

A new *Eleutherodactylus* (Anura, Brachycephalidae) from the Venezuelan Guayana, and redescription of *Eleutherodactylus vilarsi* (Melin)

CÉSAR L. BARRIO-AMORÓS¹ & CÉSAR R. MOLINA²

¹Fundación AndígenA. Apartado Postal 210. 5101-A Mérida, Venezuela. E-mail: cesarlba@yahoo.com

²Oficina Nacional de Diversidad Biológica, Ministerio del Ambiente y de los Recursos Naturales.
E-mail: cmolina@marn.gov.ve

Abstract

Eleutherodactylus aracamuni **sp. nov.** is described from the summit of Cerro Aracamuni, a granitic mountain in southern Amazonas state, Venezuelan Guayana. The new species is easily distinguished from other Guianan *Eleutherodactylus* by the absence of vomerine teeth, notched finger and toe discs, and its yellowish green coloration in life. It appears to be closely related to *E. cavernibardus*. *Eleutherodactylus vilarsi*, a common lowland species, is redescribed on the basis of additional specimens from southern Venezuela.

Key words: Amphibia; Brachycephalidae; new species, *Eleutherodactylus aracamuni* **sp. nov.**; *Eleutherodactylus vilarsi* redescription; Venezuelan Guayana

Resumen

Eleutherodactylus aracamuni **sp. nov.** es descrita de la Guayana venezolana. La nueva especie habita la cumbre del Cerro Aracamuni, una montaña granítica al sur del estado Amazonas, Guayana de Venezuela. Se distingue fácilmente de cualquier otro *Eleutherodactylus* de las Guayanas por características únicas, como la ausencia de procesos dentígeros vomerianos, discos de los dedos en manos y pies cordiformes, y su color en vida, verde amarillento. *E. cavernibardus* parece ser la especie más relacionada. *Eleutherodactylus vilarsi* se redescrive con base a material adicional del sur de Venezuela.

Introduction

There are few known representatives of the genus *Eleutherodactylus* in the Venezuelan Guayana. They occur in lowland, upland and highland habitats (as defined by Huber

1995). Highland and upland inhabitants, such as the recently described species *E. avius* Myers and Donnelly, *E. cantitans* Myers and Donnelly, *E. cavernibardus* Myers and Donnelly, *E. memorans* Myers and Donnelly, *E. pruinatus* Myers and Donnelly, *E. yaviensis* Myers and Donnelly (Myers and Donnelly, 1996, 1997), and *E. marahuaka* Fuentes and Barrio-Amorós (Fuentes and Barrio-Amorós, 2004), have a restricted range on some tepui summits and slopes. Another upland species, *Eleutherodactylus pulvinatus* Rivero, is known from the La Escalera region (Rivero, 1968, Duellman, 1997), the upland forests of the Gran Sabana region (Gorzula and Señaris, 1998), including the slopes of Auyantepui (EBRG 2730), and from Guyana (R. MacCulloch, pers. com). The remaining species of *Eleutherodactylus* from the lowlands and uplands in Amazonian/Guianan Venezuela occupy wide ranges, although only *E. vilarsi*, seems to be a common representative of the genus throughout the lowlands. The other two species, *Eleutherodactylus marmoratus* Boulenger and *Eleutherodactylus zeuctotylus* Lynch and Hoogmoed, are known in Amazonian Venezuela from scattered localities (Barrio-Amorós, 1998), and both reach to at least French Guiana to the East (Lescure, 1981, Lescure et Marty, 2000, Lynch and Hoogmoed 1977).

We describe herein a new species from the uplands of Cerro Aracamuni in the Venezuelan Pantepui (Mayr and Phelps, 1967; Hoogmoed, 1979; Barrio-Amorós 1998).

Although we have few specimens, we believe that it is imperative to describe the new species because it is unlikely that additional material will be obtained in the near future.

We also redescribe *Eleutherodactylus vilarsi* Melin, a common lowland species in the Guiana Shield and Northern Amazonia in Brazil, Peru, Colombia, and Venezuela. The original description of *E. vilarsi* was provided by Melin (1941). Other descriptions of species known to be conspecific with *E. vilarsi* were provided by Rivero (1961). Lynch (1975, 1994) gave brief diagnosis. All of them fail in provide a comprehensive description of the species. We redescribe this highly variable species to facilitate comparison with Guianan and Amazonian *Eleutherodactylus*.

Materials and methods

All measurements were taken with calipers (accurate to the nearest 0.1 mm) and are expressed in millimeters (mm). Morphological terms and measurements follow Myers and Donnelly (1996, 1997, 2001) and Lynch (1994). Terminology of the head follows Heyer et al. (1990). Measurements considered are SVL: snout-vent length; TL: tibia length; FeL: femur length; FL: foot length; HeL: head length; HW: head width; InD: internarial distance; UEW: upper eyelid width; IOD: inter orbital distance; ED: horizontal eye diameter; TD: horizontal tympanum diameter; F3D: disc width of finger III; T4D: disc width of toe IV; ETS: distance between the anterior edge of the eye to the tip of snout; 1FiL: length of finger I; 2FiL: length of finger II. Abbreviations used are CVULA (Colección de Vertebrados, Universidad de los Andes, Mérida, Venezuela); EBRG (Museo

de la Estación Biológica de Rancho Grande, Maracay, Venezuela; MBUCV (Museo de Biología de la Universidad Central de Venezuela, Caracas Venezuela); MHNLS (Museo de Historia Natural La Salle, Caracas, Venezuela), NHMG (Naturhistoriska Museet, Goteborg, Sweden), USNM (United States National Museum, Washington, U.S.A.). Comparative data of other species were taken from Duellman (1997), Hoogmoed et al. (1977), Fuentes and Barrio-Amorós (2003), Lescure (1981), Lescure et Marty (2000), Lynch (1975), Lynch and Hoogmoed (1977), Myers and Donnelly (1996, 1997, 2001) and Rivero (1968). Sexual maturity was determined by the presence of vocal slits and nuptial pads in males and by the presence of eggs or convoluted oviducts in females.

***Eleutherodactylus aracamuni* sp. nov.**

(Figs. 1, 2)

Holotype. MHNLS 17042; field number CG 195. A subadult or adult male from the summit of Cerro Aracamuni (01° 28' 36" N; 65° 50' 07" W), 1493 m, Estado Amazonas, Venezuela, collected by Carmen García on 6 November 1992.

Paratype. MHNLS 17048, a 14.8 SVL juvenile of undetermined sex with same data as the holotype.

Diagnosis

Eleutherodactylus aracamuni is an apparently small sized member of the genus. It is not assigned to any of the species groups recognized by Lynch and Duellman (1997) (1) Dorsal skin areolate, ventral skin finely areolate; (2) tympanum distinct, superficial, round, half diameter of the eye; (3) snout subovoid in dorsal view, truncate in profile; canthus rostralis distinct, rounded; (4) upper eyelid 63% wider than interorbital distance, without prominent tubercles; no cranial crests; (5) choanae very small, round, vomerine processes absent; tongue rounded; (6) male with vocal slits; no nuptial pads; (7) finger I shorter than II; fingers III and IV bearing enlarged discs, medially notched above; (8) fingers without lateral keels; (9) axillary tubercle absent; (10) ulnar tubercles absent; (11) calcars absent; no tarsal fold; (12) two metatarsal tubercles, the inner oval, two times the size of the round outer; (13) toes lacking webbing and keels; toes III, IV and V with relatively broad discs, medially notched above, smaller than those on fingers III and IV; (14) in preservative, dorsal colour uniform pale brown with a diffuse reticulation of dark brown and several white marks, grey eyelids, dark brown canthal and supratympanic stripes, lip bars; ventral coloration white with profusion of melanophores, becoming gular dark brown spots and an apparent median gular white stripe; (15) adult size unknown, subadult or adult male: 18.2 mm SVL; (16) sexual dimorphism unknown.

Eleutherodactylus aracamuni is easily distinguished from other Guianan shield *Eleutherodactylus* by the following characters (characters for *Eleutherodactylus aracamuni* in brackets). In *Eleutherodactylus avius*, *E. cantitans*, *E. memorans* and *E. yaviensis* (*unistrigatus* group) toe V is much longer than toe III [slightly longer].

Eleutherodactylus cantitans and *E. yaviensis* have basal webbing on toes [absent]. *Eleutherodactylus pruinatus* (unassigned species group) has granular dorsal skin, coarsely areolate ventral skin [dorsal skin areolate, ventral skin finely areolate], tympanum 1/3 of eye length [nearly 1/2], snout rounded in profile [truncate], vomerine odontophores [absent], discs without notches [notched discs]. All five species have weak calcars [no calcars] (Myers and Donnelly, 1996, 1997). See comparison with *E. cavernibardus* under Remarks. *Eleutherodactylus marahuaka* has smooth dorsal skin [areolate], tympanum concealed [distinct], vomerine processes present [absent] and discs without notches [notched discs] (Fuentes and Barrio, 2004). *Eleutherodactylus pulvinatus* (unassigned species group) has a smooth dorsum with scattered small tubercles [areolate without tubercles], upper eyelids with many small tubercles [no tubercles]; ulnar tubercles present [lacking] (Duellman, 1997). *Eleutherodactylus marmoratus* (*unistrigatus* group) has a smaller tympanum, 1/3 of the eye diameter [nearly 1/2], dorsal skin tubercular [areolate] (Rivero, 1961, Lescure, 1981). *Eleutherodactylus vilarsi* (*conspicillatus* group) has Finger I longer than II (shorter), grey to brown venter [white with profusion of melanophores], short limbs [long], large tympanum, 3/4 of the eye diameter [nearly 1/2] (Lynch, 1975, 1980; Melin 1940; this work). *Eleutherodactylus zeuctotylus* (*conspicillatus* group) has a rounded palmar tubercle [bifid] (Lynch and Hoogmoed, 1977).

The presence of distinctly notched discs and absence of vomerine teeth distinguish *Eleutherodactylus aracamuni* from all other *Eleutherodactylus* (except *E. cavernibardus*, see Remarks).

Description

Maximum size undetermined (subadult 18.2 mm SVL). Head longer than wide, wider than body, head width 34 % SVL. Snout subovoid in dorsal view, truncate in profile; eye-nostril distance 69 % of eye diameter; nostrils non-protuberant, directed dorsolaterally; canthus rostralis distinct, rounded, loreal region slightly concave. Upper eyelid without tubercles or warts; broader than inter orbital distance. Tympanum distinct, round, 45 % of eye diameter; flat warts infero-posterior to tympanum. A slightly developed supratympanic fold (Fig 1). Choanae very small, rounded; dentigerous processes of the vomers absent. Tongue round, posterior half free. No vocal slits; no subgular vocal sac (possibly due to its apparently juvenile size).

Dorsal skin areolate; middorsal raphe present; dorsolateral folds absent; throat smooth, venter finely areolate; ulnar tubercles and calcars absent.

Relative length of adpressed fingers III>IV>II>I; finger I very short, not reaching disc on finger II. Finger discs broader than long, disc on finger I slightly expanded, smaller than those on fingers II–IV (Fig 2 left); ungual flap deeply notched in a V shape (Fig 2 center). Fingers without lateral keels. No nuptial pads. Axillary tubercles, as described in *E. cantitans* (Myers and Donnelly, 2001) absent. Palmar tubercle flat, bifid, larger than oval thenar tubercle. Subarticular tubercles round, single, flat. Supernumerary tubercles absent.

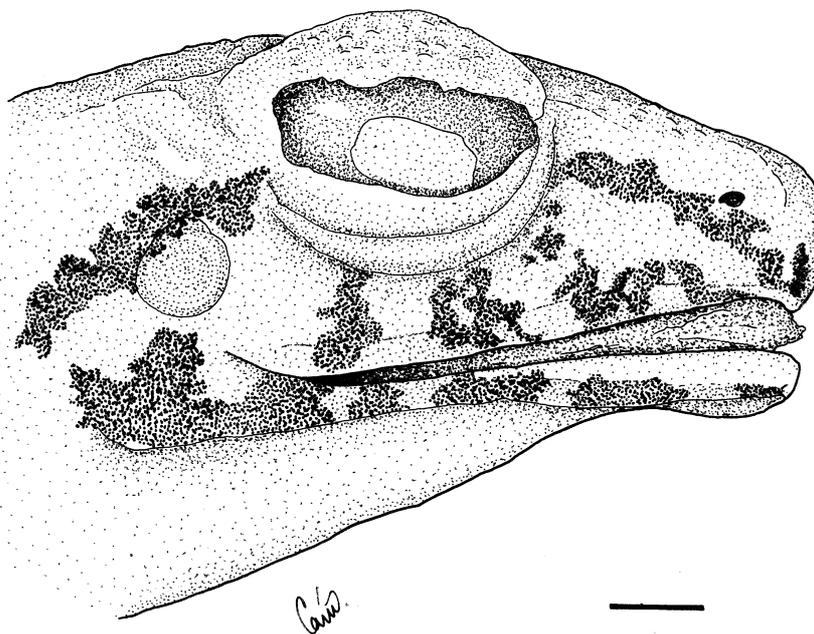


FIGURE 1. Lateral profile of the head of the holotype of *Eleutherodactylus aracamuni* **sp. nov.** Scale equal to 1 mm.

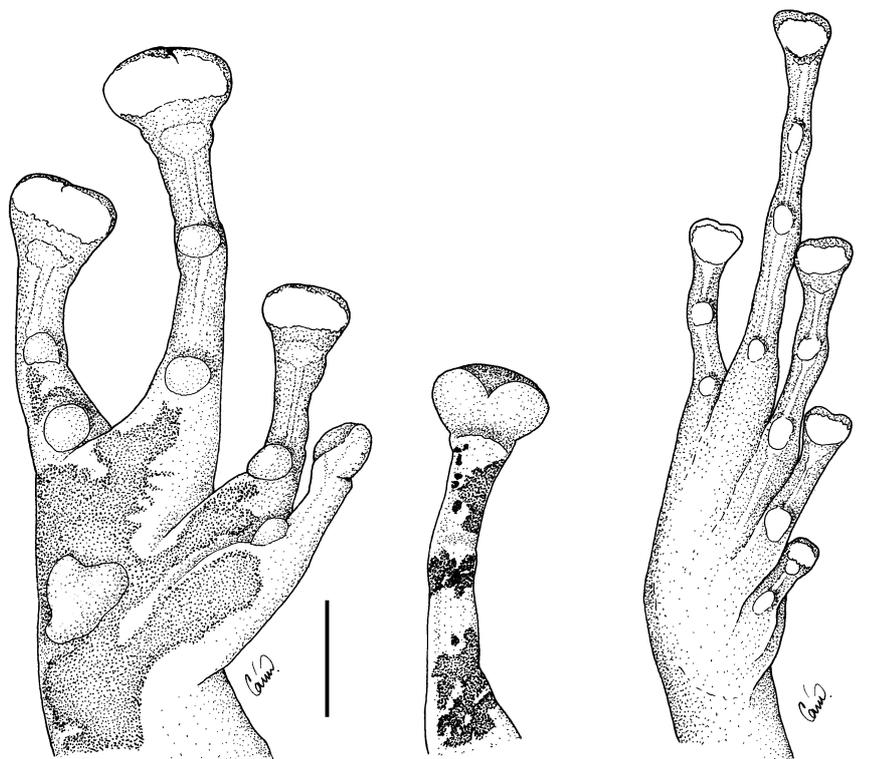


FIGURE 2. Ventral view of Hand (left), dorsal view of Finger IV (center), and ventral view of Foot (right) of the holotype of *Eleutherodactylus aracamuni* **sp. nov.** Scales equal to 1 mm.

Hind limbs long, heels overlap the snout tip when held to the sagittal plane; tibia 60 % of SVL. Relative lengths of adpressed toes IV>V>III>II>I. Disc on fourth toe distinctly narrower than III finger disc; unguis flap notched. Toes without webbing or lateral keels (Fig 2 right). No tarsal fold. Inner metatarsal tubercle elongate, oval, much larger than small, indistinct, round outer metatarsal tubercle; subarticular tubercles flat, single; supernumerary tubercles absent.

Coloration. In life, “Dorsum yellowish green with brown spots; limbs dorsally reddish brown with green. Canthal stripe brick red; supratympanic stripe ochre. Belly blackish brown, with white spots” (C. García, field notes).

In preservative, dorsal colour uniform pale brown with a diffuse reticulation of dark brown and several white marks. Eyelids grey, dark brown canthal and supratympanic stripes, lip bars present; ventral coloration white with profusion of melanophores, becoming dark brown spots in throat, and a median gular white stripe; palmar surfaces of hands and feet brown with white markings.

Measurements of holotype (in mm). SVL: 18.2; TL: 11; FeL: 8.5; FL: 8.5; HeL: 7.2; HW: 6.2; Ind: 1.6; UEW: 2.2; IOD: 1.4; EN: 1.7; ED: 2.3; TD: 1; FD: 1; 4TD: 0.8; ETS: 3.2; 1FiL: 2.6; 2FiL: 3.

Remarks

We never would decide to describe a species of such a difficult genus in base of two juvenile specimens, but in this case we can adduce some reasons that led us to do that. First, expeditions to tepuis are scarce and extremely expensive, being difficult to have again access soon to Aracamuni. Thus, we believe that it is imperative to know the tepui fauna as completely as possible. Second, we checked paratypes of *E. cavernibardus*, including a juvenile of the same size of the holotype of *E. aracamuni*. Although could be adduced that describing a new species based on young specimens is risky, in this case we see that the young *E. cavernibardus* looks very similar to the adults, as stated Myers and Donnelly (1997: 46). We are confident that juveniles of *E. aracamuni* should be as similar to adults as are juveniles of *E. cavernibardus* to adults of their species.

Eleutherodactylus aracamuni is, however, difficult to distinguish from *E. cavernibardus*. Both share features which are unusual in *Eleutherodactylus*, and are similar in colour pattern (see Myers and Donnelly, 1997). *Eleutherodactylus cavernibardus* was described as the only species in the genus which combines notched digits and the absence of dentigerous vomerine processes. When examining *E. aracamuni*, at the first glance we assigned the species to *E. cavernibardus*, after observing these rare features (notched digits and lack of vomerine teeth, plus the median gular stripe) but further and closer examination revealed important differences. The finger I is considerably shorter in *E. aracamuni* (86 % of finger II) than in *cavernibardus* (approx. 94 % based in Fig. 32 in Myers and Donnelly, 1997; 96% in MBUCV 6464 and 98% in MBUCV 6463). The dorsal skin of *E. cavernibardus* is granular to weakly tuberculate (Fig 30; Myers and Donnelly, *op. cit*), while in *E. aracamuni* it is areolate (term following Lynch and

Duellman, 1997). *Eleutherodactylus cavernibardus* has a broader head (37–41% of SVL) than *E. aracamuni* (34 %). The snout is rounded in profile in *E. cavernibardus*, and strongly truncate in *E. aracamuni*. The pattern is variable in *cavernibardus*, and both, dorsal and gular patterns of *E. aracamuni* could be within the variation found in *E. cavernibardus*. Pectoral spots, however, present in *E. cavernibardus*, are absent in both specimens of *E. aracamuni*. However, we do not consider coloration very important in such closely related species. The only other *Eleutherodactylus* in the Guiana Shield showing a median gular stripe is *E. gutturalis* Hoogmoed, Lynch and Lescure, 1977, but it is easily distinguished because it belongs to the *conspicillatus* species group, thus, having the first finger longer than second. We consider that the differences between *E. cavernibardus* and *E. aracamuni* are enough to merit separate species status. The two may be sister species, and perhaps deserving assignment to their own species group.

Natural history

Both specimens were captured during the day, not calling. They were in a moss patch on a rocky talus (0.8 m of height), in a small creek (two m wide) of tannic water and rocky bed. The creek was in a dwarf gallery forest (2.5 m canopy height).

Biogeography

Cerro Aracamuni is the northern part of the huge Neblina massif (*vide* Huber 1995), reaching a maximum elevation of 1600 m. It is a granitic mountain, not a typical sandstone tepui. The vegetation is called “broad-leaved, shrubby upland meadows on peat” by Huber & Alarcón (1988). There are only another species of amphibian known from Aracamuni, the apparently endemic *Cochranella riveroi* (Ayarzagüena 1992). Aracamuni is approximately 90 km WNW of the type locality of *E. cavernibardus*, Pico Tamacuari in the Serranía de Tapirapecó. Both highlands are separated by the lowland valley of the Siapa river. This has important biogeographic significance, as is normal that each separated tepui or Granitic mountain bears its own endemics.

Etymology

The species name refers to the inhabited “tepuí” or “Cerro” in Amazonas state, Aracamuni. It is used as a noun in nominative singular, in apposition to the generic name.

Eleutherodactylus vilarsi (Melin)

Hylodes vilarsi Melin 1941 *Göteborgs Kungl. Vetensk. Vitter. Samh. Handl. Ser. B*, 1 (4): 45.

Hylodes roseus Melin 1941 *Göteborgs Kungl. Vetensk. Vitter. Samh. Handl. Ser. B*, 1 (4): 46.

Eleutherodactylus roseus: Lutz and Kloss, 1952. *Mem. Inst. Oswaldo Cruz*, 50: 646.

Eleutherodactylus brachypodius Rivero 1961. *Bull. Mus. Comp. Zool.*, 126 (1): 61.

Eleutherodactylus conspicillatus ileamazonicus Rivero 1961. *Bull. Mus. Comp. Zool.*, 126 (1): 63.

Eleutherodactylus rosmelinus: Gorham 1966. *Das Tierreich*. 85: 98.

- Eleutherodactylus vilarsi*: Gorham 1966. *Das Tierreich*, 85: 108.
Eleutherodactylus conspicillatus guayanensis Rivero 1967 *Carib. J. Sci.*, 7 (3–4): 149.
nomen nudum
Eleutherodactylus vilarsi: Lynch 1975 *Contrib. Science* 272: 9; Lynch, 1980 *Amer. Mus. Novitates*, 2696: 17.
Eleutherodactylus (Eleutherodactylus) vilarsi: Lynch and Duellman 1997. *Univ. Kansas, Mus. Nat. Hist., Spec. Publ.*, 23: 234.
Eleutherodactylus vilarsi: Barrio-Amorós 1998. *Acta Biol. Venez.* 18 (2): 55.
Holotype. NHMG 491, from Taracuá, rio Vaupés, Terr. Amazonas, Brazil. Not examined.

Diagnosis

Eleutherodactylus vilarsi is a medium sized member of the *conspicillatus* species group *sensu* Lynch (1994) and Lynch and Duellman (1997). (1) Dorsal skin shagreened with scattered small warts, ventral skin smooth; (2) tympanum prominent, superficial, vertically oval; (3) snout subacuminate to acuminate in dorsal view, round in profile; canthus rostralis distinct, angular; (4) upper eyelid usually narrower than interorbital distance, without prominent tubercles; no cranial crests; (5) choane large, round, vomerine processes medium to large, triangular, oblique, with six to ten odontophores each; tongue round to cordiform, if that the latter, weakly notched posteriorly; (6) males with vocal slits; nuptial pads present in reproductive males; (7) finger I distinctly longer than II; fingers III and IV bearing enlarged discs; (8) fingers without lateral keels (present only in dehydrated animals); (9) axillary tubercle absent; (10) ulnar tubercles absent; (11) calcars absent; a very weak inner tarsal fold (in some animals just a non-continuous small fold) on distal 1/4 of tarsus; (12) two metatarsal tubercles, inner oval, four times size of round outer; (13) toes without lateral keels; no webbing; toes IV and V with broad discs, smaller than those on fingers III and IV; (14) in preservative, dorsal colour variable from uniform gray to brown to patterned with ill defined chevrons and X or W-like marks and usually well defined cross bars on thighs; ventral coloration usually immaculate whitish or less frequently brownish with white spots; lip bars only in patterned specimens; (15) adult males 22.8 to 33 mm SVL, adult females 31 to 49 mm SVL; (16) Sexually dimorphic in size (Table 1).

We compare *Eleutherodactylus vilarsi* with other representatives of the *conspicillatus* species group. In Venezuela only two other species, *E. terraebolivaris* and *E. zeuctotylus*, belong to this group. Although an additional species, *E. pedimontanus* La Marca from the Venezuelan Andes (La Marca 2004) was described as belonging to this group, the characters do not agree well with those of the *E. conspicillatus* group. In other parts of the Guiana shield, *E. chiastonotus* Lynch and Hoogmoed and *E. gutturalis* Hoogmoed, Lynch and Lescure, also occur. All of these can be distinguished by the following characters (*E. vilarsi* in parentheses). *Eleutherodactylus terraebolivaris*, from cloud forests in the northern Venezuelan coastal range, has a granular venter (smooth), finger I equal to II (finger I distinctly longer than II) (Rivero, 1961) and a completely allopatric distribution (Barrio-Amorós 1998, La Marca 1992, Rivero 1961). *Eleutherodactylus zeuctotylus* has a

rounded palmar tubercle (usually bifid but also can be heart-shaped and round), absence of tarsal fold (present) (Lynch and Hoogmoed, 1977). *Eleutherodactylus chiastonotus* has no tarsal fold (present), skin on dorsum without warts (usually with small warts), dorsolateral fold represented by a row of pustules (absent), small discs on fingers (larger). *Eleutherodactylus gutturalis* has upper eyelids covered by somewhat larger warts than on the rest of the body (absent), an indistinct supratympanic stripe (definite), an enlarged heel tubercle (absent), and a completely different pattern, consisting of a W shaped mark between the shoulders followed by one or two chevrons, and ventrally by a very striking median cream wide stripe on a white-spotted black throat (not as described, see coloration below).

TABLE 1. Measurements (in mm) of *Eleutherodactylus vilarsi*. Values include means \pm SD (range). See measurement acronyms in the text.

Character	Males (n=5)	Females (n=38)
SVL	26.76 \pm 4.31 (22.8–33)	38.11 \pm 4.59 (31–49)
TL	13.56 \pm 2.30 (11–17)	20.2 \pm 2.24 (15.8–25)
FeL	11.26 \pm 1.85 (8.8–14)	17.83 \pm 2.18 (13.7–22.5)
FL	11.72 \pm 1.49 (10–13.9)	16.88 \pm 1.79 (13.2–20)
HeL	10.58 \pm 1.22 (9–12.3)	15.05 \pm 1.77 (12–19)
HW	9.02 \pm 1.43 (7.3–10.8)	13.33 \pm 3.15 (2.30–19)
InD	1.98 \pm 0.4 (1.5–2.5)	3.2 \pm 1.58 (2.1–12.4)
UEW	2.74 \pm 0.15 (2.5–2.9)	3.74 \pm 0.48 (2.9–4.8)
IOD	3.06 \pm 0.09 (3–3.2)	4.08 \pm 0.47 (3.2–5)
ED	3.18 \pm 0.43 (2.7–3.7)	4.28 \pm 0.54 (3–5.2)
TD	1.96 \pm 0.09 (1.8–2)	2.59 \pm 0.34 (2–3)
F3D	1.18 \pm 0.11 (1–1.3)	1.55 \pm 0.28 (1–2)
T4D	1.02 \pm 0.11 (0.9–1.1)	1.34 \pm 0.28 (1–1.9)
ETS	4.82 \pm 0.74 (4–6)	6.99 \pm 0.85 (5.3–8.8)
1FiL	4.52 \pm 0.75 (4–5.8)	6.19 \pm 0.68 (5–7.5)
2FiL	3.70 \pm 0.73 (3–4.9)	5.22 \pm 0.68 (3.8–6.2)

Description

Based on 66 specimens from southern Venezuela (see Appendix). Females larger than males (adult males 22–33 mm SVL (mean 26.76 \pm 4.31); adult females 31–49 mm SVL (mean 38.11 \pm 4.59). Head (Fig. 3) longer than wide, as wide as the body, head width 32–34% of SVL in males, 34–38% in females. Snout subacuminate to acuminate in dorsal view, round in profile (Fig. 4); nostrils protuberant, directed dorsolaterally; canthus rostralis distinct, angular, anteriorly curved to inside, distinctly narrower posteriorly; loreal region slightly concave. Upper eyelid without tubercles or warts, narrower than IOD.

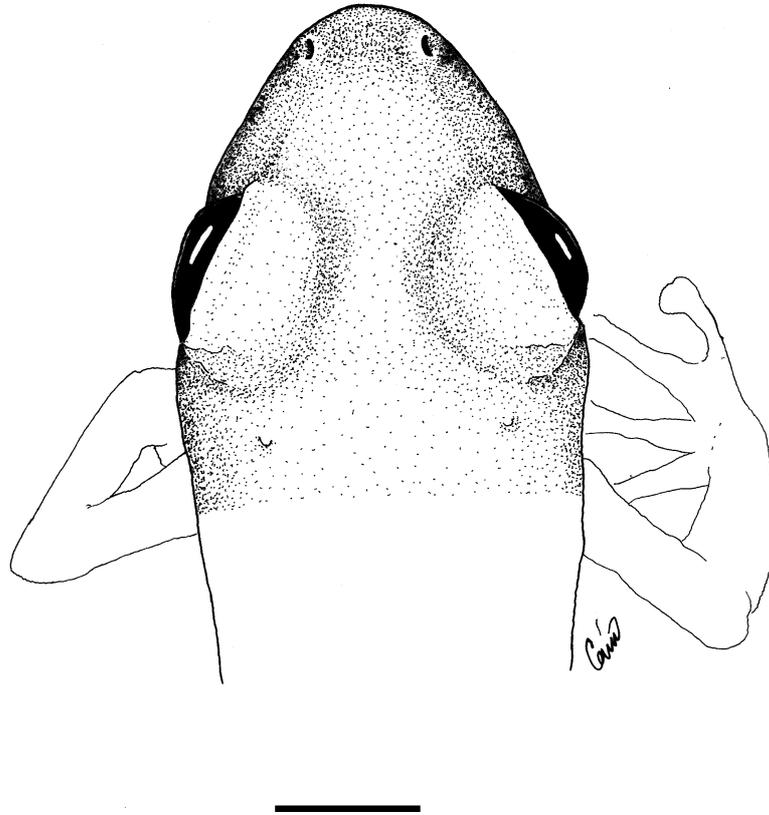


FIGURE 3. Dorsal view of the head of *Eleutherodactylus vilarsi* (MHNLS 17049). Scale equal to 2 mm.

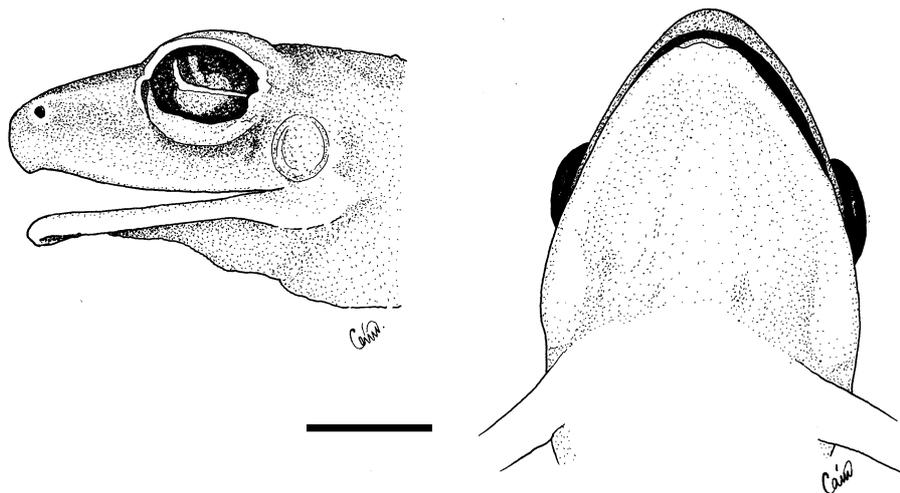


FIGURE 4. Lateral profile (left) and ventral view (right) of *Eleutherodactylus vilarsi* (MHNLS 17049). Scale equal to 2 mm.

Tympanum distinct, round or vertically oval, 50–74% of eye diameter; tympanum usually not obscured by supratympanic fold; a more or less prominent tubercle posteroventral to tympanum (sometimes absent). A well developed supratympanic fold present. Choanae large, round to oval; vomerine processes medium to large, triangular, oblique, posterior and medial to choanae, bearing six to ten odontophores in adults; two to six in young and subadults. Tongue round to weakly cordiform, posterior third free. Vocal slits present, postero-lateral to tongue; no apparent subgular vocal sac.

Dorsal skin smooth to shagreened; with or without small scattered tubercles or spicules; middorsal raphe absent; dorsolateral folds absent; throat smooth, venter usually smooth (a few specimens slightly areolate posteriorly); ulnar tubercles and calcars absent.

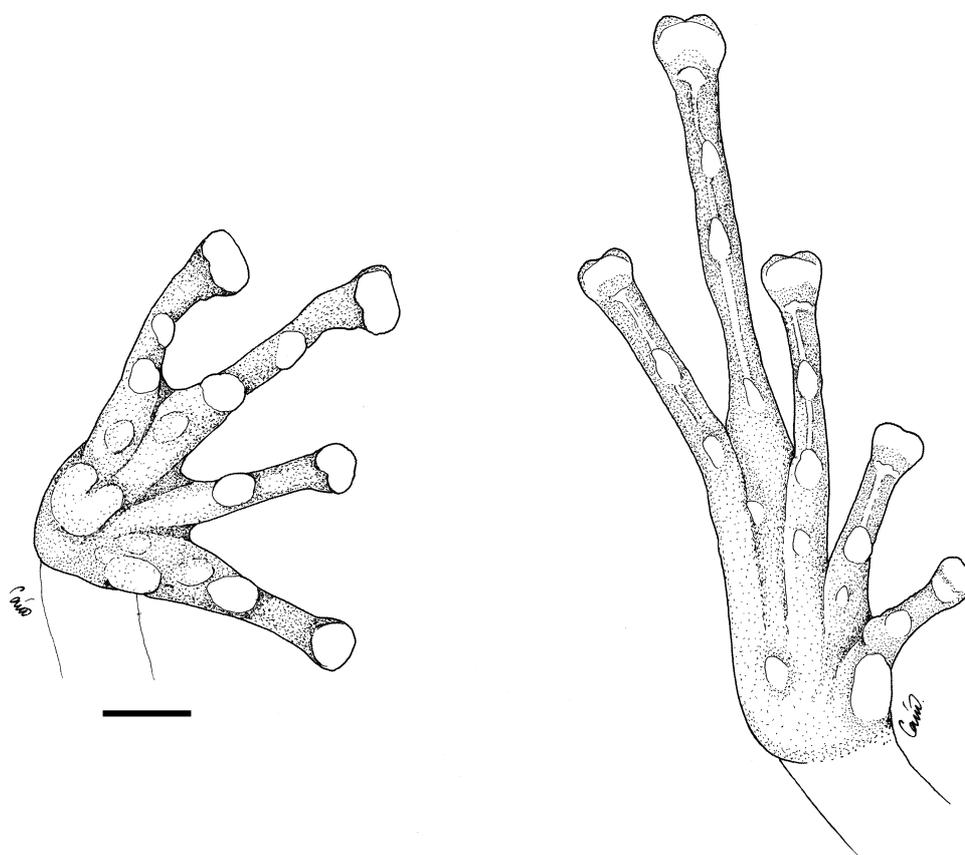


FIGURE 5. Palmar view of the hand (left) and foot (right) of *Eleutherodactylus vilarsi* (MHNLS 17049). Scale equal to 1 mm.

Relative length of adpressed fingers III>IV>I>II (Fig. 5 left); first finger usually overlapping disc on finger II; nuptial pads not evident. Finger discs broader than long, III and IV notched medially; disc on finger I distinctly expanded, equal to that of finger II and smaller than those on fingers III and IV. Fingers without lateral keels. Axillary tubercles, as described in *E. cantitans* (Myers and Donnelly, 2001) absent. Palmar tubercle almost

round to weakly, or more usually, strongly bifid, larger than elliptic thenar tubercle in females; as large as thenar tubercle in males; some adults from throughout the range (EBRG 637, 638, 644, 651, 1249, 1339, 1406, 1518, 1797, 2104, 2162, 2166) and two juveniles (EBRG 1338, 1855) possess an almost round palmar tubercle, with a flat top (Fig. 6 C); all other vouchers have bifid palmar tubercle (as in Fig 6 A). Individuals showing medium bifid development of the tubercle also exist (EBRG 638) (Fig. 6 B). Subarticular tubercles round, conical, prominent, single. Supernumerary tubercles round, smaller than subarticular tubercles, relatively smaller in females than in males.

Hind limbs usually short but variable, heels reaching from posterior to eye to beyond the snout tip when held to the sagittal plane; tibia 47–53 % of SVL in males; 48–60 % of SVL in females. Relative lengths of adpressed toes IV>V>III>II>I. IV toe disc narrower than III finger disc width (Fig. 5 right). Toes without lateral keels; toes lacking webbing. Very short and weak inner tarsal fold on distal 1/4 of tarsus, sometimes not continuous with the inner edge of the toe I, simply an isolated fold. Inner metatarsal tubercle elongate, oval, much larger than small, rounded outer metatarsal tubercle; subarticular tubercles round, conical, protuberant, single; supernumerary tubercles smaller than subarticular tubercles, round, conical.

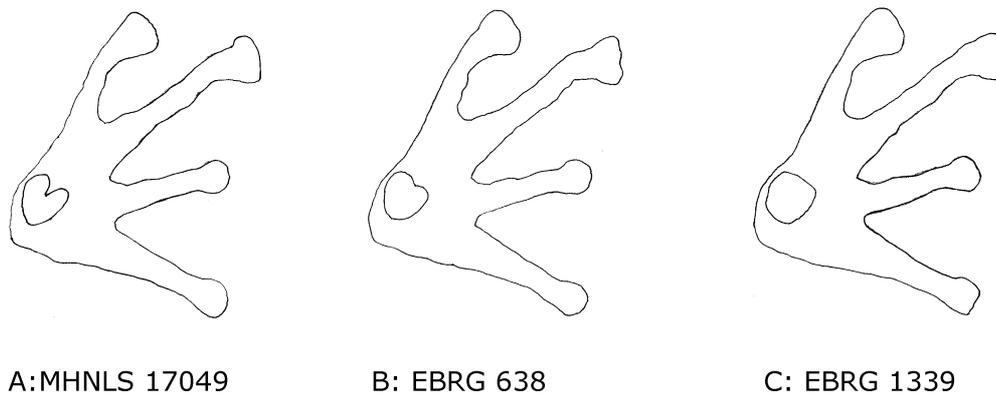


FIGURE 6. Schematic palmar view of *Eleutherodactylus vilarsi*. A: bifid palmar tubercle. B: heart shaped palmar tubercle. C: round palmar tubercle. Not at same scale.

Coloration and variation. Description of coloration is based in color slides of uncollected animals from all its Venezuelan distribution. These photos show three different main patterns.

Pattern A (Fig. 7): dorsum greenish gray, light to dark brown, unpatterned or with very small black spots; flanks same as dorsal color but paling down to whitish; upper lip dirty white anteriorly; hind limbs unpatterned or with faint dark brown cross bars. The following specimens have this pattern: EBRG 637, 1137, 1249–50, 1335, 1384, 1406, 1517–8, 1797–8, 1930, 2005, 2083, 2089, 2104, 2433–5, 2439, 2428, 2901, 3662.



FIGURE 7. Pattern A of *Eleutherodactylus vilarsi*. Santa María de Erebató, estado Bolívar. Photo: César L. Barrio-Amorós.



FIGURE 8. Pattern B of *Eleutherodactylus vilarsi*. Tobogán de la Selva, estado Amazonas. Photo: David Alba.

Pattern B (Fig. 8):strongly patterned, brown to olive background, with a W between the shoulders, and diagonal dark brown stripes across the body and limbs; lip bars present.

The following specimens exhibit pattern B: EBRG 638, 644, 647, 1861, 1929, 2166, 2432, 2440, 2902.

Pattern C (Fig. 9): intermediate between patterns A and B; light to dark brown, with indistinct bars, with or without W between the shoulders; sometimes with a lichen-like pattern. The following specimens exhibit this pattern: EBRG 651, 653, 1138, 1339, 1385, 2004, 2130, 2162, 2429, 2900.



FIGURE 9. Pattern C of *Eleutherodactylus vilarsi*. Tobogán de la Selva, estado Amazonas. Photo: David Alba.

Canthal and supratympanic dark brown stripes are present in all pattern types.

Juveniles and subadults (females up to 25 mm; the smallest male with vocal slits was 22.8 and was considered as an adult or subadult and not counted as a juvenile) are similar to adults in all characters, but all have an interorbital dark bar, which along with the canthal stripes produce a very conspicuous light triangle on the head; sometimes broken by a dark midline, and also can be two symmetrical dark brown spots between the canthal ridges. Juvenile and subadults exhibit the same pattern types as adults.

Natural history

Eleutherodactylus vilarsi is a lowland rainforest inhabitant. It is easily found at night, on low plants, leaves, rocks, mossy walls, and on the ground, near or far from streams. During the day can be found on leaf litter. Nothing is known about reproductive habits. Calling males were seen on rainy nights in May 2005 at Tobogán de la Selva, Puerto Ayacucho, Estado Amazonas, but the call recording is too bad to be processed.

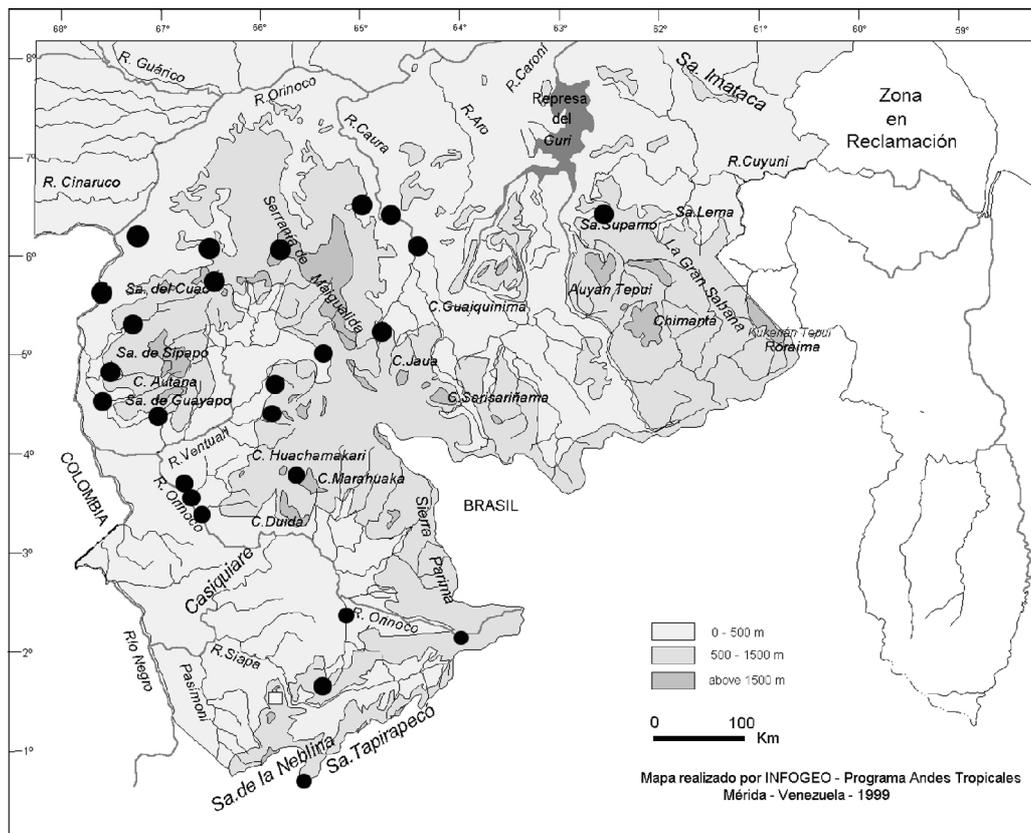


FIGURE 10. Map of southern Venezuela, with the distribution of *Eleutherodactylus aracamuni* (white square) and *E. vilarsi* (solid black dots).

Distribution

Fig. 10. In Venezuela, *E. vilarsi* is distributed through all known lowland rainforest south of the Orinoco river, except for the extreme eastern ones (e.g. Imataca). Its distribution extends south west to Brazil and Colombia, reaching northern Amazonian Peru.

Remarks

The three recognized patterns are not significant geographically, and all can be found in a same population from anywhere. In view of this great variability, it is understandable that many names have been used for this single species, which is difficult to diagnose. *Eleutherodactylus vilarsi* is a widely distributed lowland *Eleutherodactylus* in southern Venezuela, Amazonian Colombia, northeastern Perú and northern Brazil. Our sample ranges from 100 masl to 1230 masl. Rivero (1961) mentioned his *E. conspicillatus ileamazonicus* (currently synonym of *vilarsi*; Lynch (1975) from 4050 feet (approx. 1230 masl) at the slopes of Mt. Marahuaka, which is a significant elevation for a lowland

species.

We also examined digital pictures of USNM 83950, a "*E. terraebolivaris*" from Yapacana (Amazonas) identified by Cochran & Goin (1970) and a "*E. lymani*" Barbour and Noble (USNM 83576) from Salto da Hua, at the southern Venezuelan border with Brazil, also identified by Cochran & Goin (1970), and both proved to be *E. vilarsi*.

Discussion

Eleutherodactylus aracamuni seems to belong to a very specialized group of *Eleutherodactylus* with unusual features, such as the absence of vomerine processes and presence of notched discs. It is very similar to *E. cavernibardus*, and they probably may merit their own group. Another species of this distinctive group has been collected from Sarisariñama, but at the moment is being considered as *E. aff. cavernibardus* (Barrio-Amorós and Brewer-Carías *in press*).

The description of *Eleutherodactylus aracamuni*, along with other recently named high tepui *Eleutherodactylus* (Myers and Donnelly, 1996, 1997; Fuentes and Barrio-Amorós, 2004), suggests that the number of species in the Guiana Shield is underestimated. We can assume that frogs of this genus inhabit many (if not all) tepui summits and slopes. In the Neblina expedition alone (Brewer-Carías, 1988), seven undescribed species were reported (McDiarmid and Paolillo, 1988) and in the collection of MHNLS several unidentified species are waiting for study (Gorzula and Señaris, 1998). At the moment two species of the *conspicillatus* group are known from the Venezuelan Guayana, inhabiting lowlands (0–500 m) and uplands (500–1500 m) (after Huber 1995). These are *E. vilarsi* and *E. zeuctotylus* (but see comment below). Almost all upland and highland species (1500–3000 m) belong to the *unistrigatus* group: *E. avius*, *E. cantitans*, *E. marahuaka*, *E. marmoratus*, *E. memorans*, *E. pulvinatus* and *E. yaviensis*. At least four species (*E. aracamuni*, *E. cavernibardus*, *E. pruinatus* and *E. aff. cavernibardus* from Sarisariñama) are at the present moment unassigned to any species group (Myers and Donnelly, 1996, 1997; this work). Another species, *E. johnstonei* Barbour, was introduced to some cities of the Guiana region (Gorzula, 1989, Kaiser et al., 2002). Duellman (1997) placed *Eleutherodactylus pulvinatus* in the *martinicensis* series without explanation. Surprisingly, Lynch and Duellman (1997) did not assign *pulvinatus* to any species group, mentioning that the *unistrigatus* group is not present in the Guiana highlands. This must be a lapsus, because they should have known of the work of Myers and Donnelly (at least the 1996 one), and the assignation of two of their new species (*E. cantitans* and *E. yaviensis*) to the *unistrigatus* species group. Myers and Donnelly (1997) did not place *E. pulvinatus* in a species group. Herein, we include *E. pulvinatus* in the large *unistrigatus* group because it shares features typical of this group, such as an areolate venter, first finger shorter than second and fifth toe much longer than third.

Eleutherodactylus zeuctotylus cannot be readily distinguished from *E. vilarsi*, except

for the round palmar tubercle and the absence of tarsal fold. All other characters that Lynch and Hoogmoed (1977) offered for *E. zeuctotylus* actually fall within the variation of *E. vilarsi*. We already showed the interspecific variation regarding the palmar tubercle shape (bifid to heart-shaped to round) in *E. vilarsi*. Thus, the only reliable character distinguishing *E. vilarsi* from *E. zeuctotylus* is the presence of a tarsal fold. We wonder if the presence/ absence of a tarsal fold is sufficient to distinguish between two close species, that can even live sympatrically, and if would not be better to consider *E. zeuctotylus* as a synonym of *E. vilarsi*. Further studies will elucidate this matter.

At this time, our knowledge of the Guiana shield *Eleutherodactylus* is so poor, that we are not able to speculate about relationships. Many of the *unistrigatus* group species are isolated at high altitudes in tepuis with no apparent connection with other neighboring tepuis. Until many more species from highlands, uplands and lowlands are known, we will remain unconfident about phylogeny and population treats.

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Appendix I: Specimens examined

Eleutherodactylus aracamuni—see type series.

Eleutherodactylus cantitans—EBRG 3003 (Estado Amazonas, Cima Cerro Yaví. 2150 m. 50° 43' N-65° 54' W, Venezuela).

Eleutherodactylus cavernibardus—MBUCV 6459–64 (Estado Amazonas, Pico Tamacuari, 1160–1200 m. Sierra Tapirapécó, Venezuela; paratopotypes).

Eleutherodactylus pulvinatus—EBRG 2730 (Estado Bolívar, Auyantepui, camp 4, 1600 m., 5° 58' N-62° 33' W, Venezuela).

Eleutherodactylus vilarsi—Venezuela, Estado Amazonas: EBRG 637–8, 647 (Base cerro Yapacana, Atabapo, 100 m, 3° 49' N-66° 50' W, Venezuela); EBRG 644 (Base cerro Yapacana, Atabapo, 600 m); EBRG 651 (Caño Yagua, Chipital, Atabapo, 120 m, 4° 33' N-65° 31' W); EBRG 653 (Serranía Parú, Atabapo, 4° 33' N-65° 31' W); EBRG 1137–8 (Rio Puruname, Atabapo); EBRG 1249 (Rio Guayapo, Salto Moriche); EBRG 1335–1339, 1349–50 (Rio Autana, raudal Ceguera, 100 m); EBRG 1378 (rio Autana, raudal Perezza, 100 m); EBRG 1384–5 (Río Autana, 2 km W boca caño Cabeza de Manteco, Atures); EBRG 1404, 1406 (rio Sipapo, 5 km arriba boca rio Guayabo, Atures); EBRG 1929–30, 1935 (Mavaquita, upper Orinoco); EBRG 2004–5 (Raudales Atures, 12 km S Pto Ayacucho, Orinoco river); EBRG 2130 (Rio Asisa, Atabapo); EBRG 2530 (Alto Orinoco, 2° 14' 35" N-64° 02' 32" W, 400 m); EBRG 2900–2 (Campo turístico Yutajé, Río Yutajé, 150 m); EBRG 3662 (Lago Leopoldo (Paraka-Wachoi), Serranía Sipapo, 300 m, 4°57'97"N-67°29'21"W); MHNLS 17049 (Valle en Serranía de Unturán, 01° 48' 39"N-65° 24' 12"W, 200 m; CM 897 field number); MHNLS 11167 (Cerro Parú, 04° 33' N, 65° 31' W, 710 m); MHNLS 13874 (Cerro Duida, 1000 m); MHNLS 11627 (middle Mavaca river, one hour upriver from Makarapiwei, a Yanomamo village).

Venezuela, Estado Bolivar: EBRG 1797–8 (Serranía Los Pijiguaos, 600 m); EBRG 1855, 1859, 1861 (Los Pijiguaos, 550 m); EBRG 1874 (Alto Rio Cuao); EBRG 1882 (Serranía Pijiguaos, Distrito Cedeno); EBRG 2162, 2166 (Río Tabaro, ca. Boca Nichare, Reserva Forestal Caura, 100 m); EBRG 1517–8 (Hacienda Sagitario, aprox. 90 km NNE Puerto Ayacucho); EBRG 2083 (Caño Icutú, tributary of Rio Nichare, afl. Rio Caura, 200 m); EBRG 2089 (Enterrios, rio Caura, 350 m); EBRG 2104 (Cerro Mocho, 6° 08' 07"N-66°22' 05"W); EBRG 2428–29, 2432–5, 2439–41 (Cacurí, Sierra Maigualida, 890 m. 4° 59' N-65° 11' W); MBUCV 6588 (Cima Cerro Santa Rosa, El Triunfo, Serranía del Supamo, 700 m); MBUCV 5540 (as *E. conspicillatus ileamazonicus*; río Paragua, entre Guaiquinima y río Karún); CVULA 6527–8 (Triunfo, Serranía del Supamo, 350 m); CVULA 6529–31 (Santa Maria de Erebató, río Erebató, alto Caura); MHNLS 9981–83 (Fundo El Carmen, río Parguaza); MHNLS 11893 (Los Pijiguaos, 160 km SW of Caicara del Orinoco); MHNLS 11889 (Trapichote II, Los Pijiguaos).

Eleutherodactylus yaviensis—EBRG 3007, 3015 (Amazonas, Cima Cerro Yaví. 2150 m. 50°43' N-65° 54' W Venezuela; paratopotypes).

Eleutherodactylus sp.—EBRG 2998 (Bolívar, Sector E, cima Auyan tepui, 5°53' 36" N-62° 29'12" W, 1750 m, Venezuela).