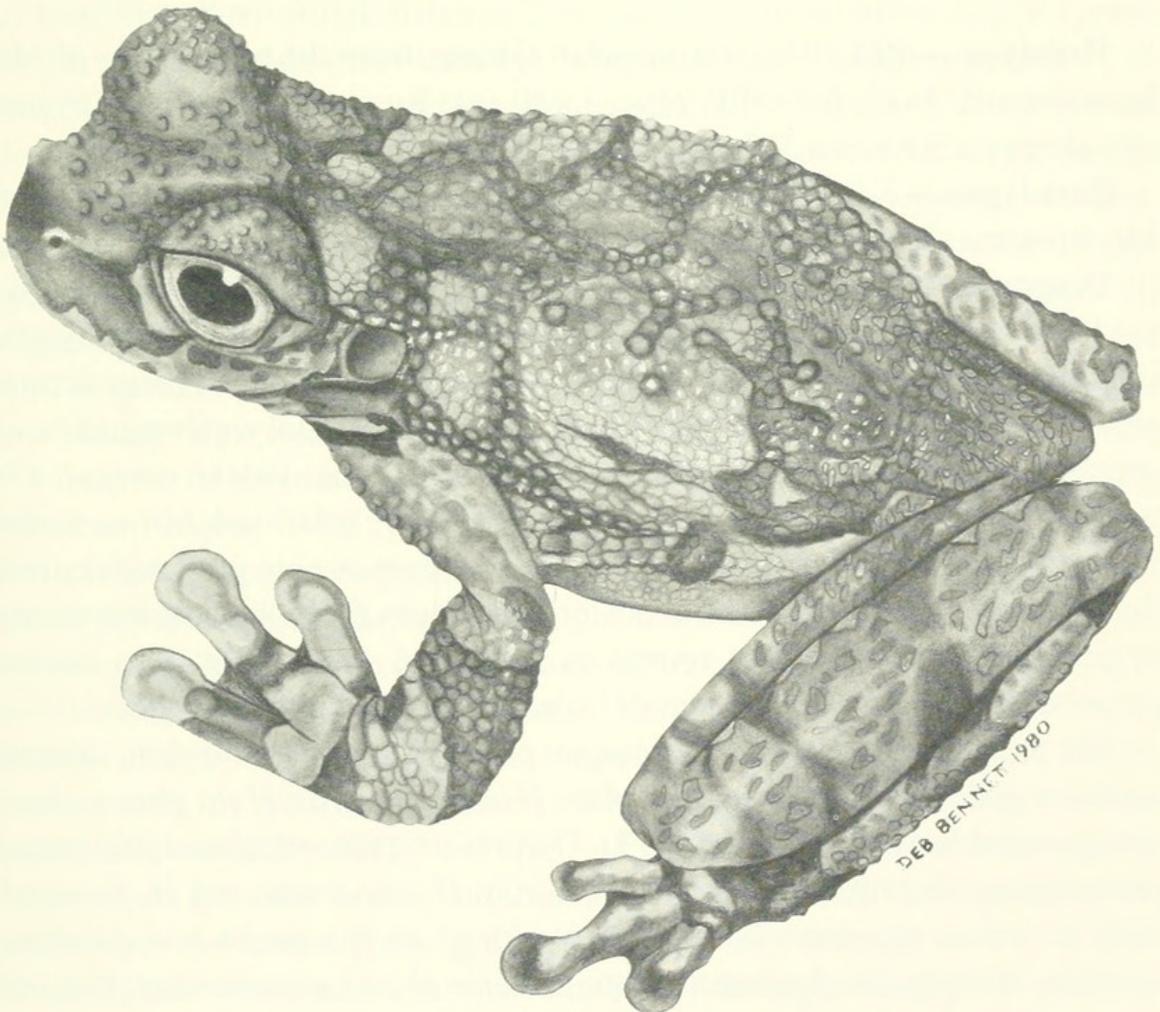


Fig. 3. Holotype of *Hyla hadroceps*, KU 69720, male, 53.9 mm SVL.

Measurements (in mm): SVL 53.9, tibia length 25.8, foot length 20.9, head length 18.1, head width 19.6, interorbital distance 5.9, upper eyelid width 5.2, eye-nostril distance 4.5, eye length 5.9, tympanum length 2.8.

Distribution.—The species is known only from the type locality in extreme southern Guyana.

Etymology.—The specific name is derived from the Greek *hadros*, meaning bulky, and the Greek *kephale*, meaning head; the name *hadroceps* alludes to the short, heavy head of the frog.

Remarks.—The single specimen has been in the collection at The University of Kansas for many years, during which time it has been examined many times and compared with other species, all to no avail in identifying it with a known species. It was part of a collection containing many common and widespread species of frogs typical of the Guianan rainforest; all were collected at the same locality and include *Adenomera andreae*, *Leptodactylus mystaceus*, *L. pentadactylus*, *L. rhodomystax*, *L. wagneri*, *Bufo* “*typhonius*,” *Epipedobates* (= *Allobates*) *femoralis*, *E. trivittatus*, *Allophryne ruthveni*, *Hyla boans*, *H. geographica*, *H. minuta*, and *Osteocephalus taurinus*.

Hyla roraima new species

Holotype.—BM 1979.560, an adult female, from the north slope of Mt. Roraima (05°38'N, 60°44'W, elev. 1,480 m), Rupununi District, Guyana, obtained on 29 August 1971 by Adrian N. Warren.

Paratypes.—KU 182470 collected with the holotype, and UGDB 14 from Mt. Roraima, 1,430 m, obtained by Michael Tamessar.

Diagnosis.—A member of the *Hyla geographica* group characterized by: (1) body slender; head distinct from body; (2) skin on dorsum of body and limbs smooth, on head tuberculate, not co-ossified with underlying dermal elements; (3) tympanum distinct; (4) fingers with vestigial webbing; (5) toes about one-half webbed; (6) fringes absent on limbs; calcar conical; (7) axillary membrane absent; (8) dorsum tan with irregular dark brown markings and middorsal dark stripe or not; flanks cream or pale gray with brown flecks or irregular vertical lines; posterior surfaces of thighs uniform cream or gray with brown flecks; ventral surfaces and webbing on foot cream; palpebral membrane reticulated; (9) vomerine odontophores angular.

The presence of prepollical spines not projecting through the skin, calcars, and vestigial webbing on the hand place *H. roraima* in the *Hyla geographica* group, as defined by Duellman (1973). The presence of a reticulated palpebrum immediately distinguishes *H. roraima* from *H. calcarata* and *H. fasciata*, both of which also have bold black markings on the flanks and posterior surfaces of the thighs; furthermore, the calcar in *H. calcarata* is large, flat, and triangular, and that in *H. fasciata* is long and tubercular. Two other members of the *Hyla geographica* group have reticulated palpebral membranes; of

these, *H. geographica* has the fingers about one-half webbed, large triangular calcars, and many (usually paired) vertical dark bars on the flanks and posterior surfaces of the thighs, whereas *H. microderma* has a low tubercle on the heel and lacks dark marks on the flanks and posterior surfaces of the thighs. *Hyla dentei* is about the same size as *H. roraima* but lacks calcars and has faint transverse dorsal markings on the body and bold transverse bars on the anterior, dorsal, and posterior surfaces of the thighs. *Hyla roraima* differs from the sympatric *H. kanaima* by having more webbing on the feet, a reticulated palpebral membrane, and angular instead of straight vomerine odontophores; furthermore, *H. kanaima* has bold reticulations on the flanks, transverse bars on the thighs, and dark flecks on the throat. *Hyla roraima* differs from the geographically adjacent *H. crepitans* (Gran Sabana of Venezuela) in coloration (vertical lines on flanks of *H. crepitans*) and by having a reticulated palpebral membrane, calcars, and more webbing on the hand.

Description of holotype.—Adult female; body slender; head markedly distinct from body, depressed, slightly longer than wide; snout moderately long, truncate in dorsal view and in profile, not projecting beyond margin of upper lip; canthus rostralis rounded; loreal region inclined ventrolaterally to round lip; nostril protuberant laterally; internarial area slightly depressed; top of head flat; interorbital distance 20% greater than width of upper eyelid; length of eye slightly more than eye-nostril distance; tympanum distinct, its length 0.43 that of eye, deflected dorsolaterally, separated from eye by distance equal to length of tympanum; supratympanic fold weak, barely covering dorsal edge of tympanic annulus. Axillary membrane absent; forearm slender, having row of indistinct, low ulnar tubercles; fingers moderately long, bearing large, round discs; width of disc on Finger III slightly less than diameter of tympanum; relative lengths of fingers $1 < 2 < 4 < 3$; subarticular tubercles distinct, large, round; supernumerary tubercles moderately large, round, present only on proximal segments; palmar tubercle bifid; thenar tubercle elongate with median projection distally; basal webbing between Fingers II–IV (Fig. 4A). Hind limb long, slender; heel bearing conical tubercular calcar; inner tarsal fold weakly defined on distal part of tarsus; inner metatarsal tubercle elliptical, flattened, visible from above; outer metatarsal tubercle low, conical; toes moderately long, bearing round discs smaller than those on fingers; relative lengths of toes $1 < 2 < 5 < 3 < 4$; subarticular tubercles large, round; supernumerary tubercles small, round, present only on proximal segments; toes about one-half webbed; webbing formula $\text{I}2\text{—}3\text{II}2\text{—}3\text{III}1\text{—}3\text{IV}3\text{—}2\text{V}$ (Fig. 4B). Skin on head weakly tuberculate, on other dorsal surfaces smooth, on ventral surfaces granular; anal sheath short; anal opening directed posteriorly at upper level of thighs, bordered below by round tubercles. Vomerine odontophores angular, abutting medially, bearing 15 and 16 teeth; tongue broadly cordiform, slightly notched posteriorly, barely free behind.

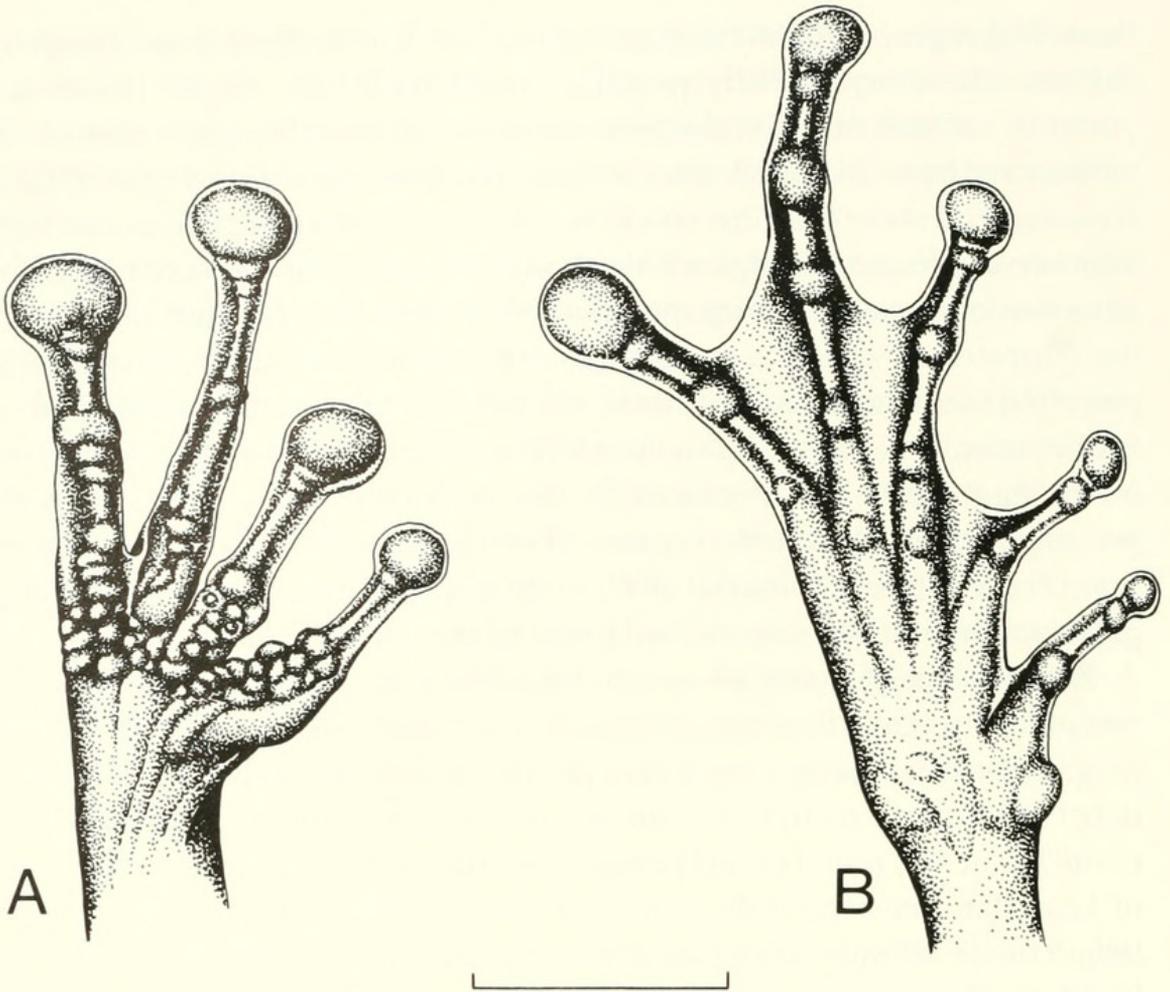


Fig. 4. Hand (A) and foot (B) of *Hyla roraima*, BM 1979.560. Line = 5 mm.

Color in preservative: Dorsum tan with irregular dark brown markings consisting of flecks on snout, interorbital mark, a crudely W-shaped mark in scapular region, pair of elongate spots anterior to sacrum, two transverse marks posterior to sacrum, and transverse bars on limbs—three on forearm, five on thigh, five on shank, and two on tarsus; flanks and posterior surfaces of thighs grayish cream with vertically elongate brown flecks; ventral surfaces dull cream; palpebral membrane finely reticulated (Fig. 5).

Measurements (in mm): SVL 45.5, tibia length 25.2, foot length 16.6, head length 16.1, head width 15.7, interorbital distance 5.4, upper eyelid width 4.1, eye-nostril distance 4.8, eye length 5.1, tympanum length 2.2.

Variation.—The two paratypes are females having SVLs of 38.5 and 42.2 mm and 14–14 and 13–13 vomerine teeth. They are essentially like the holotype in proportions and structure. In coloration, there are some minor differences. One (UGDB 14) has a narrow black middorsal line on the head and anterior part of the body. Both have more extensive dark markings on the body than does the holotype; each has a large dark spot on the snout, broad interorbital bar, large X-shaped mark in the scapular region, and broad, transverse mark in sacral region. In UGDB 14, the flanks have dark flecks, and in KU 182470, dark vertical lines.

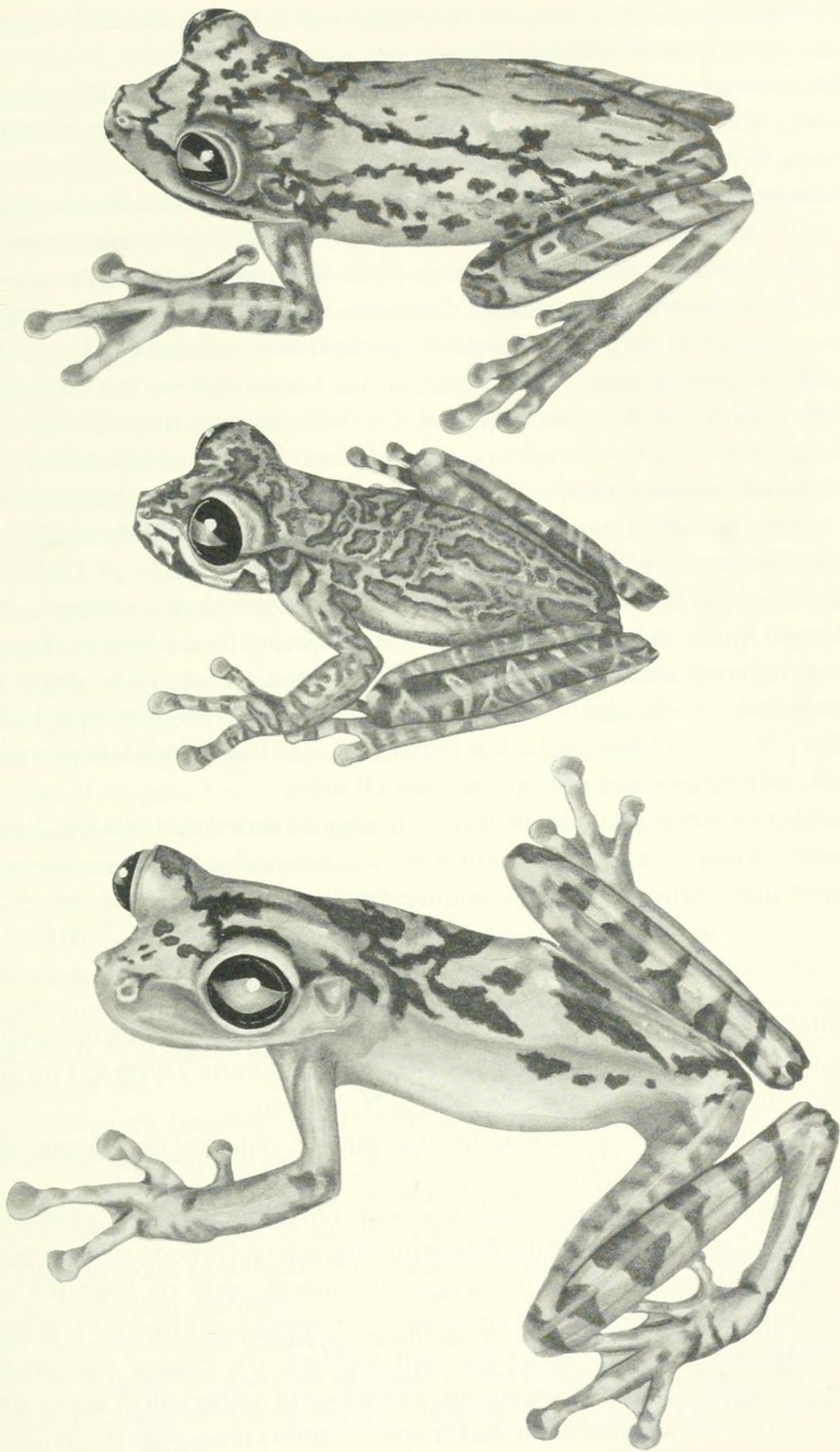


Fig. 5. Species of *Hyla*. Top. *Hyla kanaima*, KU 182469, female, 49.1 mm SVL. Middle. Holotype of *Hyla warreni*, BM 1979.561, female, 36.2 mm SVL. Bottom. Holotype of *Hyla roraima*, BM 1979.560, female, 45.5 mm SVL.

Distribution.—*Hyla roraima* is known only from the forested slopes of Mt. Roraima in southwestern Guyana.

Etymology.—The specific name is a noun in apposition for the type locality, Mt. Roraima, the “legendary” tepui on the common border of Guyana, Venezuela, and Brazil.

Remarks.—The type series of *H. roraima* consists of females, whereas that of *H. microderma* is made up of five males having snout-vent lengths of 31.0–32.7 mm ($\bar{x} = 31.7$) mm (Pyburn, 1977:406). Although *H. microderma* occurs far to the west (Río Vaupés, Colombia), the only known locality is on the western part of the Guiana Shield. Because *H. microderma* and *H. roraima* are alike in having vestigial webbing on the hands and having reticulated palpebral membranes, it was suspected that the specimens from Mt. Roraima might be females of *H. microderma*. In addition to body size and relative sizes of the calcars, the major differences between the two species are in coloration. The smaller species, *H. microderma* lacks markings on the flanks and thighs, whereas the larger *H. roraima* has dark markings on those surfaces. Duellman (1973:523, 525) noted the ontogenetic development of dark markings on the flanks and thighs in *H. calcarata* and *H. fasciata*, but no noticeable changes occurred after sexual maturity; also, no ontogenetic changes in shape and proportional size of calcars were noted. Thus, the differences between adult males of *H. microderma* and adult females of *H. roraima* are interpreted as specific differences, not intraspecific sexual ones.

Field data accompanying Warren's specimens noted that the frogs were collected in montane forest at night. One was on a palm frond, another on a leaf over a slow-moving stream, and the third on the forest floor.

Hyla warreni new species

Holotype.—BM 1979.561, an adult female, from the north slope of Mt. Roraima (05°38'N, 60°44'W, elev. 1,480 m), Rupununi District, Guyana, obtained on 2 September 1971 by Adrian N. Warren.

Paratopotype.—KU 182471, an adult female, obtained on 3 September 1971 by Adrian N. Warren.

Diagnosis.—A moderate-sized *Hyla* with a maximum known snout-vent length of 36.2 mm and having the following characters: (1) body slender; head relatively large, blunt; (2) skin on dorsum smooth; skin on head not co-ossified with underlying dermal elements; (3) tympanum distinct; (4) fingers webbed basally; (5) toes about one-half webbed; (6) fringes and calcars absent on limbs; (7) axillary membrane extending to midlength of upper arm; (8) dorsum brown with irregular darker spots; venter cream with brown spots on throat; (9) vomerine odontophores short, transverse.

Hyla warreni superficially resembles *Hyla* (= *Osteocephalus*) *rodriguezi*, which differs from *H. warreni* by having angular vomerine odontophores,

elongate choanae, small tubercles on the dorsum, different coloration, an abbreviated axillary membrane, and relatively short fingers with simple subarticular tubercles. *Hyla warreni* has an extensive axillary membrane and longer fingers with bifid subarticular tubercles on Fingers III and IV. The absence of black and yellow flash colors and extensive webbing on the hand distinguish *H. warreni* from members of the *Hyla marmorata* group. The absence of dermal fringes distinguishes *H. warreni* from *H. tuberculosa*, and the smooth skin and vestigial webbing separate it from *H. hadroiceps*.

Description of holotype.—An adult female; body moderately slender; head relatively large, as wide as long; snout short, truncate in dorsal view and in profile, not projecting beyond margin of lip; canthus rostralis distinct, rounded; loreal region slightly concave, sloping gradually to rounded lip; nostril protuberant dorsolaterally; internarial area deeply depressed; top of head flat; length of eye greater than eye-nostril distance; interorbital distance slightly greater than width of upper eyelid; tympanum distinct, its diameter 0.34 that of eye, separated from eye by distance slightly greater than length of tympanum; supratympanic fold moderately heavy, covering upper part of tympanum and curving to point above angle of jaw. Axillary membrane extending more than one-half length of upper arm; forearm moderately robust, with two indistinct ulnar tubercles distally; fingers long, bearing round discs; width of disc on Finger III equal to diameter of tympanum; relative lengths of fingers $1 < 2 < 4 < 3$; subarticular tubercles moderately small, round; distal tubercles on Fingers III and IV distinctly bifid; supernumerary tubercles small, round, numerous on proximal segments; palmar tubercle bifid; thenar tubercle elliptical; fingers webbed basally; webbing formula **II**²—**3II**³—**3**—**IV** (Fig. 6A). Hind limb long, slender, lacking tarsal fold and tubercles; inner metatarsal tubercle elongate, round in section, projecting, visible from above; outer metatarsal tubercle small, subconical; toes moderately long, bearing round discs slightly smaller than those on fingers; relative lengths of toes $1 < 2 < 3 < 5 < 4$; subarticular tubercles small, round; supernumerary tubercles small, round, sparse on proximal segments; toes about one-half webbed; webbing formula **I**²—**2**⁺**II**¹—**2**⁺**III**¹—**2**⁺**IV**²—**1**⁺**V** (Fig. 6B). Skin on dorsal surfaces smooth; skin on belly and proximal posteroventral surfaces of thighs coarsely granular; skin on other ventral surfaces smooth; anal sheath short; anal opening directed posteriorly at upper level of thighs, bordered below by two pairs of tubercles. Vomerine odontophores widely separated medially, short, transverse, slightly posterior to level of posterior margins of small, round choanae, bearing 5 and 6 teeth; tongue circular, shallowly notched behind, free posteriorly for about one-fourth of its length.

Color in preservative: Dorsum pale brown with numerous, irregular, small dark brown spots; flanks creamy tan with small brown spots; limbs creamy tan with brown transverse marks—two on forearm, five on thigh, four on shank,

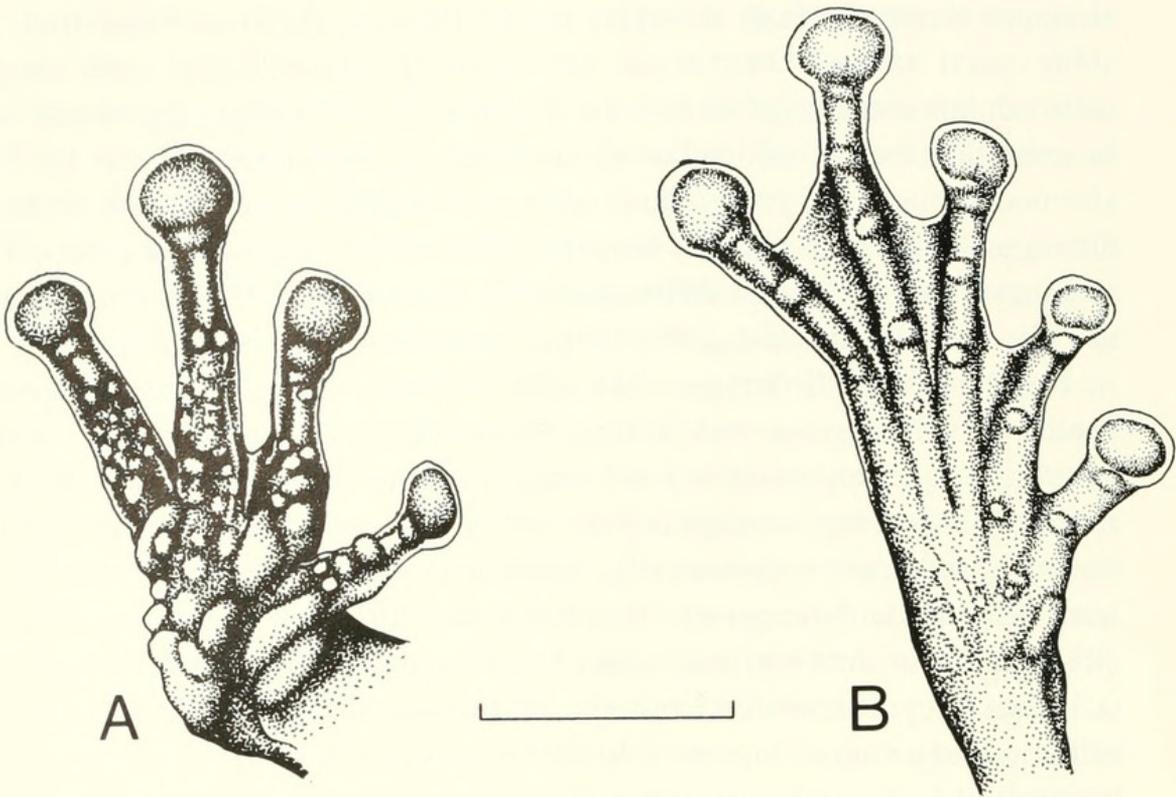


Fig. 6. Hand (A) and foot (B) of *Hyla warreni*, BM 1979.561, female. Line = 5 mm.

and three on tarsus; posterior surfaces of thighs tan; side of head tan with dark brown labial bars demarcating two broad, creamy white marks—one below eye, one posterior to eye; venter dull cream with large brown spots and reticulations on chin (Fig. 5).

Measurements (in mm): Snout-vent length 36.2, tibia length 20.3, foot length 14.5, head length 12.8, head width 12.8, interorbital distance 3.7, width of upper eyelid 3.1, eye-nostril distance 3.2, eye length 4.2, tympanum length 1.8.

Variation.—The single female paratype has a snout-vent length of 32.9 mm and 7–8 vomerine teeth; the proportions and coloration are essentially the same as in the paratype, except that the ventral spotting extends onto the chest.

Distribution.—The species is known only from the northern slopes of Mt. Roraima in southwestern Guyana.

Etymology.—The species is named for the collector, Adrian N. Warren.

Remarks.—The specimens were collected in montane forest. According to Warren's field notes, the holotype was on a palm frond at night, and the paratype was sleeping by day in the fork of a fallen branch.

Two other large species of *Hyla* (*H. kanaima* and *H. roraima*) were found at the same locality with *H. warreni*. *Hyla kanaima* differs by having long, transverse vomerine odontophores, simple subarticular tubercles on the fingers, boldly reticulated flanks, and no pale labial spots. *Hyla roraima* differs by having angular vomerine odontophores, small tubercles on the head, calcars, and unicolor lips and venter.

Hyla kanaima Goin and Woodley

Goin and Woodley (1969) described *Hyla kanaima* from Mt. Kanaima, near Amatuk Falls on Potaro River, Guyana, and suggested that the species was related to *Hyla geographica*. We report here on three new specimens of *H. kanaima* from a new locality for the species. These specimens provide new information on the variation in the species. Therefore, we present a new diagnosis of the species and a description of the new specimens.

Diagnosis.—A member of the *Hyla geographica* group characterized by: (1) body moderately slender; head distinct from body; (2) skin on dorsum smooth; skin on head not co-ossified with underlying dermal elements; (3) tympanum distinct; (4) fingers unwebbed; (5) toes about one-third webbed; (6) fringes absent on limbs; calcar small, blunt; (7) axillary membrane absent; (8) dorsum tan with irregular longitudinal markings and no middorsal dark stripe; flanks boldly mottled brown and cream; posterior surfaces of thighs with broad dark brown bars continuous with those on dorsal surfaces; ventral surfaces of thighs pale gray with brown flecks; belly creamy gray with brown flecks; webbing on feet cream with brown flecks; palpebral membrane unpigmented; (9) vomerine odontophores long, diagonal.

The presence of calcars and prepollical spines not projecting through the skin and the absence of webbing between the fingers place *H. kanaima* in the *Hyla geographica* group as defined by Duellman (1973). The absence of a reticulated palpebrum immediately distinguishes *H. kanaima* from *H. geographica*, *H. microderma*, and *H. roraima*. *Hyla dentei* is about the same size as *H. kanaima* and also has bold transverse markings on the thighs; however, *H. dentei* has faint transverse markings on the dorsum. Two other species in the *Hyla geographica* group, *H. calcarata* and *H. fasciata*, have unpigmented palpebral membranes. Both of these have bold black markings on the flanks and posterior surfaces of the thighs; furthermore, the calcar in *H. calcarata* is large, flat, and triangular, and that in *H. fasciata* is long and tubercular. *Hyla kanaima* differs from the sympatric *H. roraima* by having less webbing on the feet, an unpigmented palpebral membrane, and straight instead of angular vomerine odontophores; furthermore, *H. roraima* has small brown flecks or irregular vertical lines on the flanks, uniformly cream or pale gray (with brown flecks) posterior surfaces of the thighs, and uniformly cream ventral surfaces and webbing.

Description of three adult females.—Body moderately slender; head markedly distinct from body, depressed, slightly longer than wide; snout moderately long, rounded in dorsal view, truncate in profile, not projecting beyond margin of upper lip; canthus rostralis rounded; loreal region inclined ventrolaterally to round lip; nostril slightly protuberant laterally; internarial area noticeably depressed; top of head flat; interorbital distance equal to width of upper eyelid; length of eye about equal to eye-nostril distance; tympanum

distinct, its length 0.31–0.42 ($\bar{x} = 0.34$) that of eye, deflected dorsolaterally, separated from eye by distance slightly less than length of tympanum; supratympanic fold moderately heavy, covering upper third of tympanum. Axillary membrane absent; forearm slender, lacking ulnar tubercles; fingers moderately long, bearing large, round discs; width of disc on Finger III equal to length of tympanum; relative lengths of fingers $1 < 2 < 4 < 3$; subarticular tubercles moderately large, round; supernumerary tubercles large, round; palmar tubercle indistinctly trifold; thenar tubercle elongate; webbing absent (Fig. 7A). Hind limb long, slender; heel bearing small, round protuberance; inner tarsal fold weakly defined on distal part of tarsus; inner metatarsal tubercle ovoid, rounded, barely visible from above; outer metatarsal tubercle absent; toes moderately long, bearing round discs slightly smaller than those on fingers; relative lengths of toes $1 < 2 < 5 = 3 < 4$; subarticular tubercles moderately large, subconical; supernumerary tubercles slightly smaller, round; toes about one-third webbed; webbing formula $\text{I2—3II}(2\text{--}2^+)\text{—3III3—}(3^{\text{--}}\text{--}3^{\text{+}})\text{IV}(3^{\text{--}}\text{--}3^{\text{+}})\text{—2V}$ (Fig. 7B). Skin on dorsum smooth; skin on belly and ventral surfaces of thighs granular; skin on other ventral surfaces smooth; anal sheath short; anal opening directed posteriorly at upper level of thighs. Vomerine odontophores straight, abutting medially, inclined posterolaterally, bearing 15 and 19 ($\bar{x} = 16.5$) teeth; tongue cordiform,

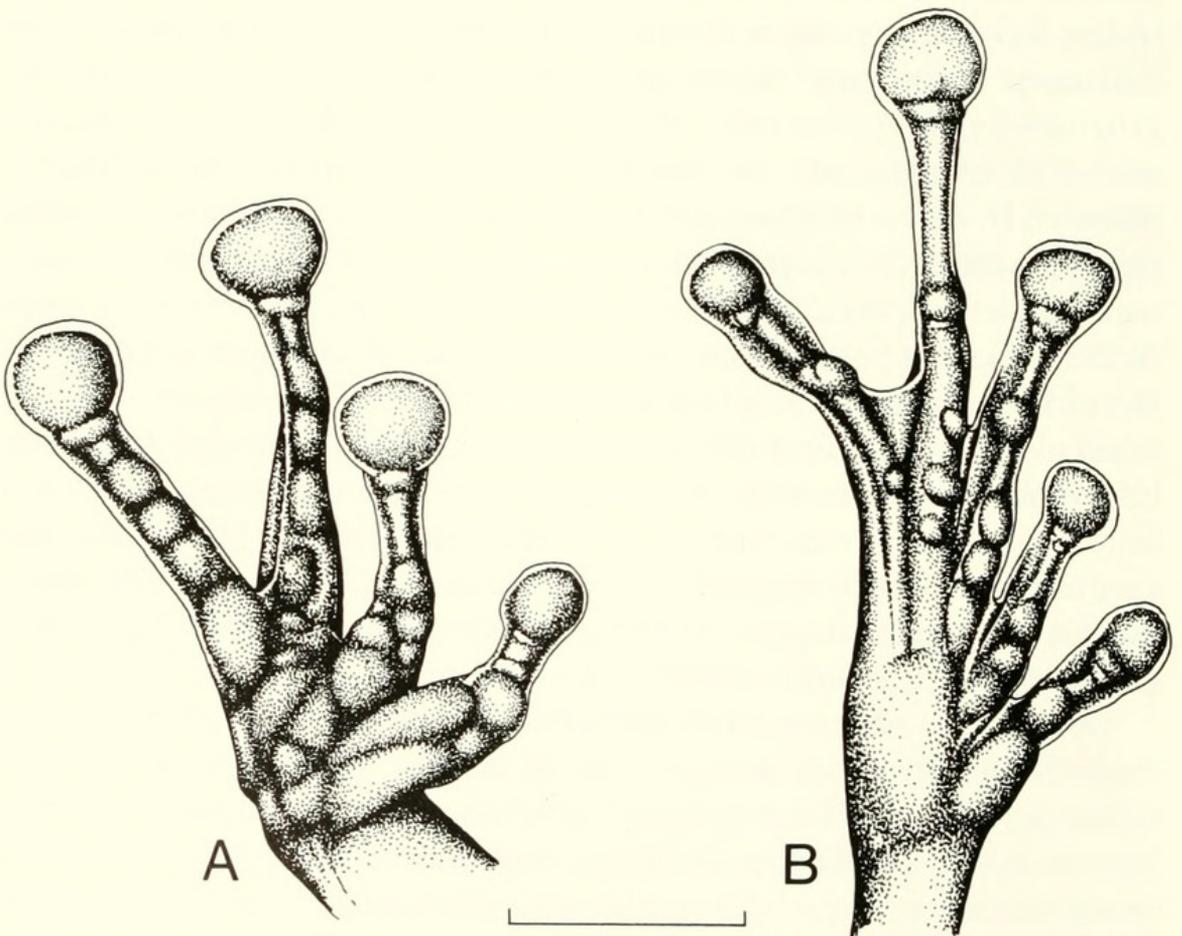


Fig. 7. Hand (A) and foot (B) of *Hyla kanaima*, KU 182469. Line = 5 mm.

shallowly indented behind, barely free posteriorly.

Color in preservative: Dorsum tan with dark brown markings with irregular edges consisting of canthal stripe, narrow interorbital bar, dorsolateral stripe extending from posterior corner of eyelid medially to scapular region and thence posterolaterally to groin, longitudinal stripe above insertion of forelimb, two to four blotches in sacral region, small spots and dashes on head and medial part of body, and transverse bars on limbs—two on upper arm, three or four on forearm, seven or eight on thigh, four or five on shank, and four or five on tarsus. Flanks mottled dark brown and cream; posterior thighs marked with continuation of transverse bars on dorsal surfaces of thighs; venter creamy gray with brown flecks, largest on throat; palpebral membrane unpigmented (Fig. 5).

Measurements (in mm): SVL 46.0–49.1 (\bar{x} = 47.6), tibia length 23.1–24.8 (\bar{x} = 24.2), foot length 16.3–17.3 (\bar{x} = 16.8), head length 16.8–17.7 (\bar{x} = 17.2), head width 15.3–16.7 (\bar{x} = 16.1), interorbital distance 4.3–5.1 (\bar{x} = 4.7), upper eyelid width 4.5–5.0 (\bar{x} = 7.4), eye-nostril distance 4.9–5.7 (\bar{x} = 5.3), eye length 5.8–6.2 (\bar{x} = 6.0), tympanum length 2.1–2.7 (\bar{x} = 2.4).

Remarks.—These females (BM 1983.1428, KU 182469, UGDB 13) are essentially like the type series, of which two females have SVLs of 46.3 and 48.0 mm, and three males have SVLs of 37.0–37.8 mm (\bar{x} = 37.4) (Goin and Woodley, 1969). The structure of the new specimens agrees with the description of the type series given by Goin and Woodley (1969). Two specimens (BM 1983.1428 and KU 182469) have somewhat bolder color patterns but otherwise are like the type series; a transverse dark mark connects the dorsolateral dark stripes in the scapular region in BM 1983.1428. One specimen (UGDB 13) has the dorsolateral stripes fragmented into a longitudinal series of spots and has more distinct bars on the limbs.

The new specimens were found at an elevation of 1,430 m on the north slope of Mt. Roraima on 29 August 1971 by Adrian N. Warren and on 26 October 1973 by Michael Tamessar. This locality is approximately 155 km west of the type locality, Mt. Kanaima. All three females contain relative large (1.8 mm diameter), pigmented oviducal eggs. The large size of these eggs and the absence of ponds on the slopes of Mt. Roraima suggest that *H. kanaima* deposits eggs in streams.

OSTEOCEPHALUS STEINDACHNER, 1862

Trueb and Duellman (1971) recognized five species in the genus *Osteocephalus*; Duellman (1974) placed *Hyla langsdorffii* Duméril and Bibron in the genus, and Martins and Cardoso (1987) named *O. subtilis* from southwestern Brazil. Herein we transfer *Hyla rodriguezi* Rivero to the genus, thereby bringing the number of recognized species of *Osteocephalus* to eight. We are aware of an undescribed species from Auyán-tepuí in southern

Venezuela (specimens in RMNH and USNM) and at least one undescribed species in the middle Amazon Basin and the Guianan lowlands that is structurally similar to the larger sympatric *Osteocephalus taurinus*. This new species and *O. taurinus* differ in breeding habits and advertisement calls (Walter Hödl and Barbara Zimmerman, pers. comm.; MSH, pers. observation).

Because *O. rodriguezii* has less webbing on the hands and feet than do any of the other species, the webbing characters listed in the diagnosis of the genus by Trueb and Duellman (1971:7) should be modified to read: fingers no more than one-third webbed, and toes more than one-half webbed. Our material of *O. rodriguezii* necessitates a new description of the species using the characters and numerical diagnosis equivalent to that of Trueb and Duellman (1971).

Osteocephalus rodriguezii (Rivero), new combination

Diagnosis.—(1) Size small, sexual dimorphism slight; maximum observed snout-vent length in males 34.7 mm, in females 38.1 mm; (2) skin on dorsum in males bearing numerous minute, spinous tubercles; (3) skin on flanks smooth; (4) web extending nearly to base of antepenultimate phalanx of Finger III; (5) dorsum dark brown with faint darker middorsal blotch extending from eyelids to sacral region; (6) venter dull cream with brown flecks or reticulations on margin of chin and in some individuals extending onto chest; (7) narrow pale labial stripe expanded below orbit; (8) flanks gray with small, dark brown spots; (9) dermal roofing bones of skull slightly exostosed; (10) dermal sphenethmoid absent; (11) nasals widely separated medially; (12) anteromedial margin of frontoparietal between mid- and anterior levels of orbit; (13) frontoparietal fontanelle partially exposed; (14) palatine not serrate; (15) parasphenoid lacking odontoids; (16) zygomatic ramus of squamosal extending about one-third distance to maxillary arch; (17) transverse processes of Vertebra III wider than sacral diapophyses; transverse processes of Vertebrae IV–VII narrower, subequal in length; (18) intermandibularis and submentalis muscles connected; (19) supramandibular portion of interhyoideus muscle forming simple tubular posterolateral extension; associated skin unmodified.

Osteocephalus rodriguezii differs from all other species in the genus by its small size; the maximum snout-vent length in males of *O. rodriguezii* is 34.7 mm, whereas the smallest adult male of any other species is 37.9 mm in *O. buckleyi*, a species that differs further from *O. rodriguezii* by having extreme sexual dimorphism in size, the skin on the dorsum in males bearing a mixture of large and small, nonspinous tubercles, and the skin on the flanks areolate. Structurally, *O. rodriguezii* is most like *O. leprieurii*, which differs in being larger (smallest male 41.2 mm) and in having a pattern of transverse dark bars on the dorsum and the venter and flanks immaculate.

Description of species.—(17 males, 2 females, 2 juveniles, including type series). Body moderately slender; head wider than body, nearly as wide as long, depressed; snout moderately long, round in dorsal view and in profile, projecting slightly beyond margin of lip; canthus rostralis slightly elevated, angular; loreal region concave; lip rounded; nostril slightly protuberant dorsolaterally; internarial area depressed; top of head flat; skin not co-ossified with underlying dermal bones; tympanum distinct, separated from eye by distance equal to about one-half length of tympanum; supratympanic fold moderately heavy, covering upper one-fourth of tympanum. Axillary membrane extending one-fourth length of upper arm; forearm moderately slender, bearing row of low tubercles ventrolaterally; fingers moderately long, bearing round discs; width of disc on Finger III about two-thirds length of tympanum; relative lengths of fingers $1 < 2 < 4 < 3$; subarticular tubercles moderately large, round, simple; supernumerary tubercles small, subconical, present only on proximal segments; palmar tubercle bifid; thenar tubercle elliptical; brown nuptial excrescences present; fingers barely webbed basally. Hind limb moderately short, robust; small tubercle present or not on heel; tarsal folds and tubercles absent; inner metatarsal tubercle elliptical, flat, visible from above; outer metatarsal tubercle indistinct or absent; toes moderately short, bearing round discs slightly smaller than those on fingers; subarticular tubercles large, round; supernumerary tubercles absent; toes about one-half webbed; webbing formula **I**($1\frac{1}{2}$ –2)—(2 – $2\frac{1}{2}$)**III** $1\frac{1}{2}$ —($2\frac{1}{2}$ –3)**III** $1\frac{1}{2}$ —($2\frac{1}{2}$ –3)**IV**2—(1 – $1\frac{1}{2}$)**V**. Skin on dorsum smooth, bearing numerous small, pointed tubercles in males and scattered spicules in females; skin on flanks smooth; skin in post-tympanic region and axilla weakly areolate; skin on belly and proximal posteroventral surfaces of thighs coarsely granular; other ventral surfaces smooth; anal sheath long; anal opening directed ventrally at lower level of thighs, opening bordered laterally by small tubercles. Vomerine odontophores angular, diverging posteriorly, narrowly separated medially, between diagonally elliptical choanae, each bearing 6–10 teeth; total number of vomerine teeth 12–18 (\bar{x} = 14.9) in males, 18–19 (\bar{x} = 18.5) in females; tongue broadly cordiform, shallowly notched behind, barely free posteriorly; vocal slit small, at posterolateral margin of tongue; vocal sac bifid, posterior on throat with lateral extension behind angle of jaw.

Color in preservative: Dorsum brown with faint darker brown middorsal blotch (only evident peripherally in some individuals) extending from eyelids and/or interorbital region to sacrum or postsacral region; dark brown, irregular or transverse marks on dorsal surfaces of limbs—two on forearm and three each on thigh, shank, and tarsus; dark brown canthal and supratympanic stripes; area above latter usually paler than rest of dorsum; posterior surfaces of thighs brown; labial stripe creamy tan, expanded below orbit; flanks gray with small dark brown spots; anal and ulnar tubercles cream; venter cream with brown flecks on margin of chin; brown flecks or reticulations on middle

of throat and chest in some specimens.

Color in life: Dorsum dark brown with pinkish tan supratympanic mark; side of head dark brown; labial stripe cream; flanks grayish brown with dark brown spots; anal tubercles creamy white; throat creamy yellow with gray flecks; belly cream; hidden surfaces of limbs dull reddish brown; iris dull grayish bronze with fine black reticulations (Fig. 8).

Measurements (in mm) and proportions (17 males followed by 2 females): snout-vent length (SVL) 27.6–34.7 (\bar{x} = 31.8), 35.9–38.1 (\bar{x} = 37.0); tibia length/SVL 0.450–0.569 (\bar{x} = 0.509), 0.501–0.515 (\bar{x} = 0.508); foot length/SVL 0.350–0.396 (\bar{x} = 0.379), 0.383–0.384 (\bar{x} = 0.384); head length/SVL 0.330–0.374 (\bar{x} = 0.348), 0.339–0.340 (\bar{x} = 0.340); head width/SVL 0.318–0.360 (\bar{x} = 0.340), 0.325–0.331 (\bar{x} = 0.328); tympanum/eye 0.711–0.875 (\bar{x} = 0.781), 0.766–0.771 (\bar{x} = 0.769).

Distribution.—*Osteocephalus rodriguezii* is known from elevations of 1,100–1,210 m on the north face of the Sierra de Lema and the northern part of the Gran Sabana in Estado de Bolívar, southeastern Venezuela. Locality records are: Km 144 on El Dorado–Santa Elena de Uairén road, 1210 m [KU 166998–7013, 167767 (C&S)]; Paso del Danto (MCZ 64740, UPR-M 2207, 2209–11).

Remarks.—The specimens examined include the type series. The above description differs from that of Rivero (1968) in that he stated erroneously that the skin on the dorsum was granular and that the feet were three-fourths webbed. Rivero (1968) described the species from “Paso del Danto ... ca. 1400 m above San Isidro.” Paso del Danto is a narrow, steep incline adjacent to the Salto del Danto encompassing elevations of 1,000–1,150 m above sea level. Rivero found the frogs in terrestrial bromeliads in March, a relatively



Fig. 8. *Osteocephalus rodriguezii*, KU 167007, female, 35.9 mm SVL.

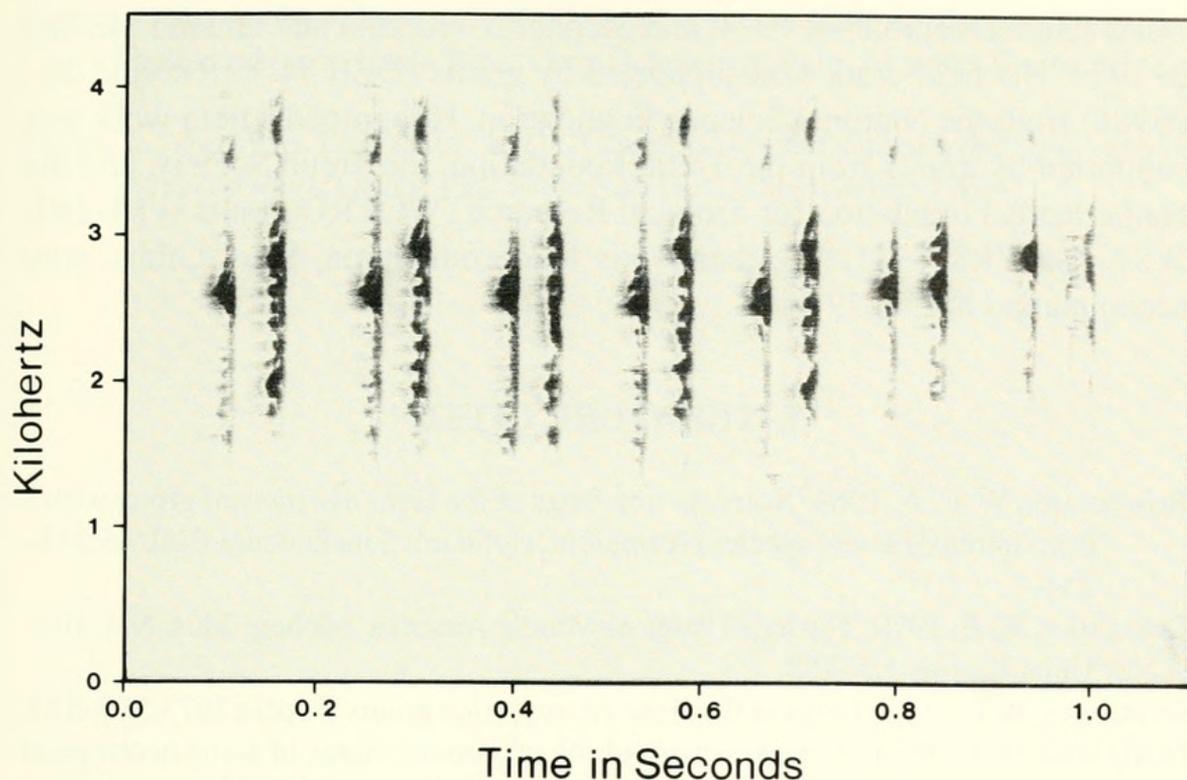


Fig. 9. Advertisement call of *Osteocephalus rodriguezii*. KU Tape 1298; effective band width 45 Htz; recorded at 16°C on 22 July 1974 at Km 144 on El Dorado–Santa Elena de Uairén road.

dry time of year in the Sierra de Lema. On 17 and 22 July, 1974, the frogs were found breeding in shallow pools on the Gran Sabana at Km 144 on the El Dorado–Santa Elena de Uairén road, 1,210 m (26 km by road S of Paso del Danto). No frogs of this species were found in terrestrial bromeliads at Paso del Danto in July 1974, May and June 1978, or January 1979. These limited data on habitat and behavior, together with the short hind limbs, suggest that this species may be terrestrial, as opposed to the arboreal habits of the other species in the genus.

At Km 144 males were calling from low vegetation and from shallow water; the latter were not floating in the water but were partially submerged and grasping vegetation with their hands. The mating call consists of 5–8 short, biphasic notes (Fig. 9). Analysis of recordings (KU Tapes 1296–1298) of three individuals recorded at 16°C reveals that the mean number of notes per call is 6.6. The repetition rate is 14–20 ($\bar{x} = 16$) calls per min; the dominant frequency is at 1,700–2,000 Htz.

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