

# ADDITIONAL NEW SPECIES OF FROGS (GENUS *ELEUTHERODACTYLUS*) FROM CLOUD FORESTS OF EASTERN DEPARTAMENTO DE CALDAS, COLOMBIA

Por

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## Resumen

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Se describen cuatro especies más de los bosques nublados altos en los municipios de Pensilvania y Samaná, Caldas. Con estas descripciones, 18 especies del género han sido registrado de esta región pequeña entre los 1800 y 2150 m.s.n.m.

**Palabras claves:** Amphibia, Leptodactylidae, especies nuevas, taxonomía

## Abstract

Four additional species of the genus *Eleutherodactylus* are described from the high cloud forests of the municipalities of Pensilvania and Samaná, Caldas. With these descriptions, 18 species of the genus have been recorded from this small region lying between 1800 and 2150 meters.

**Key words:** Amphibia, Leptodactylidae, new species, taxonomy

## Introduction

The field sites of the *ceja andina* of Pensilvania and Samaná, Caldas, are the richest available for eleutherodactyline frogs in spite of being at relatively high elevations (1800-2150 m). Lynch & Rueda-A (1997)

reported 14 species of the genus *Eleutherodactylus* from the forests at Puerto Suárez, Rancho Quemado, and El Estadero. Lynch (1997) pointed out that one of these species was actually undescribed and named *E. necopinus* for populations from the northern Cordillera Central previously called *E. ruizi*. The fourteen species are: *E. babax*, *E. cabrerai*, *E. dorsopictus*, *E. erythropleura*, *E. lichenoides*, *E. maculosus*, *E. mantipus*, *E. necopinus*, *E. permixtus*, *E. thectopternus*, *E. tribulosus*, *E. uranobates*, *E. veletis*, and *E. w-nigrum*. To these, four additional

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species of the genus from these sites are described below. Several more remain to be described based on materials collected during fieldwork in 1992-1994.

### Materials and Methods

Measurements and terminology follow **Lynch & Duellman** (1997). In the species accounts, we use the following abbreviations: E-N (distance from eye to nostril), HW (greatest width of head), IOD (interorbital distance), SVL (snout to vent length).

### Accounts of Species

#### *Eleutherodactylus actinolaimus* sp. nov.

**Holotype.** ICN 39941, an adult female, one of a series collected 6 November 1993 by José Vicente Rueda, Nicolas Rueda, Fabio Quevedo & Humberto Piñedos (field number VR 4600).

**Type-locality.** COLOMBIA, Departamento de Caldas, Municipio de Samaná, corregimiento de Florencia, El Estadero, ca 6 km SW Florencia, 2000 m.s.n.m.

**Paratopotypes.** Males (ICN 39944-45, 39948-49, 39951, 39959, 39967) and females (ICN 39946, 39952-53, 39960) taken at El Estadero 9-12 Nov. 1993 and 9-11 June 1994.

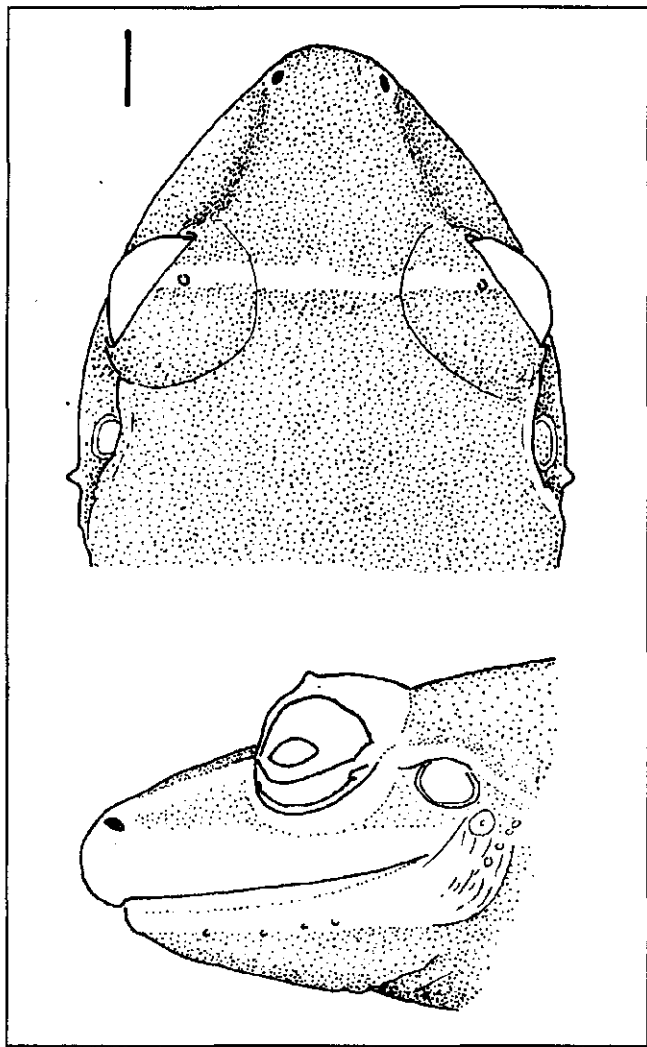
**Etymology.** Greek (*aktinos*, meaning ray + *laimos*, meaning throat) in reference to the radiating lines on the throat.

**Diagnosis.** (1) Skin of dorsum shagreen, that of venter areolate; ill-defined dorsolateral folds, sometimes as a series of well-separated subconical tubercles; (2) tympanum prominent, round, less than  $\frac{1}{2}$  eye length; (3) snout subacuminate in dorsal view, acutely rounded in lateral profile; snout long; (4) minute subconical tubercle on upper eyelid; no cranial crests; (5) vomerine odontophores prominent, oval or subtriangular in outline, separated; (6) males lack vocal slits and nuptial pads; testes white; (7) first finger shorter than second; disks round, largest on outer fingers; (8) lateral fringes of fingers narrow, crenulate towards base of fingers; (9) ulnar tubercles present; (10) calcar on heel; prominent series of outer tarsal tubercles; inner tarsal tubercle low; (11) two metatarsal tubercles, inner oval, 5-6 times size of subconical outer; numerous supernumerary plantar tubercles; (12) toes with lateral keels, no webbing; toe V very long; large discs on toes, slightly smaller than those of fingers; (13) dorsal pattern polymorphic; usually with

thin cream interorbital bar, brown dorsal chevrons, canthal-supratympanic stripe, limb bars; labial bars less evident; venter cream with brown suffusion or reticulation; throat bearing brown lines radiating to lips from midline; posterior surfaces of thighs brown with numerous cream flecks; (14) adults moderate-sized, males 22.4-27.5 ( $\bar{x} = 24.5 \pm 0.6$ ,  $N = 7$ ) mm, females 32.0-36.2 ( $\bar{x} = 33.9 \pm 0.8$ ,  $N = 5$ ) mm SVL.

*Eleutherodactylus actinolaimus* closely resembles *E. permixtus* (appear to be juveniles) even to the point of having nearly the same dorsal color pattern variations. However, *E. actinolaimus* is a smaller frog than *E. permixtus* (for northern populations, males 23.2-31.4,  $\bar{x} = 26.7 \pm 0.5$ , females 34.3-45.4,  $\bar{x} = 39.7 \pm 0.6$  mm SVL), has a conical heel tubercle (vs. a nonconical tubercle), subconical tubercle on top of upper eyelid (vs. rounded tubercle on posterolateral quarter of upper eyelid), more acuminate snout, series of ulnar tubercles (vs. an antebrachial tubercle only), dark rays on the throat (absent), and brown posterior surfaces of the thighs with cream flecks (vs. black with white spots in northern populations). To date, *E. permixtus* is not known to be sympatric with *E. actinolaimus* although it has been found a few hundred meters higher in this series of forests.

**Description** (proportions based on 7 males and 5 females). Head not as wide as body, longer than wide; HW 37.7-41.8 ( $\bar{x} = 39.1 \pm 0.7$ ) % SVL in males, 38.6-40.1 ( $\bar{x} = 39.5 \pm 0.3$ ) % in females; snout nearly acuminate in dorsal view, rounded in lateral profile, long; E-N 92.5-109.4 ( $\bar{x} = 100.0 \pm 2.4$ )% eye length in males, 100.0-114.3 ( $\bar{x} = 108.4 \pm 2.7$ ) % in females; nostrils weakly protuberant, directed dorsolaterally; canthus rostralis rounded but evident, straight; upper lips weakly flared in adult females; upper eyelid width 78.6-103.4 ( $\bar{x} = 91.0 \pm 4.0$ ) % IOD in males, 76.2-96.9 ( $\bar{x} = 86.7 \pm 4.0$ ) % in females; upper eyelid bearing subconical tubercle at top (Fig. 1) of eyelid (not located on posterolateral quarter as in many *Eleutherodactylus*); no cranial crests; tympanum round, its length 27.6-37.5 ( $\bar{x} = 32.9 \pm 1.2$ ) % eye length in males, 29.5-42.9 ( $\bar{x} = 37.6 \pm 2.4$ ) % in females, its uppermost edge concealed by thick supratympanic fold; one conical postictal tubercle posteroventral to tympanum; indistinct subconical tubercles along ventral edge of lower jaw (Fig. 1); choanae round, well medial of palatal shelf of maxillary arch, small; vomerine odontophores median and posterior to choanae, oval to subtriangular in outline, each slightly larger than a choana, bearing a transverse row of 2-5 teeth, separated medially by distance equal  $\frac{1}{3}$ - $\frac{2}{3}$  width of an odontophore; tongue round, its posterior



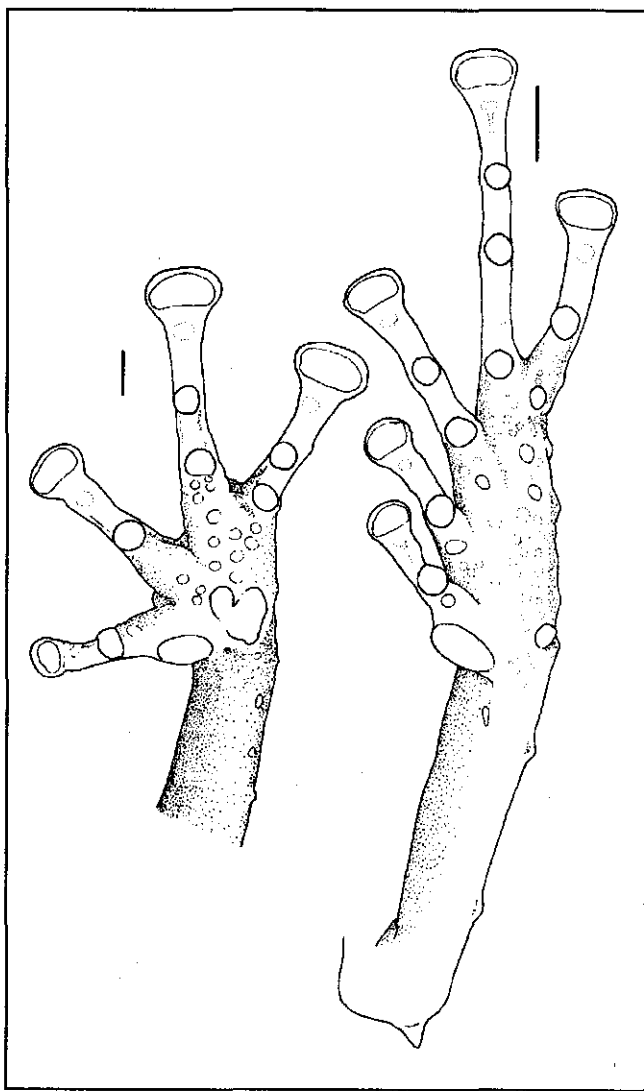
**Figure 1.** *Eleutherodactylus actinolaimus* sp. nov. (ICN 39961). Eyelid tubercles are on top of upper eyelid (contrast with Fig. 3). Scale equals 2 mm.

border not notched, posterior 1/6 not adherent to floor of mouth; males lack vocal slits.

Skin of dorsum fine shagreen, that of venter coarsely areolate (less so on throat); no dorsolateral folds; discoidal folds well anterior to groin; no anal sheath or perianal tubercles; arm slender; 2-3 low, subconical ulnar tubercles; hands large; palmar tubercle bifid, twice size of oval thenar; numerous nonpungent supernumerary palmar tubercles (Fig. 2); subarticular tubercles round, pungent, nonconical; fleshy lateral fringes on digits, including fringe along outer edge of palm; all fingers with expanded discs and broad pads; those of outer fingers

larger than those of inner fingers and broader than tympanum length; first finger shorter than second; males lack nuptial pads.

Heel bearing short calcar (Fig. 2); series of 3-4 subconical outer tarsal tubercles; inner edge of tarsus bearing elongate tubercle one inner metatarsal tubercle length proximal to inner metatarsal tubercle which is 2 1/2 times as long as wide and 4-6 times size of round, pungent outer metatarsal tubercle; numerous small supernumerary plantar tubercles plus larger ones at bases of toes I-IV; subarticular tubercles more pungent, round, nonconical (basal subarticular tubercles of toes



**Figure 2.** *Eleutherodactylus actinolaimus* sp. nov. Hand (ICN 39953) and foot (ICN 39961). Scale equals 2 mm.

IV-V smaller than others); lateral keels on toes; all toes bearing round discs and broad pads (smaller than those of fingers); tip of toe V reaches near distal edge of distal subarticular tubercle of toe IV, tip of III to distal edge of penultimate subarticular tubercle of toe IV; heels broadly overlapping when flexed hindlimbs are held perpendicular to sagittal plane; shank 54.1-62.8 ( $\bar{x} = 57.2 \pm 1.3$ ) % SVL in males, 55.2-57.8 ( $\bar{x} = 56.0 \pm 0.5$ ) % in females.

Dorsum tan or gray with brown markings (interorbital bar, canthal stripe, labial bars, dorsal chevrons, limb bars), sometimes edged with cream; pale interorbital bar coincident with tubercles on upper eyelids (Fig. 1); venter white with brown spots; throat white with brown markings forming a series of rays from center line to margins of lips; groin and posterior surfaces of thighs brown with cream flecks.

In life, dorsum pale olive-brown or greenish-yellow with dark green canthal-supratympanic stripe and interorbital bar; side of head yellowish with narrow brown labial bars; flanks bearing broad, olive-green, diagonal bars; groin and concealed surfaces of thighs rosy-yellow; posterior surfaces of thighs bearing tiny white (rarely yellow) spots; ventral surfaces yellow or rosy-yellow with reddish-brown lines on the throat and minute brown flecks over the venter; iris of females bright yellow, that of males red or orange (Pratt's ruby).

**Measurements of holotype in mm.** SVL 35.5, shank 19.6, HW 14.1, head length 14.1, chord of head length 15.3, upper eyelid width 3.7, IOD 3.9, tympanum length 1.8, eye length 4.2, E-N 4.8.

**Natural history.** Half the sample available consists of immature individuals. The collections were made in November and June. The November sample contains four juveniles whereas the June sample contains 13. Although the samples are small, because the November sample contained only three large juvenile females (25.6-29.5,  $\bar{x} = 27.0$  mm SVL) whereas the June sample contains a broader range of sizes of juvenile females (17.5-29.0,  $\bar{x} = 23.2 \pm 1.1$  mm SVL, N = 10), one might conclude seasonality in reproduction. However, the June sample also contains two young females (30.1-30.8 mm SVL) suggesting reproduction well before that (those) producing the smaller juvenile females. Tentatively, we view reproduction in *E. actinolaimus* as aseasonal.

Like *E. permixtus*, *E. actinolaimus* is pattern polymorphic but only three morphs are known (mottled, 26/30; striped, 1/30; and vertebral raphe, 3/30). Such an array of polymorphs is consistent with that for most

populations of *E. permixtus* (Lynch et al., 1994:25) except for the abundance of the vertebral raphe morph.

The type-locality is found in the transition zone between the temperate and cold levels of this Andean slope where remnants of subandean forests are permanently fog-shrouded and the annual precipitation is greater than 4000 mm. The canopy of the forests reaches 15-20 meters and the trees have straight trunks with smooth bark covered with many epiphytes, mosses, and bromeliads. *Eleutherodactylus actinolaimus* is a relatively abundant species on low vegetation (below 1.5 m above the ground) in zones of dense secondary forest and along forested streams.

**Referred specimens (juveniles).** Municipio Samaná: Topotypes (ICN 39942-43, 39947, 39950, 39954-58, 39961-66, 39968). Rancho Quemado, 1940 m. (ICN 32287, 32295).

#### *Eleutherodactylus factiosus* sp. nov.

**Holotype.** ICN 40030, an adult female, one of a series collected 9 June 1994 by José Vicente Rueda, Nicolas Rueda, Fabio Quevedo & Humberto Piñedos (field number VR 4542).

**Type-locality.** COLOMBIA, Departamento de Caldas, Municipio de Samaná, corregimiento de Florencia, El Estadero, ca 6 km SW Florencia, 2000 m.s.n.m.

**Paratopotypes.** Males (ICN 40031-40, 40047-50, 40066, 40071-74, 40076, 40080, 40083-94) and females (ICN 40044-46, 40053, 40055, 40058, 40068, 40077-79) collected 6-12 Nov. 1993. Taken with holotype, males (ICN 40106-13, 40115-18, 40135-49, 40153) and females (ICN 40096-97, 40126-30).

**Paratype.** Male (ICN 40158) taken in municipio Pensilvania, Km 24, carretera Pensilvania-Arboleda, "Puerto Suárez", 2000-2150 m.

**Etymology.** Latin (*factiosus*) meaning usually given to contention or forming parties, used in reference to the striking sexual dimorphism in the coloration on the flanks.

**Diagnosis.** (1) Skin very fine shagreen dorsally, that of venter areolate; indistinct and incomplete dorsolateral folds from scapula to sacrum; (2) tympanum prominent, round; (3) snout subacuminate in dorsal view, rounded in lateral profile; canthus rostralis sharp, slightly convex; (4) minute tubercle on upper eyelid; no cranial crests; (5) vomerine odontophores oblique, elevated, widely separated; (6) males lack vocal slits; nuptial pads present;

testes white; (7) first finger shorter than second; round discs on fingers, largest on fingers III-IV; (8) fingers bearing narrow lateral keels; (9) ulnar tubercles nonconical; (10) minute tubercle on heel, none on outer tarsus; inner tarsal fold short, ending in tubercle; (11) two metatarsal tubercles, inner oval, 6-8 times size of subconical outer; numerous supernumerary plantar tubercles; (12) toes bearing lateral keels, no webbing, large round discs (smaller than those of fingers); toe V very long; (13) side of head dark with white spots along lip; dorsal pattern poorly developed, venter cream with brown flecking, most intense on throat; posterior surfaces of thighs brown with cream flecks; males have large pale area edged in brown on posterior flank/groin; females have diffuse pale patch in groin (edges not well-defined); (14) males 17.9-21.8 ( $\bar{x} = 20.1 \pm 0.2$ ,  $N = 57$ ) mm, females 28.5-33.0 ( $\bar{x} = 30.8 \pm 0.4$ ,  $N = 19$ ) mm SVL.

*Eleutherodactylus factiosus* is a member of the subgenus *Eleutherodactylus* as diagnosed by Lynch & Duellman (1997) but is not obviously similar to any particular other species of the group. Very few other species of the genus have darkened faces (obscuring labial bars) and these pertain to other species groups.

**Description** (proportions based on 16 males and 16 females). Head wider than body, as long as wide; HW 37.2-40.8 ( $\bar{x} = 38.8 \pm 0.2$ ) % SVL in males, 38.8-43.0 ( $\bar{x} = 41.0 \pm 0.3$ ) % in females; snout subacuminate in dorsal view, rounded in lateral profile (Fig. 3), long; E-N 76.5-103.3 ( $\bar{x} = 94.4 \pm 1.6$ ) % eye length in males, 95.4-110.3 ( $\bar{x} = 104.6 \pm 1.1$ ) % in females; nostrils protuberant, directed laterally; canthus rostralis well-defined, sinuous; loreal region flat, sloping abruptly to lips; lips not flared; upper eyelid width 69.2-113.6 ( $\bar{x} = 86.6 \pm 3.2$ ) % IOD in males,

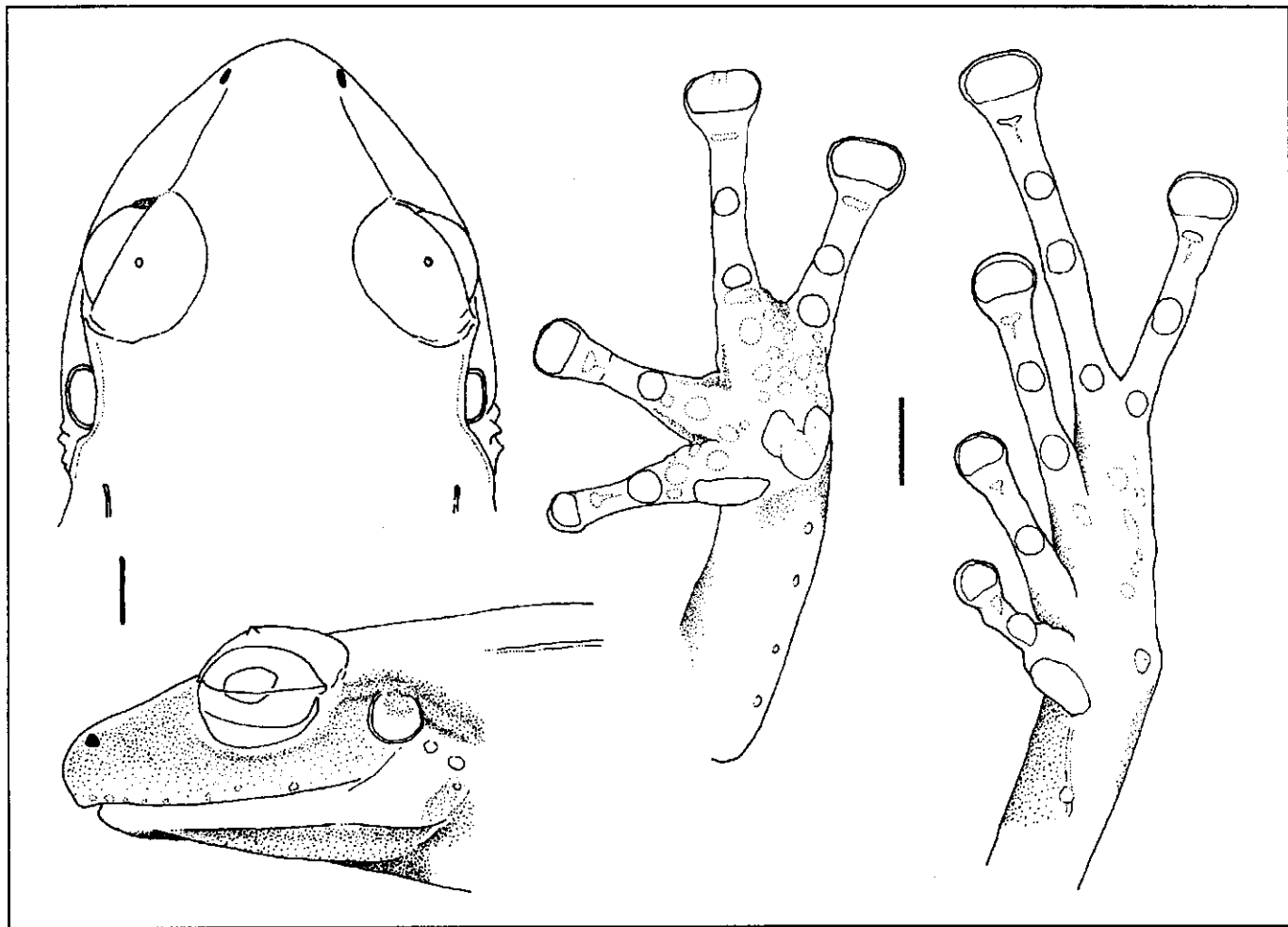


Figure 3. *Eleutherodactylus factiosus* sp. nov. Head in dorsal (ICN 40078) and lateral views (ICN 40068); Hand and foot (ICN 40078). Scale equals 2 mm.

67.5-82.5 ( $\bar{x} = 75.7 \pm 1.4$ ) % in females; upper eyelid with low subconical tubercle slightly posterior to top of eyelid; no cranial crests; tympanum slightly higher than long, upper edge hidden by thin supratympanic fold; tympanum length 37.1-44.8 ( $\bar{x} = 41.6 \pm 0.6$ ) % eye length in males, 31.0-45.0 ( $\bar{x} = 39.4 \pm 0.9$ ) % in females; pair of subconical postrectal tubercles posteroventral to tympanum; no tubercles along margin of lower jaw; choanae subtriangular in outline, well medial of palatal shelf of maxillary arch; vomerine odontophores median and posterior to choanae, elevated, oval in outline, each bearing slanted row of up to 5 teeth, separated medially by a distance equal  $2/3$  width of an odontophore; tongue longer than broad, posterior edge with shallow notch, posterior  $2/5$  not adherent to floor of mouth; males lack vocal slits.

Dorsum very fine shagreen with ill-defined, partial dorsolateral folds (middle of body only); no anal sheath nor perianal tubercles; throat smooth, venter coarsely areolate with discoidal folds well anterior to groin; arms slender; ulnar tubercles indistinct (present) except for antibrachial; hands large; thenar tubercle oval, much smaller than bifid palmar tubercle; supernumerary palmar tubercles prominent; subarticular tubercles round, subconical; lateral keels present on fingers, including one along outer edge of palm; fingers bearing broad round disks and ventral pads, those on fingers III-IV as large as tympanum and larger than others (Fig. 3); first finger slightly shorter than second; single white nuptial pad on thumb of male.

Small round tubercle on heel; no tubercles on outer edge of tarsus; fold-like tubercle with central nubbin on distal  $1/3$  of inner edge of tarsus; inner metatarsal tubercle  $2 \frac{1}{2}$  times as long as wide, more than 6 times size of round subconical outer metatarsal tubercle; numerous supernumerary plantar tubercles, those at bases of toes I-IV largest; subarticular tubercles round, nonconical, basal tubercles of toes IV-V smallest; toes bearing lateral keels, no webbing; all toes with round discs, slightly smaller than those of outer fingers; tip of toe III to middle or base of penultimate subarticular tubercle of toe IV, that of toe V to distal border of distal subarticular tubercle of toe IV (Fig. 3); heels broadly overlapping when flexed hindlimbs held perpendicular to sagittal plane; shank 54.1-58.8 ( $\bar{x} = 56.5 \pm 0.3$ ) % SVL in males, 52.4-60.1 ( $\bar{x} = 55.2 \pm 0.6$ ) % in females.

Dorsum brown with vague dorsal chevrons and interorbital bar; limb bars narrow, oblique; dark canthal-supratympanic stripe; labial bars ill-defined because side of head is dark brown; venter cream reticulated or mottled

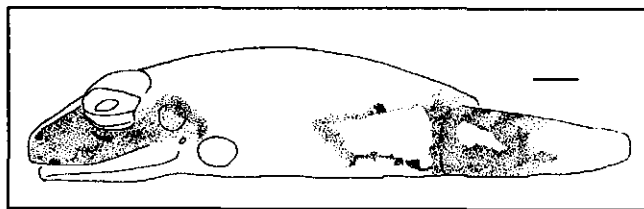


Figure 4. Lateral view of flank of male *Eleutherodactylus factiosus* sp. nov. showing color pattern. (ICN 40083). Scale equals 2 mm.

with brown; posterior surfaces of thighs brown; prominent white blotch in groin (Fig. 4), edged with dark brown (sometimes with smaller one on anterior surface of thighs), small white spots at upper edge of brown field on posterior surfaces of thighs, and pale line on underside of shank in males; anterior and posterior surface of thighs, underside of shank brown with extensive flecking of salmon in females; females also have a salmon patch in groin (edges not well-defined). Several specimens have pale blotches on the snout and smaller similar blotches on the knee and elbow.

In life, dorsum pale yellowish-brown to dark brown with black interorbital bar and spots forming dorsal chevron; side of head black; iris dark red; venter dirty white or gray, stippled with black; males have a yellow spot in the groin and lower flank; in females, these areas are orange or pink; posterior surfaces of thighs pale gray; the pale spots on the snout, knee, and elbow are beige in life.

**Measurements of holotype in mm.** SVL 32.7, shank 17.2, HW 13.5, head length 12.9, chord of head length 14.0, upper eyelid width 3.3, IOD 4.0, tympanum length 1.9, eye length 4.4, E-N 4.6.

**Natural history.** *Eleutherodactylus factiosus* is one of the most abundant species of *Eleutherodactylus* in the interiors of forested habitats, along the crests of ridges, and in the forest-edge ecotone. It is nocturnal and is found on low vegetation (less than 1.5 m above the forest floor), preferring the lowest strata of the vegetation. Several examples were found in the stomach contents of *Hemiphractus johnsoni*, a carnivorous hylid common in the area.

Juvenile males were found rarely (three, 14.6-17.5 mm SVL) whereas juvenile females were much more common (accounting for more than 60% of the specimens found in November and 40 % of those found in June). Juvenile females are as large as 26.3 mm SVL. Females showing the beginnings of convolutions of the oviducts were found

in June and November and measure 26.4–29.6 mm SVL). Reproduction appears to be aseasonal. Adult females are conspicuously less common than adult males during each collecting period, suggesting that there may be some habitat segregation as well in this species.

**Referred specimens (juveniles).** Municipio Pensilvania, Km 24, "Puerto Suárez", 2000–2150 m (ICN 40157). Municipio Samaná, Topotypes (ICN 40041–43, 40051–52, 40054, 40056–57, 40059–65, 40067, 40069–70, 40075, 40081–82, 40095, 40098–105, 40119–25, 40131–34, 40150–52, 40154–56), Rancho Quemado, 1940 m (ICN 32292–94), Samaná, carr. hacia la Cristalina, Km. 5.6, 1350 m (ICN 40159), carr. Samaná - vereda California, Km. 1.6–3.0 (ICN 40160).

**Remarks.** This small frog is strikingly sexually dimorphic in coloration. The yellow markings in males and the red (or reddish) markings in females recall *E. erythropleura* (Lynch, 1993). *Eleutherodactylus factiosus*, like *E. erythropleura*, is pattern polymorphic. Four polymorphs are known for *E. factiosus*: (A) striped dorsum (one male, four females), (B) pale dorsolateral stripes (five males, nine females), (C) mottled [but see below] (50 males, 41 females), and (E) dorsoconcolor pattern (five males, three females). The distributions of these four polymorphs among sexes appear to be the same. However, within morph (C), we recognized three variants — pale snout, plain (chevrons poorly developed or absent), and chevron. Of the 47 males scored, six had pale snouts, 29 had chevrons, and 12 were plain whereas among the 21 females scored, five had pale snouts, one had chevrons, and 15 were plain. Even if these variants represent arbitrary divisions of continuous variation, they demonstrate additional sexual dimorphism in color pattern.

Although most specimens have been taken in the forest remnants between about 1800 and 2000 m, two specimens were found at lower elevations where the forests have been nearly eliminated. The rarity of this frog near Samaná could be explained as either the rarity expected near a distributional limit or as a consequence of habitat alteration. In addition to the records from Depto. **Caldas**, specimens of this species were collected by JDL in January 1998 in Depto. **Antioquia**, municipio de Guatapé, vereda Santa Rita, Hacienda Montepinar, 1840–1890 m (6° 18' 16" N, 75° 08' 06" W).

*Eleutherodactylus fetusus* sp. nov.

**Holotype.** ICN 40003, an adult female, one of a series collected 3 November 1994 by José Vicente Rueda and others (field number VR 4872).

**Type-locality.** COLOMBIA, Departamento de Caldas, Municipio de Pensilvania, Km 24 de la carretera Pensilvania a Arboleda, sitio "Puerto Suárez", 2150 m.

**Paratopotypes.** Males (ICN 40015, 40020, 40022–23, 40028), females (ICN 40016–18, 40025).

**Paratypes.** Municipio Pensilvania: entre el Km 18 carretera Pensilvania-Arboleda hasta el Km 28 de la misma carretera, 2000–2650 m (ICN 40026–27, males). Municipio Samaná: El Estadero, 1800–2000 m (males, ICN 40005–06, 40010–14, female ICN 40008), El Estadero, 1850 m (female, ICN 40029).

**Etymology.** Latin (*fetusus*) meaning fertile, in reference to the very large testes in reproductively active males.

**Diagnosis.** (1) Skin of dorsum finely shagreen with or without subconical warts on head, flanks, and lower back, that of venter areolate; no dorsolateral folds; (2) tympanum small, higher than long; (3) snout rounded in dorsal and lateral profiles; canthus rostralis concave, not sharp; (4) small conical tubercles on posterior ½ of upper eyelid; no cranial crests; (5) vomerine odontophores triangular in outline, elevated, narrowly separated; (6) males lack vocal slits and nuptial pads; testes very large, white; (7) first finger shorter than second; broad discs on outer fingers; (8) fingers bearing lateral fringes; (9) series of ulnar tubercles, less distinct toward elbow; (10) small conical tubercles along inner and outer edges of tarsus and on heel; (11) two metatarsal tubercles, inner oval, ca 6 times size of round outer; supernumerary plantar tubercles at bases of toes; (12) toes bearing lateral keels, no webbing, and large discs (smaller than those of fingers); toe V very long; (13) dorsum brown with black or olive with brown markings; venter cream to nearly black; concealed surfaces of limbs black with occasional cream flecks; (14) adults moderate-sized, males 24.5–30.2 ( $\bar{x} = 28.9 \pm 0.6$ ,  $N = 9$ ) mm, females 38.3–48.2 ( $\bar{x} = 43.2 \pm 0.9$ ) mm SVL.

**Description** (proportions based on 9 males and 10 females). Head as broad as body, wider than long; HW 38.7–41.3 ( $\bar{x} = 39.9 \pm 0.3$ ) % SVL in males, 37.6–44.9 ( $\bar{x} = 40.0 \pm 0.6$ ) % in females; snout subacuminate in dorsal view, rounded in lateral profile; E–N 82.2–100.0 ( $\bar{x} = 89.0 \pm 2.1$ ) % eye length in males, 83.9–104.0 ( $\bar{x} = 91.4 \pm 1.8$ ) % in females; nostrils weakly protuberant, directed dorsolaterally; canthus rostralis rounded, concave; loreal region concave, sloping gradually to weakly flared lips; upper eyelid bearing small conical tubercles (Fig. 5), its width 100.0–134.6 ( $\bar{x} = 119.3 \pm 4.7$ ) % IOD in males, 90.5–126.8 ( $\bar{x} = 109.6 \pm 3.7$ ) % in females; no cranial

crests; supratympanic fold obsolete, covering uppermost edge of tympanic annulus; tympanum higher than long, its length 22.0-29.3 ( $\bar{x} = 25.5 \pm 0.9$ ) % eye length in males, 23.6-38.0 ( $\bar{x} = 26.5 \pm 1.3$ ) % in females, separated from eye by twice its length, in shallow depression (Fig. 5); one subconical postrictal tubercle; choanae small, round, well medial of palatal shelf of maxillary arch; vomerine odontophores median and posterior to choanae, oval to subtriangular in outline, narrowly separated medially, each bearing a transverse row of 4-6 teeth; tongue longer than wide, its posterior border lacking notch, posterior 1/3 not adherent to floor of mouth; males lack vocal slits.

Numerous small subconical tubercles on dorsum and flanks; skin of limbs bearing fewer such tubercles; no anal sheath nor perianal tubercles; skin of venter areolate, that

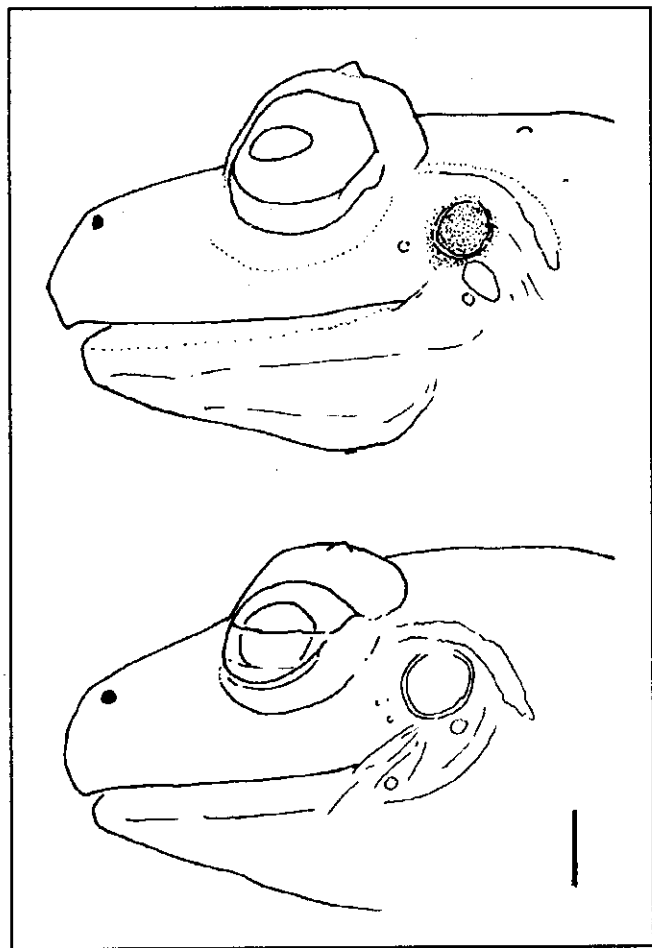


Figure 5. Side of head of *Eleutherodactylus fetosus* sp. nov. (ICN 40019) and *E. permixtus* (ICN vr5042A) showing difference in tympanum size. Scale equals 2 mm.

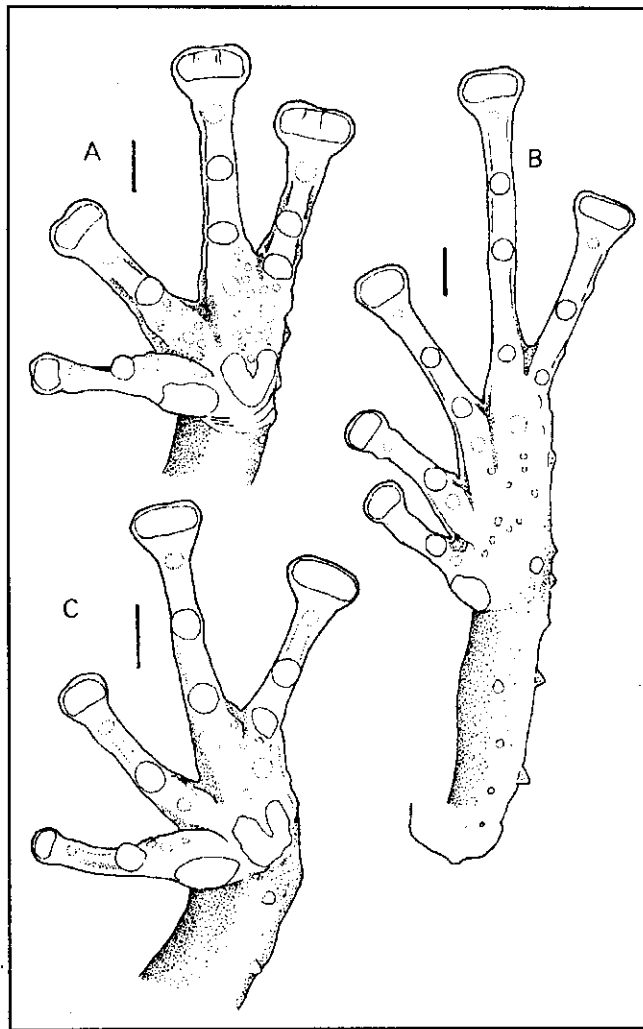


Figure 6. (A) Hand and (B) foot of *Eleutherodactylus fetosus* sp. nov. (ICN 40017). (C) Hand of *Eleutherodactylus torrenticola* sp. nov. (ICN 39998). Scale equals 2 mm.

of throat almost smooth; discoidal folds well anterior to groin; 3-4 ulnar tubercles, antebrachial largest; palmar tubercle bifid, much larger than oval thenar; numerous supernumerary palmar tubercles (Fig. 6), few prominent; subarticular tubercles round, elevated, nonconical; fingers bearing lateral keels or fringes; discs round, expanded, much larger than tympanum, that on thumb much smaller than others but obviously expanded; first finger slightly shorter than second; males lack nuptial pads.

Minute subconical tubercle on heel, part of a continuous series of similar tubercles along outer edge of tarsus; less distinct row along inner edge of tarsus, the most distal most prominent (Fig. 6); inner metatarsal



tubercle 2 ½ times as long as wide, about 8-10 times size of subconical outer metatarsal tubercle; numerous supernumerary plantar tubercles, arranged in rows corresponding to metatarsals; subarticular tubercles round, nonconical, smallest at bases of toes IV-V; toes bearing weak lateral fringes (or keels), no webbing; toe discs round, smaller than those of outer fingers; tip of toe V reaches distal edge of distal subarticular tubercle of toe IV, that of toe III reaches beyond distal border of penultimate subarticular tubercle of toe IV; heels broadly overlapping when flexed hindlimbs held perpendicular to sagittal plane; shank 49.0-56.7 ( $\bar{x}$  = 52.6 ± 0.8) % SVL in males, 47.7-53.7 ( $\bar{x}$  = 51.1 ± 0.6) % in females.

Dorsum brown to olive with darker markings, pattern diffuse; pale area just anterior to interorbital bar; canthal stripe and labial bars present with hint of pale labial stripe; slanted brown bars on flanks coalescing ventrally; limb bars as wide as interspaces, weakly oblique on shanks; venter darker (nearly black) than throat, all spotted or mottled with dark brown; groin, posterior surfaces of thighs, undersides of shanks black with sparse cream flecks.

In life, dorsum reddish-brown, dark brown, olive brown, or yellowish with a green tint and irregularly-shaped black spots (and interorbital bar) over the head and back and diagonal black bars on the flanks; labial bars brown; limb bars brown; groin, lower flanks, anterior and posterior surfaces of thighs black or sepia with minute cream or pale yellow spots (occasionally lacking); iris dark reddish brown; ventral coloration sexually dimorphic: in females, throat and chest pale yellow with reddish tint and brown or black wash; undersides of limbs black with slight rose wash; in males, throat and chest reddish with black markings; belly much blacker in males than in females.

**Measurements of holotype in mm.** SVL 48.2, shank 23.0, HW 18.1, head length 16.2, chord of head length 18.0, upper eyelid width 3.1, IOD 4.3, tympanum length 1.5, eye length 6.0, E-N 5.2.

**Referred specimens (juveniles).** Municipio Pensilvania, Topotypes. ICN 40019, 40021, 40024); Km 18 hacia Arboleda, 2000-2450 m (ICN 36555). Municipio Samaná: El Estadero (ICN 40007, 40009); Rancho Quemado, 1940 m (ICN 32285-86, 32296-98).

**Natural history.** Males were encountered on low vegetation near streams as were occasional females. Most females were found on rocks in the stream, a habitat noted by the collectors as being the habitat of *Cryptobatrachus*. In the field, this species was confused with *E. cabrerai*

and with *E. veletis*, two species sharing the "camouflaged" color pattern. Juvenile females having straight oviducts with no enlargement are 24.6-34.2 mm SVL. Nine males (ICN 32297-98, 40011-12, 40015, 40020, 40022-23, 40028) have large testes (4.3-6.5 mm long) whereas five males (ICN 40005-06, 40010, 40013-14) have small testes (0.7-1.7 mm long). A single male (ICN 40005) has two small testes whereas the remaining males appear to have the testes fused medially to form a flattened oval (5.7 X 4.1 X 2.0 mm in ICN 40015). In males having greatly enlarged testes, the testis is displaced to the right (by the stomach). The males with small testes are 24.7-26.8 mm SVL whereas those with large testes are 25.4-30.3 mm SVL. The small testes males were collected in Oct. 1993 (ICN 40005-06) and June 1994 (ICN 40010, 40013-14). Those having large testes were collected in June 1994 (ICN 40011-12) and November 1994 (others). If testis size is an indication of sexual activity, it does not correlate tightly with either size or date of collection.

***Eleutherodactylus torrenticola* sp. nov.**

**Holotype.** ICN 39969, an adult female, one of a series collected 6 November 1993 by José Vicente Rueda, Nicolas Rueda, Fabio Quevedo & Humberto Piñedos (field number VR 3961).

**Type-locality.** COLOMBIA, Departamento de Caldas, Municipio de Samaná, corregimiento de Florencia, El Estadero, ca 6 km SW Florencia, 1800-2000 m.s.n.m.

**Paratopotypes.** Males ICN 39970, 39974, 39976-77, 39980, 39984-85, 40001-02, females 39994, 39996.

**Paratypes.** Municipio Pensilvania, Km 24 de la carretera Pensilvania-Arboleda, quebrada Las Mercedes, 2000-2150 m (males, ICN 39991-92, female ICN 39999). Km 18 hacia Arboleda, 2000-2450 m (Male 36558, female ICN 36557).

**Etymology.** Latin (*torrentis*) + (*cola*), living in a swift stream; used in reference to the the microhabitat.

**Diagnosis.** (1) Skin of dorsum tuberculate in males, more smooth in females, that of venter areolate; no dorsolateral folds; (2) tympanum small, situated in depression; (3) snout subacuminate in dorsal view, rounded in profile; canthus rostralis evident, not sharp; lips weakly flared in females; (4) conical tubercle on posterior part of upper eyelid; cranial crests prominent in females; (5) vomerine odontophores large, triangular in outline, nearly in median contact; (6) males lack vocal slits; nuptial pads present; testes white; (7) fingers long, I shorter than II,

discs round to truncate, largest on outer fingers; (8) fingers bearing prominent lateral fringes; (9) ulnar tubercles subconical; (10) small subconical tubercles on heel and outer edge of tarsus; small round tubercle just proximal to inner metatarsal tubercle on inner edge of tarsus; (11) two metatarsal tubercles, inner oval, ca 6-8 times size of nonconical outer; supernumerary plantar tubercles at bases of toes; (12) toes bearing lateral fringes, no webbing, large discs (smaller than those of fingers); tip of toe V reaches base of distal subarticular tubercle of toe IV; (13) dorsum gray-brown with black flecks and rust postocular folds; flanks prominently banded black over cream; thighs and tarsi boldly banded black over rusty cream; venter cream with black reticulation, throat sometimes with traces of Y-shaped figure; (14) adults large, males 26.2-32.1 ( $\bar{x} = 29.1 \pm 0.5$ ,  $N = 12$ ) mm, females 39.7-52.6 ( $\bar{x} = 44.3 \pm 2.2$ ,  $N = 6$ ) mm SVL.

Two features (iris color in life and the cranial crests) suggest that *E. torrenticola* is the nearest relative of the recently described (Lynch, 1996) *E. deinops* (characters in parentheses). The two are readily distinguished because the tympanum is smaller and in a depression in *E. torrenticola* (23-40% eye length, not in a depression), males lack vocal slits (present), the ulnar tubercles are prominent and subconical (nonconical), there is a round inner tarsal tubercle (low fold), and the bold barring on the thighs (none).

**Description** (proportions based on 12 males and 6 females). Head narrower than body, as wide as long; HW 39.7-43.2 ( $\bar{x} = 41.2 \pm 0.3$ ) % SVL in males, 40.9-42.6 ( $\bar{x} = 41.7 \pm 0.3$ ) % in females; snout subacuminate in dorsal view, rounded in lateral profile, short; E-N 72.2-100.0 ( $\bar{x} = 86.6 \pm 2.2$ ) % eye length in males, 84.2-110.4 ( $\bar{x} = 95.9 \pm 3.7$ ) % in females; nostrils weakly protuberant, directed dorsolaterally; canthus rostralis rounded; loreal region concave, sloping gradually to flared lips; subconical tubercle on upper eyelid; upper eyelid width 100.0-150.2 ( $\bar{x} = 129.0 \pm 4.6$ ) % IOD in males, 97.4-107.3 ( $\bar{x} = 101.9 \pm 1.7$ ) % in females; prominent cranial crests in females; tympanum small, its length 16.7-29.2 ( $\bar{x} = 23.1 \pm 1.1$ ) % eye length in males, 20.8-33.3 ( $\bar{x} = 26.8 \pm 2.2$ ) % in females, higher than long, in depression (Fig. 7); subconical tubercle in front of tympanum; postrictal tubercles conical; faint tubercles along margin of lower jaw; upper edge of maxillary arch forming sharp ridge to angle of jaws; choanae small, well medial to palatal shelf of maxillary arch; vomerine odontophores median and posterior to choanae, narrowly separated, massive, triangular in outline, each bearing 7-8 teeth in weakly slanted row (median end of row more anterior);

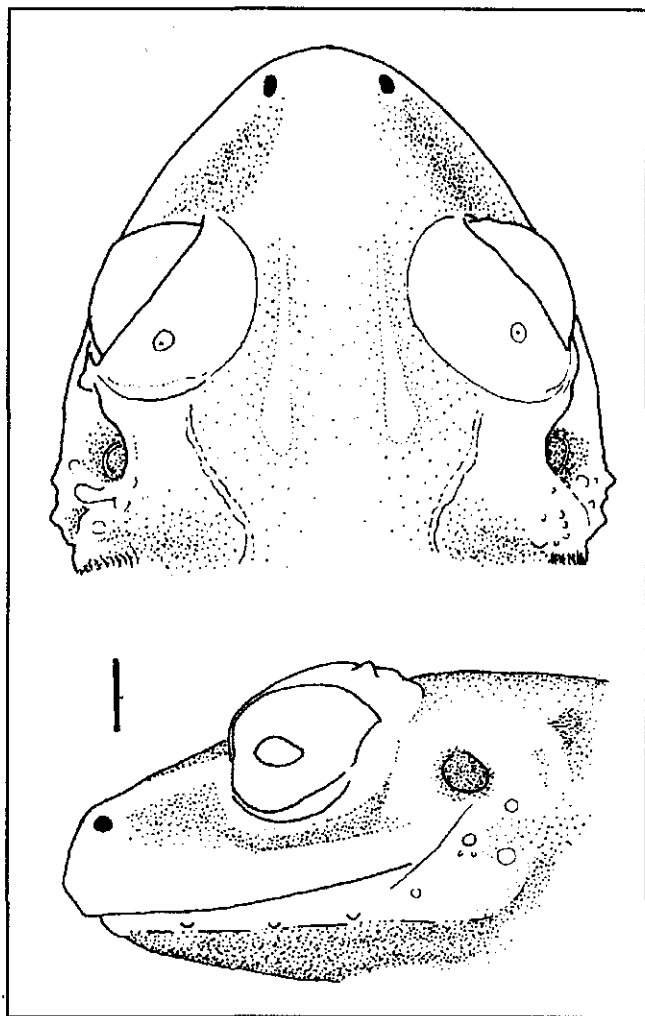


Figure 7. *Eleutherodactylus torrenticola* sp. nov. Head (ICN 39998). Scale equals 2 mm.

tongue round, bearing shallow notch along posterior border, posterior 1/3 not adherent to floor of mouth; males lack vocal slits.

Skin of dorsum smooth in females with scattered nonconical tubercles, short postocular folds, and indefinite short folds in dorsolateral position; skin of dorsum of males more tuberculate; flanks and venter areolate; discoidal folds well anterior to groin; no anal sheath nor perianal tubercles; 3-4 subconical ulnar tubercles; thenar tubercle oval, 1/2 size of bifid palmar; numerous supernumerary palmar tubercles; subarticular tubercles more pungent, round; fingers bearing lateral fringes including traces as tubercles along outside of palm; fingers long, slender, bearing expanded, round or

truncate, discs, largest on outer fingers; first finger slightly shorter than second (Fig. 6); nuptial pad cream.

Small conical tubercle on heel, 3-4 minute tubercles along outer edge of tarsus, one inner tarsal tubercle; inner metatarsal tubercle  $2\frac{1}{4}$  times as long as wide, about 6 times size of subconical outer; supernumerary plantar tubercles at bases of toes I-IV; subarticular tubercles round, pungent, nonconical (smallest at bases of toes IV-V); toes bearing narrow lateral fringes, no webbing, round discs (slightly smaller than those of outer fingers); tip of toe III to distal edge of penultimate subarticular tubercle of toes IV, that of toe V to middle or distal edge of distal subarticular tubercle of toe IV; heels broadly overlapping when flexed hindlimbs held perpendicular to sagittal plane; shank 54.4-62.6 ( $\bar{x} = 57.4 \pm 0.7$ ) % SVL in males, 52.5-59.8 ( $\bar{x} = 56.4 \pm 0.3$ ) % in females.

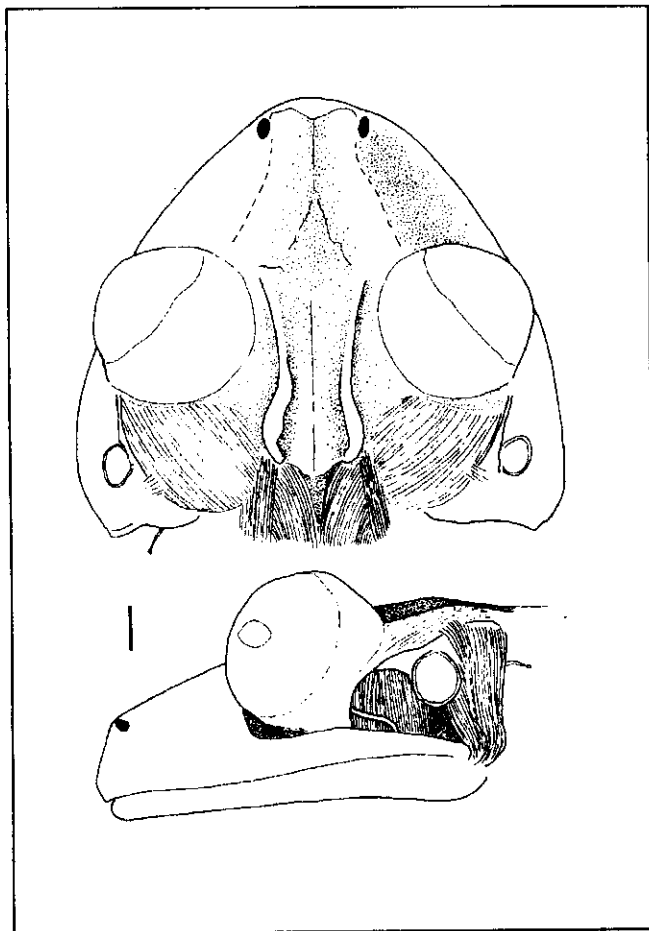


Figure 8. Skinned head of *Eleutherodactylus torrenticola* sp. nov. (ICN 39994). Scale equals 2 mm.

Dorsum brown with black flecks and cream postocular folds; black slanted bars (nearly vertical posteriorly) on flanks; black labial bars (or spots); tympanum black; limbs barred, least evident on shank; venter marbled brown on cream, some evidence of chevrons on chin; thighs prominently banded (anteriorly and posteriorly) as are underside of shanks and tops of tarsi and feet.

In life, dorsum brown (Raw Umber) or olive brown (Hair Brown) speckled in some individuals with cream; irregularly-shaped black spots scattered over dorsal surfaces; lips and limbs with diffuse brown bars; in females, flanks and hidden surfaces of limbs reddish-pink with black diagonal bars; in males, these surfaces are gray-white with black bars; ventral surfaces rose with brown flecking, especially on throat; iris lemon yellow with radiating black lines.

**Measurements of holotype in mm.** SVL 48.8, shank 26.3, HW 20.0, head length 18.6, chord of head length 19.3, upper eyelid width 5.4, IOD 5.2, tympanum length 2.0, eye length 6.7, E-N 6.1.

**Natural history.** *Eleutherodactylus torrenticola* is found on vegetation along broad streams and on their banks in areas covered by subandean forest fragments. The streams are exposed to sun during the day. During the dry season (December to March), these streams disappear or have their volumes reduced considerably. At the type-locality, the species is found along streams within the forest and is very scarce along the forest edge, defined by the activities of pasture clearing.

**Remarks.** The cranial crests are prominent and smooth (Fig. 8). The mandibular ramus of the trigeminal nerve passes lateral to the jaw adductors. The depressor mandibulae has a few fibers crossing the squamosal to insert on the aponeurosis over the adductor muscles. No fibers of the depressor mandibulae insert on the dorsal fascia (Fig. 8).

If we are correct in relating *E. torrenticola* and *E. deinops* (based on the curious radiating black lines of the iris and the relatively weak similarity in the form of the cranial crests), this pair of species provides an additional biogeographic connection between the western cordilleras (matching that for *E. necopinus* and *E. ruizi*, Lynch, 1997, and the suggestion that *E. lichenoides* is a near relative of three species from the Cordillera Occidental, *E. albericoi*, *E. diaphonus*, and *E. diogenes*, Lynch & Rueda-A., 1997).

**Referred specimens (juveniles).** Municipio Pensilvania, Km 24 carr. Pensilvania-Arboleda, sitio Puerto Suárez, 2000-2150 m (ICN 39988-90); carr. Pensilvania-Arboleda, entre el Km 18 y el Km 24, 2000-2650 m (ICN 39993). Municipio Samaná: Topotypes (ICN 39971-73, 39975, 39978-79, 39981-83, 39986-87, 39995, 39997-98).

## Discussion

Eighteen species are now known (reported) from the forests of Florencia, Caldas. One of these (*E. w-nigrum*) is a biogeographic weed, distributed over most of the Andes of Colombia and Ecuador at elevations between 800 and 3200 m (Lynch, 1979). Five species (*E. babax*, *E. cabrerai*, *E. erythropleura*, *E. mantipus*, and *E. thectopternus*) are species known from the Cordillera Occidental and the Cordillera Central without known connecting populations (i.e., the distributions appear to be dichopatric, broken by the lowland and arid Cauca valley). The remaining twelve species are endemic to the northern part of the Cordillera Central (and only *E. actinolaimus*, *E. festosus*, *E. lichenoides*, *E. torrenticola*, *E. tribulosus*, and *E. veletis* remain "endemic" to the forests of Florencia). Perhaps most significant about the distributions is that *E. necopinus* is the sister species to *E. ruizi* of the Cordillera Occidental, *E. torrenticola* appears to be the sister species of *E. deinops*, also endemic to the Cordillera Occidental, and *E. lichenoides* is the only species of the *E. diaphonus* species group found outside of the Cordillera Occidental.

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