

THREE NEW FROGS OF THE GENUS *ELEUTHERODACTYLUS* (AMPHIBIA, LEPTODACTYLIDAE) FROM GUAUQUINIMA TABLE MOUNTAIN, BOLIVAR, VENEZUELA

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Abstract: *Eleutherodactylus guaiquinimensis* sp. nov., *Eleutherodactylus stegolepis* sp. nov., and *Eleutherodactylus tepuiensis* sp. nov. are described from the summit of Cerro Guaiquinima, a table mountain ("tepui") in Bolivar state, Venezuelan Guayana. *Eleutherodactylus guaiquinimensis*, a member of the *unistrigatus*-group, is unique among other tepui *Eleutherodactylus* in the following combination of characters: dorsal skin finely granular with few small tubercles, ventral skin slightly areolate; finger I shorter than finger II; fingers without lateral keels, calcars absent; toes without lateral keels; no webbing. *Eleutherodactylus stegolepis*, a member of the *conspicillatus* group, can be distinguished from other tepui *Eleutherodactylus* by the following combination of characters: dorsal skin smooth to finely granular, ventral skin smooth; finger I longer than finger II, fingers with very weak lateral keels; three round, small ulnar tubercles present; calcars absent; toes with weak lateral keels; no webbing. *Eleutherodactylus tepuiensis*, a member of the *unistrigatus*-group, is most similar to *E. memorans*, from which it can be distinguished by smooth dorsal skin, absence of tubercles marking the course of the arms of a dorsal W-shaped dark marking and presence of scattered larger tubercles dorsally and ventrally to the supratympanic fold. Most *Eleutherodactylus* on Guaiquinima Tepui are endemics; the only exception is *Eleutherodactylus vilarsi*, collected at 1520 m a.s.l.

Key words: Amphibia, Leptodactylidae, taxonomy, *Eleutherodactylus guaiquinimensis* sp. nov., *Eleutherodactylus stegolepis* sp. nov., *Eleutherodactylus tepuiensis* sp. nov., *Eleutherodactylus vilarsi*, *Pristimantis*, Venezuelan Guayana, Guiana Shield.

Resumen: A. Schlüter y D. Rödder. "Tres nuevas ranas del género *Eleutherodactylus* (Amphibia, Leptodactylidae) del tepuy Guaiquinima, Bolívar, Venezuela". *Eleutherodactylus guaiquinimensis* sp. nov., *Eleutherodactylus stegolepis* sp. nov. y *Eleutherodactylus tepuiensis* sp. nov. son descritos de la cumbre del Cerro Guaiquinima, un tepuy del Estado Bolívar, Guayana Venezolana. *Eleutherodactylus guaiquinimensis*, miembro del grupo *unistrigatus*, es único entre los *Eleutherodactylus* de tepuyes en la siguiente combinación de caracteres: piel dorsal finamente granular con pocos tubérculos pequeños, piel ventral ligeramente aureolada; dedo I de la mano más corto que el dedo II; dedos de la mano sin quillas laterales, calcares ausentes; dedos del pie sin quillas laterales; sin membranas. *Eleutherodactylus stegolepis*, miembro del grupo *conspicillatus*, se distingue de otros *Eleutherodactylus* de tepuyes por la siguiente combinación de caracteres: piel dorsal lisa a finamente granular. Piel ventral lisa; dedo I de la mano más largo que el dedo II, dedos con quillas laterales débiles; tres tubérculos ulnares redondeados débiles, tubérculos ulnares débiles presentes; calcares ausentes; dedos del pie con quillas laterales débiles; sin membranas. *Eleutherodactylus tepuiensis*, miembro del grupo *unistrigatus*, es muy similar a *Eleutherodactylus memorans*, del cual se distingue por su piel dorsal lisa, ausencia de tubérculos que delimitan una marca oscura en forma de W y presencia de grandes tubérculos aislados dorsal y ventralmente al pliegue supratimpánico. La mayoría de *Eleutherodactylus* de la cumbre del Cerro Guaiquinima son endémicos, con la única excepción de *Eleutherodactylus vilarsi*, colectado en una elevación de 1520 m.s.n.m.

Palabras clave: Amphibia, Leptodactylidae, taxonomía, *Eleutherodactylus guaiquinimensis* sp. nov., *Eleutherodactylus stegolepis* sp. nov., *Eleutherodactylus tepuiensis* sp. nov., *Eleutherodactylus vilarsi*, *Pristimantis*, Guayana venezolana, Escudo de Guayana.

INTRODUCTION

The Venezuelan sandstone table mountains are remnants of an extensive sandstone plateau, the Roraima Plateau, which covered a part of the Guianan Region during the Tertiary period (Haffer 1974). The Guianan Region, bordered by the Río Orinoco, the Casiquiare Canal, and the Río Negro to the west, by the Río Amazonas to the south, and by the Atlantic Ocean to the north and east (McDiarmid and Donnelly 2005), is geologically known as the Guiana Shield (Fittkau 1974, Gansser 1954, Hollowell and Reynolds 2005). Hoogmoed (1979) listed over 160 anuran species occurring in the Guiana Shield. Recent estimates of the number of taxa are about 253 (Señaris and

MacCulloch 2005, Kok 2006, Kok *et al.* 2006 a, b, MacCulloch & Lathrop 2005, McDiarmid and Donnelly 2005, MacCulloch *et al.* 2006). For all of Venezuela, the number of anuran species has increased during the last decades: 202 (La Marca 1992), 250 (La Marca 1997), and 284 (Barrio-Amorós 2004). In the past decades, there has been a steady increase in the number of newly described anurans in the Neotropics. This is partially due to the advancement and application of newly developed and sophisticated analysis methods (Köhler *et al.* 2005). Some attempts have been made to split *Eleutherodactylus* into smaller units and we are aware of the taxonomic

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changes proposed by Frost *et al.* (2006). Only 12 out of more than 700 known *Eleutherodactylus* species were included in their taxonomic analyses and the authors point out that the arrangement of the genus *Eleutherodactylus* within the family Brachycephalidae "is only partially successful inasmuch as it leaves "*Eleutherodactylus*" [...] of dubious monophyly or even demonstrated polyphyly...." (Frost *et al.* 2006). The mentioned taxonomic changes are controversially discussed (e.g. Smith and Chiszar 2006; Wiens *et al.* 2007). Recently, Heinicke *et al.* (2007) reassigned *Eleutherodactylus* into the three genera *Craugastor*, *Eleutherodactylus*, and *Pristimantis* based on a genetic study comprising 280 eleutherodactyline frogs. According to this classification, all former Venezuelan *Eleutherodactylus* fall within the genus *Pristimantis*. Heinicke *et al.* (2007) sampled 87 of 393 described species in their South American clade. While this number greatly increases previously available DNA sequence data, it still represents a minority of taxa within this group (McCracken *et al.* 2007). Pending the review of additional taxa, we acknowledge the likely placement of the species described herein to the genus *Pristimantis* but maintain the use of *Eleutherodactylus* for this work.

Among all tepuis that have been investigated so far, fewer than

half are known to be inhabited by frogs of the genus *Eleutherodactylus* (Fuentes and Barrio-Amorós 2004); these include Yavi (Myers and Donnelly 1996), Tamacuari (Myers and Donnelly 1997), Yutajé (Myers and Donnelly 2001), Guanay, Corocoro, Aprada-Tepui, Auyán-Tepui, Terekyurén (Murisipán)-Tepui, Yuruaní-Tepui (Gorzula and Señaris 1999), Neblina (McDiarmid and Paolillo 1988), Ayanganna (Fuentes and Barrio-Amorós 2004) and the Roraima-Tepui (McCulloch *et al.* 2007). Available data about the distribution, ecology, and population status of most of the known *Eleutherodactylus* species are scarce. In many cases their taxonomic status has not conclusively been resolved because only limited material from the Guiana Shield area is available (Barrio-Amorós and Molina 2006).

Guaiquinima Tepui is situated along the eastern side of the Paragua River, Estado Bolívar (Fig. 1). It is one of the largest Venezuelan table mountains (approximately 1600 km² including talus slopes; platform 1000 km²) (Steyermark and Dunsterville 1980). The tepui has a maximum elevation of 1520 m a.s.l. and is located at 5° 47' 10" N 63° 50' 30" W. Annual rainfall is 4600 mm (EDELCA, 1991), greater than that on Auyan (2700 mm). The summit has a dense vegetation cover with a high percentage of tall forest, a fairly level topography and few rock outcrops (Steyermark

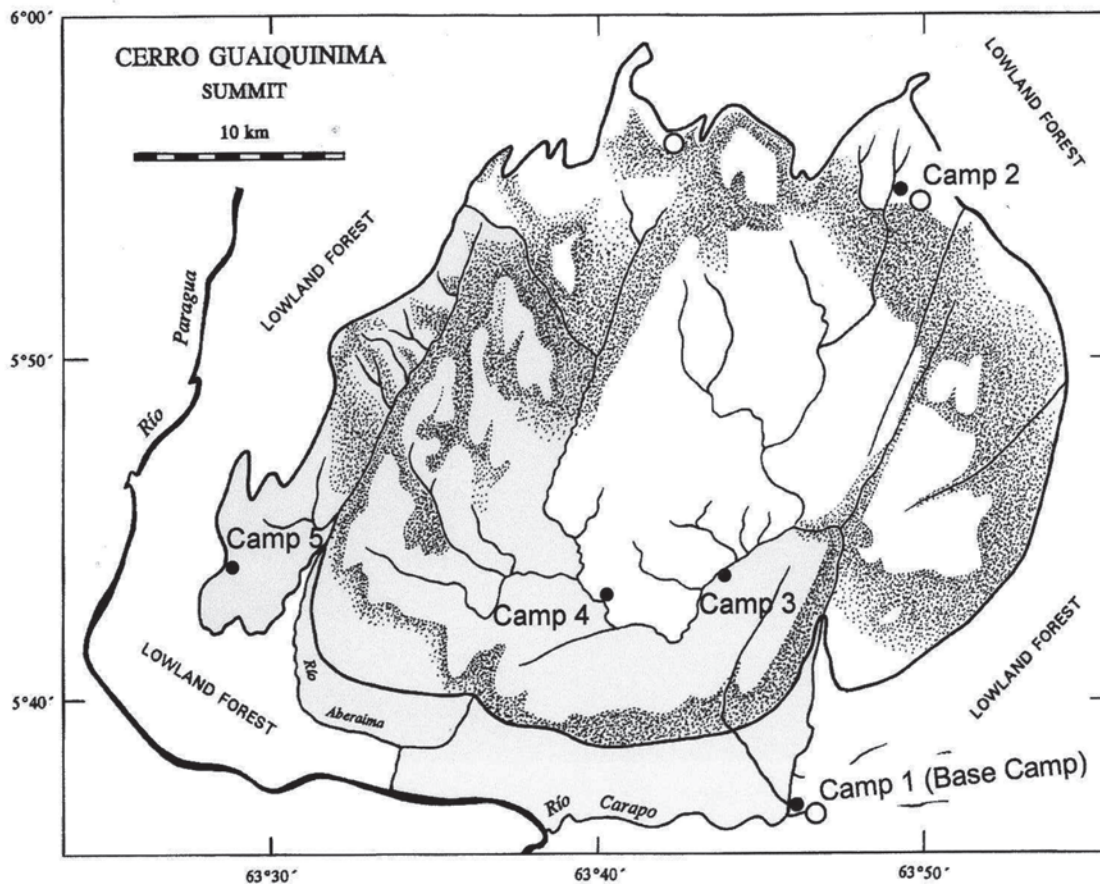


FIG. 1. Summit area of the Guaiquinima Tepui showing locations of FUDECI Summit Camps of the expedition. Frogs of the genus *Eleutherodactylus* have been found in FUDECI Camps 3, 4, 5 and in Camp 1 (lowland base camp). Open circles depict locations studied by Donnelly and Myers (1991). Map adapted from Steyermark and Dunsterville (1980) and Donnelly and Myers (1991).

Meseta del Cerro Guaiquinima indicando posiciones de campamentos de la expedición de FUDECI. Anuros del género Eleutherodactylus fueron encontrados en los campamentos No. 3, 4, 5 y en campamento 1 (campamento central). Círculos abiertos indican localidades investigadas por Donnelly y Myers (1991). Mapa adaptado de Steyermark y Dunsterville (1980) y Donnelly y Myers (1991).



FIG. 2. Views of FUDECI Camp 3 (A) (type locality of *Eleutherodactylus stegolepis* and *Eleutherodactylus tepuiensis*), FUDECI Camp 4 (B) (type locality of *Eleutherodactylus guaiquinimensis*). Photos: A. Schlüter.

Aspectos del campamento 3 (A) (localidad tipo de Eleutherodactylus stegolepis y Eleutherodactylus tepuiensis), y del campamento 4 (B) (localidad tipo de Eleutherodactylus guaiquinimensis). Fotografías: A. Schlüter.

and Dunsterville 1980). Detailed descriptions of the tepui and the surrounding area are given in Donnelly and Myers (1991) and Mägdefrau *et al.* (1991). During an expedition to Guaiquinima Tepui in January and February 1990, AS collected specimens at several locations (Fig. 2; Mägdefrau *et al.* 1991, Schlüter and Mägdefrau 1991). In the same year, Donnelly and Myers (1991) also led an expedition to Guaiquinima. However, neither group reported any frogs belonging to the genus *Eleutherodactylus*.

A total of 41 species of *Eleutherodactylus* are currently known from Venezuela (Señaris & MacCulloch 2005, Barrio-Amorós and Molina 2006, Frost 2007). Among the material collected on Guaiquinima Tepui during the 1990 expedition we identified three *Eleutherodactylus* species that cannot properly be assigned to any species of the genus. These new species are described herein.

MATERIAL AND METHODS

Specimens were collected at four different localities on the summit of Guaiquinima Tepui, Venezuela (Mägdefrau *et al.* 1991). Vouchers were euthanized using Chlorobutanol® (1,1,1,-Trichloro-2-methyl-2-propanol hemihydrate) and subsequently preserved in ethanol (70%).

Diagnosis and descriptions follow Lynch and Duellman (1997). All measurements were taken with callipers to the nearest 0.1 mm. Sex was determined by examination of gonads via a small ventral incision. Abbreviations for measurements are: SVL = snout-vent length; TiL = tibia length; FeL = femur length; TaL = tarsus length; FL = foot length; HeL = head length; HW = head width; Ind = internasal distance; UEW = upper eyelid width; IOD = interorbital distance; EN = eye-nostril distance (straight line distance between anterior corner of eye and nostrils); ED = horizontal eye diameter; TD = horizontal tympanum diameter; FD = disc width of finger III; 4TD = disc width of toe IV; ETS = eye-tip of snout distance (straight line distance between the anterior corner of eye and tip of snout); 1FiL = length of finger I; 2FiL = length of finger II. Museum acronyms follow Leviton *et al.* (1985). Type specimens are deposited in the herpetological collection of the Staatliches Museum für Naturkunde in Stuttgart, Germany (SMNS). Information on distribution patterns and the conservation status of Venezuelan *Eleutherodactylus* were obtained from IUCN *et al.* (2006). For comparison we examined alcohol-preserved specimens from the herpetological collections of the SMNS, the Zoologisches Forschungsmuseum Alexander Koenig, Bonn, Germany (ZFMK), and the Muséum National d'Histoire Naturelle, Paris, France (MNHN).

SPECIES DESCRIPTIONS

Eleutherodactylus guaiquinimensis sp. nov.
(Figs. 3, 4)

Holotype

SMNS 8004.1; a male from Guaiquinima Tepui, Estado Bolívar, Venezuela, 5° 44' N 63° 38' W, 980 m a.s.l., "Camp 4" in Mägdefrau *et al.* (1991); collected by A. Schlüter on 6 February 1990 at night near the great waterfall.

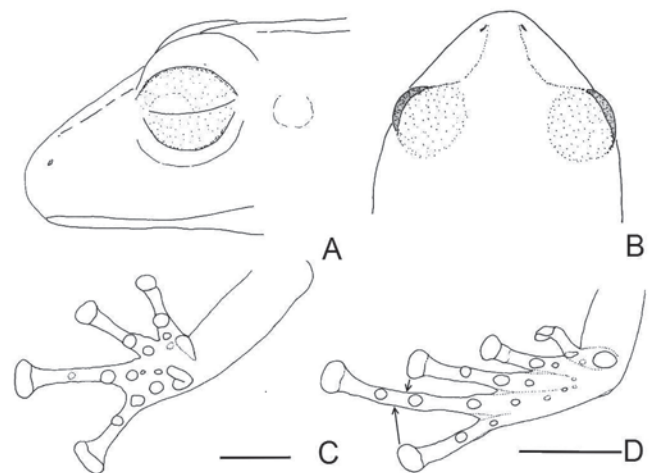


FIG. 3. Lateral (A) and dorsal (B) view of head and ventral view of hand (C) and foot (D) of *Eleutherodactylus guaiquinimensis* sp. nov., holotype. Scale 0.5 cm.

Aspecto lateral (A) y dorsal (B) de la cabeza y aspectos ventrales de mano (C) y pié (D) de Eleutherodactylus guaiquinimensis sp. nov., holotipo. Escala 0.5 cm.

Paratype

SMNS 8004.2; a male from the type locality; collected by A. Schlüter on 6 February 1990 at night near a small trail.

Etymology

The specific epithet derives from the type locality of the new species (Guaiquinima Tepui) and the Latin suffix *-ensis* (meaning native of or resident in).

Diagnosis

A small species of the *unistrigatus* species group *sensu* Lynch and Duellman (1997). (1) Dorsal skin finely granular with few small tubercles, ventral skin slightly areolate; (2) tympanum distinct, vertically oval; supratympanic fold visible, but not protuberant; (3) snout rounded to slightly subovoid in dorsal view, acuminate in profile; canthus rostralis concave, indistinct, edge rounded; (4) upper eyelid without tubercles; (5) choanae round, larger than nostrils; vomers medium-sized, posterior and medial to choanae, no vomerine dentigerous processes; tongue round, filling the whole mouth, with posterior half free; (6) males without vocal slits or nuptial pads; (7) finger I shorter than finger II; (8) fingers without lateral keels; (9) axillary tubercle absent; (10) ulnar tubercles absent; (11) calcars absent; (12) two metatarsal tubercles, inner tubercle oval, much larger than small, round outer tubercle; (13) toes without lateral keels; no webbing; toe IV with relatively broad oval to slightly triangular disc, slightly larger than discs on toes III and V; (14) in preservative, dorsal colour pattern tan with distinct brown reticulation, ventral colouration white;

two dark lip bars weakly visible, crossbands present on forearms, thighs and shanks; (15) two males 32.4 mm and 33.6 mm SVL.

Eleutherodactylus guaiquinimensis is easily distinguished from other Guiana Shield species by the following characters (those of *E. guaiquinimensis* in parenthesis): adults of *E. avius* have a brown or grey mottled throat in preservative (white), and a tubercular dorsal skin which may become smooth in preserved specimens (finely granular) (Myers and Donnelly 1997). *Eleutherodactylus aracamuni* has distinctly notched finger discs (not notched), finger I much shorter than finger II, not reaching to disc of finger II (reaching to disc of finger II), and no supernumerary tubercles (present) (Barrio-Amorós and Molina 2006). *Eleutherodactylus memorans* has a tubercular dorsal skin (finely granular) and a dark W-shaped dorsal mark, where present, it has a row of tubercles along its outer arms (absent) (Myers and Donnelly 1997). In *E. pruinatus* and *E. cavernibardus*, discs of toes III and V reach just beyond the penultimate subarticular tubercle of toe IV (disc of toe III reaches the penultimate subarticular tubercle of toe IV). In *E. marahuaka* the tympanum is indistinct (weakly distinct). *Eleutherodactylus cantitans* and *E. yaviensis* have basal webbing on toes (absent). In *E. cantitans* toes and fingers bear weak lateral fringes (absent), and axillary tubercles are present (absent) (Myers and Donnelly 2001). *Eleutherodactylus yaviensis* has no visible tympanum (weakly distinct) (Myers and Donnelly 2001). *Eleutherodactylus marmoratus* has a tubercular dorsum (finely granular), and basal toe webbing (absent) (Lescure and Marty 2000, Rivero 1961). *Eleutherodactylus pulvinatus* has a smooth dorsum with scattered small tubercles (finely granular with few small tubercles)

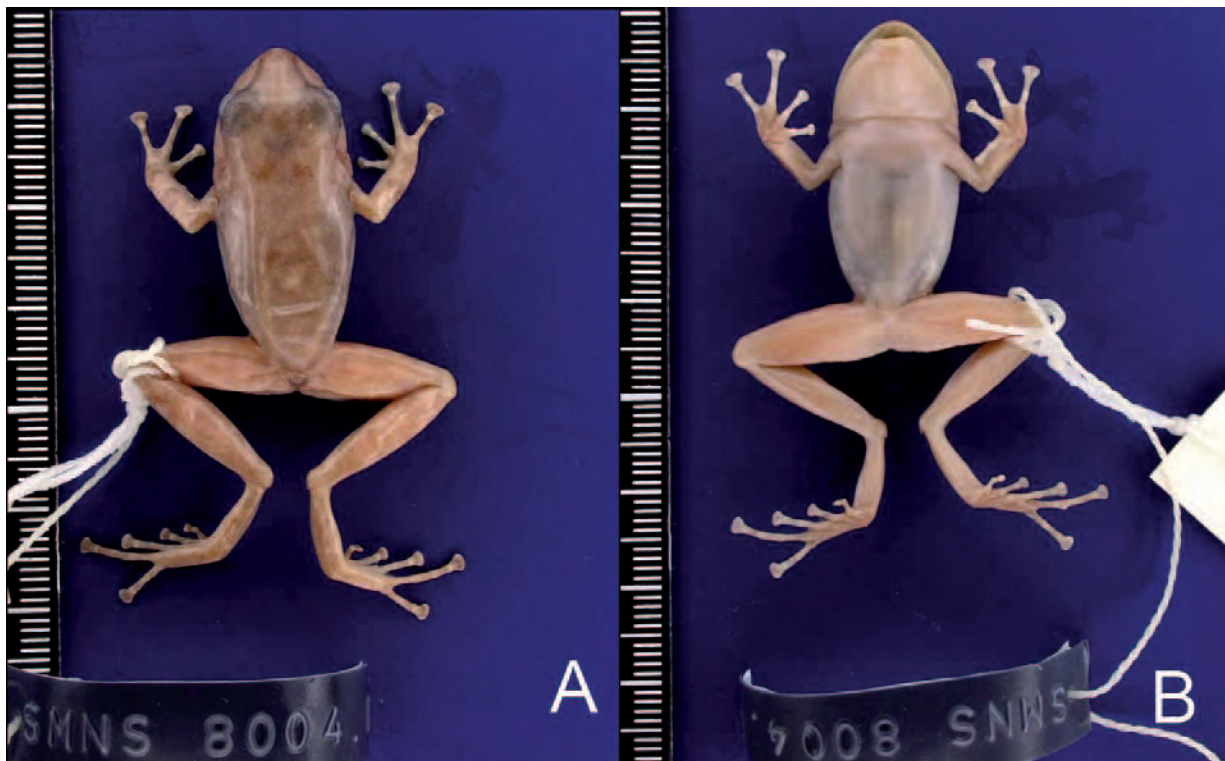


FIG. 4. Holotype (A: dorsal; B: ventral) of *Eleutherodactylus guaiquinimensis* (SMNS 8004.1). Photos: A. Schultheiß. Holotipo (A: dorsal; B: ventral) de *Eleutherodactylus guaiquinimensis* (SMNS 8004.1). Fotografía: A. Schultheiß.

and upper eyelids with many small tubercles (without tubercles) (Duellman 1997). *Eleutherodactylus vilarsi* has a shagreened dorsum with scattered enlarged warts (finely granular with few small tubercles), grey to brown venter (white), long thighs, SVL/TiL 1.8 (shorter tibia, SVL/TiL 2.1) (Barrio-Amorós and Molina 2006). In *E. zeuctotylus* and *E. stegolepis* finger II is shorter than I ($I < II$). *E. tepuiensis* has several tubercles in the tympanic region (absent).

Eleutherodactylus guaiquinimensis is unique among other Venezuelan tepui *Eleutherodactylus* in the following combination of characters: dorsal skin finely granular with few small tubercles, ventral skin slightly areolate; finger I shorter than finger II; fingers without lateral keels, calcars absent; toes without lateral keels; no webbing.

Description of Holotype

Snout outline rounded to slightly subovoid from above, acuminate in profile; head not distinct from body in dorsal view; canthus rostralis concave, rounded and indistinct; nostrils slightly protuberant, directed laterally to slightly dorsolaterally; choanae round, larger than nostrils; vomers medium sized, posterior and medial to choanae, no vomerine dentigerous processes; tongue round, filling the whole mouth with posterior half free; cranial crests absent; nostrils separated by a distance nearly equal to IOD; eyes large, their diameter slightly larger than EN; upper eyelids without tubercles; tympanum weakly visible, vertically oval, TD = 25% ED, separated from the eye by a distance of 2/3 of its own diameter; males with single vocal sac and without vocal slits; dorsum weakly granular with few small tubercles, without skin folds; belly and chest areolate; throat smooth; relative length of adpressed fingers $I < II < IV < III$, not webbed, discs elliptical to slightly triangular; palmar tubercle partly bifid and heart shaped; thenar tubercle oval, elongated toward finger I, about half the size of the palmar tubercle; subarticular tubercles round, protruding; few small, round supernumerary tubercles present; relative length of adpressed toes $I < II < III < V < IV$, not webbed, discs elliptical to slightly triangular; inner metatarsal tubercle protuberant, oval, much larger than outer; outer metatarsal tubercle very small and nearly round; subarticular tubercles single, round, slightly protuberant; all supernumerary tubercles smaller than subarticular tubercles; no ulnar tubercles present; calcars absent (Fig. 3).

Colour

Dorsal ground colour pattern mainly red to brown with darker reticulation. Thighs and shanks with golden reticulation. Venter white; two weak dark lip bars, shank and forearm bands visible; iris golden. In preservative, red and brown colour changes to brown, otherwise there is little change (Fig. 4).

Measurements

Given as holotype / paratype, in mm: SVL: 33.4 / 33.6; TiL: 16.4 / 15.4; FeL: 18.1 / 16.6; HeL: 11.9 / 12.2; HW: 12.6 / 12.9; Ind: 2.9 / 2.9; UEW: 5.0 / 5.0; IOD: 3.3 / 3.3; EN: 3.6 / 3.7; ED: 4.9 / 4.1; TD: 1.2 / 1.4; FD: 2.0 / 1.9; 4TD: 1.4 / 1.6; ETS: 5.5 / 5.3; 1FiL: 4.4 / 4.4; 2FiL: 5.1 / 5.2; TaL: 11.0 / 10.0; FL: 14.1 / 14.5.

Habitat

The holotype and paratypes of *E. guaiquinimensis* were collected at

night (6 Feb 1990) at "FUDECI Camp 4" (Fig. 2), 5°44'N 63°38'W, 980 m a.s.l. The entire area was covered with *Stegolepis* sp. (Rapateaceae) and some *Clusia* sp. (Clusiaceae) shrubs growing on wet rock surfaces.

Eleutherodactylus stegolepis sp. nov.
(Figs. 5, 6, 7)

Holotype

SMNS 8006.1; a male from Guaiquinima Tepui, Estado Bolivar, Venezuela, 5°54' N, 63°28' W, 780 m elev., "FUDECI Camp 3" in Mägdefrau *et al.* (1991); collected at night by A. Schlüter on 12 February 1990.

Paratype

SMNS 8006.2; a juvenile with same data as the holotype.

Etymology

The new species is named after *Stegolepis squarrosa* (Rapateaceae), dominant floral species on the summit of Guaiquinima Tepui. Plants of this genus are confined to the tepuis of northeastern South America. The name is used as a noun in apposition.

Diagnosis

A medium-sized frog of the *conspicillatus* species group *sensu* Lynch and Duellman (1997). (1) Dorsal skin smooth to finely granular, ventral skin smooth; (2) tympanum distinct, supratympanic fold weakly protuberant; (3) snout rounded in dorsal view, acuminate in profile; canthus rostralis concave, edge rounded; (4) upper eyelid without tubercles; (5) choanae round, larger than nostrils; vomerine dentigerous processes small, bearing 2-3 teeth, posterior and medial to choanae; tongue round to slightly cordiform, filling the entire mouth; (6) males without vocal slits and no visible nuptial pads; (7) finger I longer than finger II; (8) fingers with very weak lateral keels; (9) axillary tubercle absent; (10) three round, small ulnar tubercles; (11) calcars absent; (12) two metatarsal tubercles, inner tubercle oval,

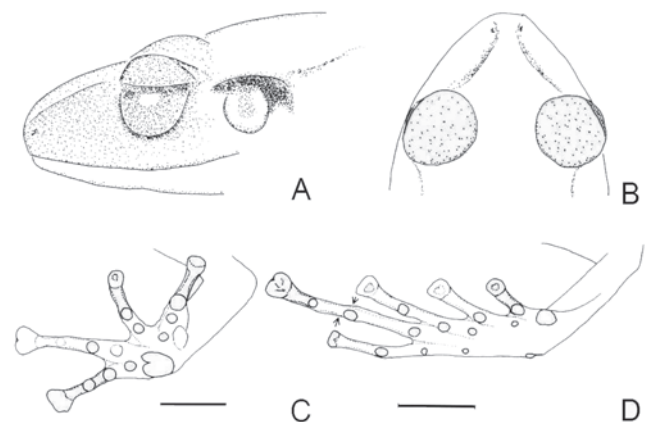


FIG. 5. Lateral (A) and dorsal (B) view of head and ventral view of hand (C) and foot (D) of *Eleutherodactylus stegolepis* sp. nov., holotype. Scale 0.5 cm. Aspecto lateral (A) y dorsal (B) de la cabeza, y aspecto ventral de mano (C) y pie (D) de *Eleutherodactylus stegolepis* sp. nov., holotipo. Escala 0.5 cm.



FIG. 6. *Eleutherodactylus stegolepis*, holotype. Photo: A. Schlüter.
Eleutherodactylus stegolepis, holotipo. Fotografía: A. Schlüter.

about 2-3 times size of oval outer tubercle; (13) toes with weak lateral keels; no webbing; toe IV with relatively broad disc, 1/3 larger than those on the other toes; (14) in preservative, dorsal colouration mainly uniform tan to brownish, ventral colouration white; lip bars absent, thigh bands only visible in the paratype; iris silver to grey with fine black reticulations; (15) SVL in one male 46.2 mm, in one juvenile 20.7 mm.

Eleutherodactylus stegolepis is easily distinguished from other Guiana Shield species by the following characters (those of *E. stegolepis* in parenthesis): adults of *E. avius* have a brown or grey mottled throat in preservative (creamish), and a tubercular dorsal

skin which may become smooth in preserved specimens (smooth to finely granular) (Myers and Donnelly 1997). *Eleutherodactylus aracamuni* has finger I much shorter than finger II (finger I longer than finger II), distinctly notched finger discs (not notched) and no vomerine teeth (present) (Barrio-Amorós and Molina 2006). *Eleutherodactylus memorans* has a tubercular dorsal skin (finely granular) and a dark W-shaped dorsal mark, where present, a row of tubercles along its outer arms are present (absent) (Myers and Donnelly 1997). In *E. pruinatus* and *E. cavernibardus*, discs of toes III and V reach just beyond the penultimate subarticular tubercle of toe IV (disc of toe III reaches the penultimate subarticular tubercle and disc of toe V slightly beyond it). In *E. anotis* and *E. marahuaka* the tympanum is indistinct (distinct). *E. cantitans* and *E. yaviensis* have basal webbing on toes (absent). *Eleutherodactylus cantitans* has the first finger slightly shorter than the second (longer), and axillary tubercles (absent) (Myers and Donnelly 2001). *Eleutherodactylus yaviensis* has no tympanum (distinct tympanum) (Myers & Donnelly 2001). *Eleutherodactylus marmoratus* has a tubercular dorsum (smooth), and basal toe webbing (absent) (Lescure and Marty 2000, Rivero 1961). *Eleutherodactylus pulvinatus* has a smooth dorsum with scattered small tubercles (smooth without tubercles), fingers and toes lacking lateral fringes (weakly present), and upper eyelids with many small tubercles (without tubercles) (Duellman 1997). *Eleutherodactylus vilarsii* has a shagreened dorsum with scattered enlarged warts (smooth without warts), grey to brown venter (white), and long thighs, SVL/TiL 1.8 (shorter tibia, SVL/TiL 2.0) (Barrio-Amorós and Molina 2006). *Eleutherodactylus zeuctotylus* has a rounded palmar tubercle (partly bifid) (Lynch and Hoogmoed



FIG. 7. Holotype (A: dorsal; B: ventral) of *Eleutherodactylus stegolepis* (SMNS 8006.1). Photos: A. Schultheiß.
 Holotipo (A: dorsal; B: ventral) de *Eleutherodactylus stegolepis* (SMNS 8006.1). Fotografías: A. Schultheiß.

1977). *Eleutherodactylus guaiquinimensis* sp. nov. has the first finger shorter than the second (longer). *Eleutherodactylus tepuiensis* sp. nov. has several scattered tubercles in the tympanic region (absent).

Eleutherodactylus stegolepis is unique among tepui *Eleutherodactylus* by the following combination of characters: dorsal skin smooth to finely granular, ventral skin smooth; finger I longer than finger II, fingers with very weak lateral keels, no webbing; three round, small ulnar tubercles; calcars absent; toes with weak lateral keels; no webbing.

Description of Holotype

Snout outline rounded from above, acuminate in profile; head weakly distinct from body in dorsal view; canthus rostralis concave, rounded but distinct, well developed; nostrils slightly protuberant, directed dorsolaterally; choanae round, larger than nostrils; vomerine dentigerous processes small, bearing 2-3 teeth, posterior and medial to choanae; tongue slightly cordiform, filling the entire mouth, posterior 2/3 free; cranial crests absent; nostrils separated by a distance of 3/4 IOD; eyes large, their diameter slightly smaller than EN; upper eyelids without tubercles; tympanum distinct, about 1/2 the diameter of the eye, separated from the eye by 2/3 of tympanum diameter; male with single vocal sac and without vocal slits; dorsum smooth to weakly granular, without skin folds; belly, chest and throat smooth; relative length of adpressed fingers II < I < IV < III, not webbed, discs triangular; palmar tubercle large, partly bifid; thenar tubercle half the size of palmar tubercle, elliptical; subarticular tubercles large, slightly protruding; last subarticular tubercle on finger I larger than the others and two supernumerary tubercles, one at the base of finger I and one at the base of finger IV; relative length of adpressed toes I < II < III < V < IV, not webbed, discs round to slightly triangular; inner metatarsal tubercle protuberant, oval, larger than outer; outer metatarsal tubercle nearly round; subarticular tubercles nearly the same size as outer metatarsal tubercle and slightly protuberant; a small, round supernumerary tubercle at the base of toes II, III and V, respectively; three small ulnar tubercles present in the holotype, absent in the paratype; calcars absent (Fig. 5).

Colour

Dorsal ground colour mainly uniform tan to brown, ventral colouration white; lip bars absent, thigh crossbands visible only in paratype; iris silver to grey with fine black reticulations (Fig. 6). In preservative, red colour changes to brown, otherwise there is little change (Fig. 7).

Measurements

Given as holotype / paratype in mm. SVL: 46.2 / 20.7; TiL: 23.3 / 9.5; FeL: 24.6 / 10.9; HeL: 17.2 / 8.3; HW: 17.2 / 7.3; Ind: 3.4 / 2.1; UEW: 6.0 / 3.4; IOD: 4.4 / 2.2; EN: 6.2 / 3.3; ED: 5.5 / 2.9; TD: 2.8 / 1.3; FD: 2.2 / 0.8; 4TD: 1.8 / 0.6; ETS: 8.1 / 3.6; 1FiL: 7.9 / 3.0; 2FiL: 7.0 / 2.9; TaL: 12.4 / 5.8; FL: 21.9 / 8.5.

Habitat

Holotype and paratype of *E. stegolepis* were collected at night at "FUDECI Camp 3" (Fig. 2), 5°54'N 63°28'W, 780 m elev., sitting on rock between *Stegolepis squarrosa* (Rapateaceae), the dominant floral species on the summit of the Guaiquinima Tepui.

Eleutherodactylus tepuiensis sp. nov. (Figs. 8, 9, 10)

Holotype

SMNS 8005.1; a male from Guaiquinima Tepui, Estado Bolivar, Venezuela, 5°54' N, 63°28' W, 780 m elev., "FUDECI Camp 3" in Mägdefrau *et al.* (1991); collected by A. Schlüter on 12 February 1990.

Etymology

The specific epithet derives from the word "tepui", a Pemón word for "mountain" and the Latin suffix *-ensis* (meaning "belonging to").

Diagnosis

A small species apparently belonging to the *unistrigatus* species group *sensu* Lynch and Duellman (1997). (1) Dorsal skin smooth to finely granular with few larger tubercles posterior to the eye and above the tympanum, ventral skin areolate; (2) tympanum small but distinct, supratympanic fold visible as a small stripe, very weakly protruberant; (3) snout rounded in dorsal view, acuminate in profile; canthus rostralis slightly concave, edge rounded and indistinct; (4) upper eyelid with few small tubercles; (5) choanae round, larger than nostrils; very small and indistinct vomers posterior and medial to choanae, no vomerine dentigerous processes; tongue round to slightly cordiform, filling the whole mouth; (6) male without vocal slits and nuptial pads; (7) finger I shorter than finger II; (8) fingers without lateral keels; (9) axillary tubercle absent; (10) three round, small and indistinct ulnar tubercles present; (11) calcars absent; (12) inner metatarsal tubercle oval, outer metatarsal tubercle very small, but distinct; (13) toes with weak lateral keels; no webbing; toe IV with relatively broad partly bifid disc, slightly larger than disc on toe V; discs on toes I, II and III about 2/3 the size of disc of toe IV; (14) in preservative, dorsal ground colour uniform tan, brownish dorsolaterally, triangular dark marks on the

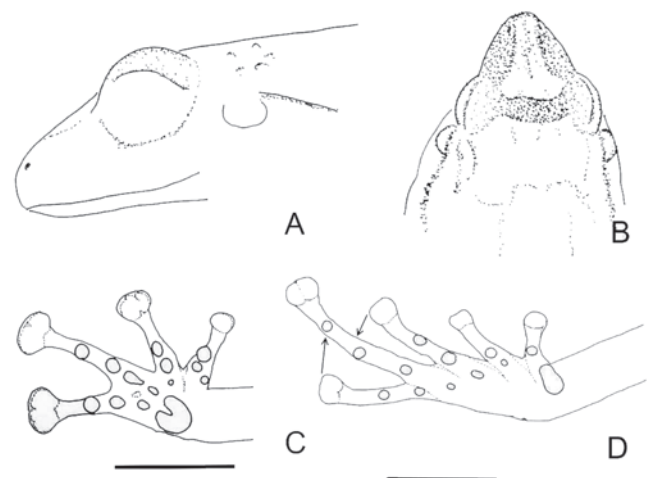


FIG. 8. Lateral (A) and dorsal (B) view of head and ventral view of hand (C) and foot (D) of *Eleutherodactylus tepuiensis* sp. nov., holotype. Scale 0.5 cm. Aspecto lateral (A) y dorsal (B) de la cabeza, y aspecto ventral de mano (C) y pie (D) de *Eleutherodactylus tepuiensis* sp. nov., holotipo. Escala 0.5 cm.



FIG. 9. Holotype of *Eleutherodactylus tepuiensis* (SMNS 8005.1), immediately after preservation. Photo: A. Schlüter.

Holotipo de Eleutherodactylus tepuiensis (SMNS 8005.1), inmediatamente después de preservación. Fotografía: A. Schlüter.

dorsal face of the arms; ventral colouration white, throat slightly pink; two distinct lip bars below each eye, a dark interorbital bar and a dark canthal bar, a dark band from the posterior edge of the tympanum reaching to the arm insertion; three distinct crossbands on the forearm and the shanks; anterior thigh surfaces distinctly crossbanded, posterior of thigh uniform tan; iris dark, not distinct; (15) SVL 34.7 mm.

Eleutherodactylus tepuiensis is easily distinguished from other Guiana Shield species by the following characters (those of *E. tepuiensis* in parenthesis). Adults of *E. avius* have a brown or grey mottled throat in preservative (white to pinkish), and a tubercular dorsal skin which may become smooth in preserved specimens (smooth to finely granular) (Myers and Donnelly 1997). *E. aracamuni* has distinctly notched finger discs (not notched), no supernumerary tubercles (present), discs of toe V and toe III reaching to the penultimate tubercle of toe IV (toe V reaching to the distal tubercle of toe IV) and an indistinct, round outer metatarsal tubercle (distinct) (Barrio-Amorós and Molina 2006). *Eleutherodactylus memorans* has a tubercular dorsal skin (smooth to finely granular), a dark W-shaped dorsal mark, where present, a row of tubercles along its outer arms are present (absent), and lacks scattered larger tubercles dorsally and ventrally to the supratympanic fold (present) (Myers and Donnelly 1997). In *E. pruinatus* and *E. cavernibardus*, when toes III and V are addressed against toe IV, discs reach just beyond the penultimate subarticular tubercle (disc of toe V reaches the distal tubercle, disc of toe III reaches the penultimate tubercle). In *E. marahuaka* the tympanum is indistinct (distinct). *E. cantitans* and *E. yaviensis* have basal webbing on toes (absent). Hands and feet of *E. cantitans* bear weak lateral fringes (absent), and it has axillary tubercles (absent) (Myers and Donnelly 2001). *Eleutherodactylus yaviensis* has no tympanum (distinct tympanum) (Myers & Donnelly 2001). *Eleutherodactylus marmoratus* has a tubercular dorsum (smooth with few tubercles dorsolateral), and basal toe webbing (absent) (Lescure and Marty 2000, Rivero

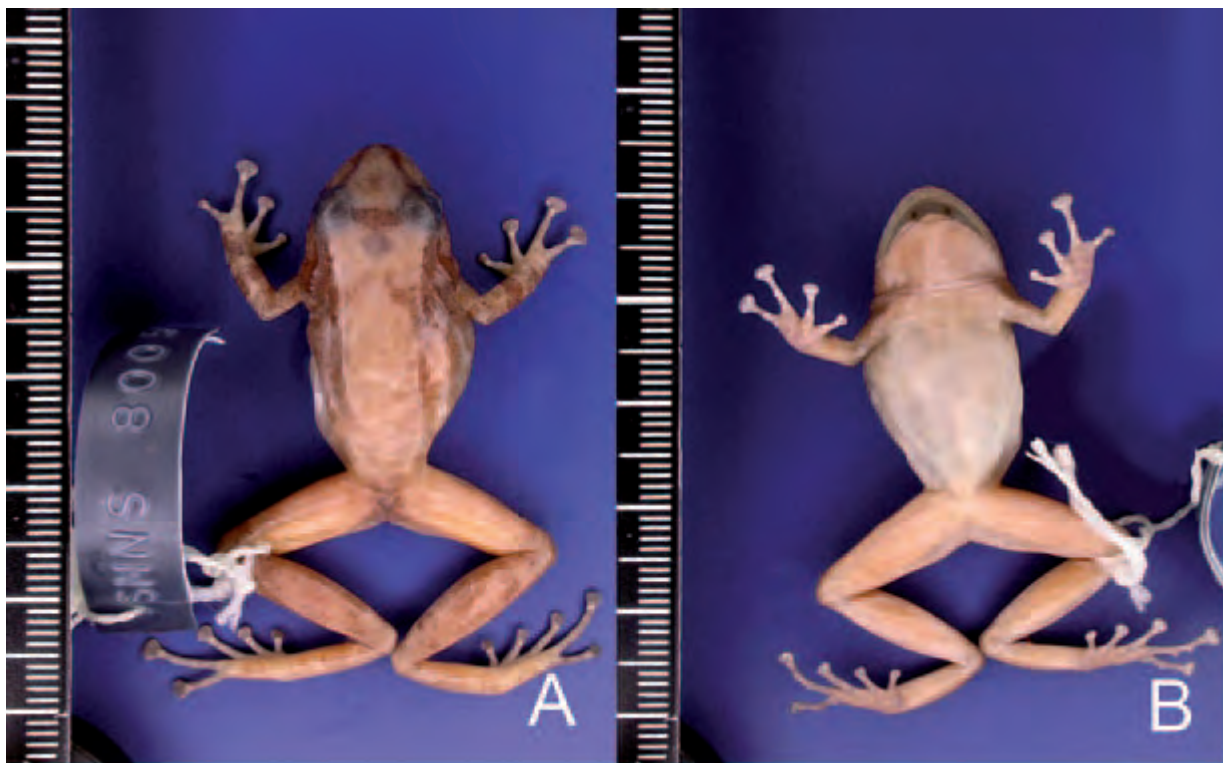


FIG. 10. Holotype (A: dorsal; B: ventral) of *Eleutherodactylus tepuiensis* (SMNS 8005.1). Photos: A. Schultheiß.

Holotipo (A: dorsal; B: ventral) de Eleutherodactylus tepuiensis (SMNS 8005.1). Fotografías: A. Schultheiß.

1961). *Eleutherodactylus pulvinatus* has ulnar tubercles (absent), and males of *E. pulvinatus* have vocal slits (absent) (Duellman 1997). *Eleutherodactylus vilarsi* has a shagreened dorsum with scattered enlarged warts (smooth with a few tubercles dorsolaterally), grey to brown venter (white with a pink throat), long thighs, SVL/TiL 1.8 (shorter tibia, SVL/TiL 2.1) (Barrio-Amorós and Molina 2006). In *E. zeuctotylus* the first finger is longer than the second (shorter), and the palmar tubercle is round (partly bifid) (Lynch and Hoogmoed 1977). *Eleutherodactylus stegolepis* sp. nov. has the first finger longer than the second (shorter), and *E. quaiquinimensis* sp. nov. lacks scattered tubercles in the tympanic region (present).

Eleutherodactylus tepuiensis is unique among other Venezuelan tepui *Eleutherodactylus* in the following combination of characters: dorsal skin smooth to finely granular with few larger tubercles posterior to the eye and above the tympanum, ventral skin areolate; tympanum small, distinct; finger I < finger II, fingers without lateral keels, no webbing; three round, small and indistinct ulnar tubercles present; calcars absent; a single oval inner metatarsal tubercle, outer metatarsal tubercle very small; toes without lateral keels, no webbing.

Description

Snout outline rounded from above, acuminate in profile; head weakly distinct from body in dorsal view; canthus rostralis concave, rounded and indistinct; nostrils not protuberant, directed dorsolaterally; choanae round, larger than nostrils; very small and indistinct vomers posterior and medial to choanae, no vomerine dentigerous processes; tongue slightly cordiform, filling the whole mouth; cranial crests absent; nostrils separated by a distance of 3/4 IOD; eyes large-sized, their diameter slightly smaller than EN; upper eyelids with few, very small tubercles; tympanum distinct, about 1/4 the diameter of the eye, separated from the eye by a distance of 1/3 of TD; supratympanic fold weakly developed, extending posterior to arm insertion; a few scattered tubercles above and below the supratympanic fold; male with single vocal sac and without vocal slits; dorsal skin smooth to finely granular with a few larger tubercles dorsolaterally posterior of the eye and above the tympanum, ventral skin areolate; relative length of adpressed fingers I < II < IV < III, not webbed, discs elliptical and bifid; discs of fingers III and IV slightly larger than the tympanum diameter, discs of fingers I and II smaller; palmar tubercle relatively large, well defined, anteriorly bifid, proximal part somewhat indistinct; thenar tubercle elliptical; subarticular tubercles as broad as finger, not protruding; few small supernumerary tubercles, two at the base of finger III, one at the base of finger IV; relative length of adpressed toes I < II < III < V < IV, not webbed, discs elliptical; disc of toe IV same size as disc of finger IV; inner metatarsal tubercle protuberant, oval, larger than outer tubercle; outer metatarsal tubercle very small, ovoid; subarticular tubercles round, smaller than toe width and slightly protruding; supernumerary tubercles absent; calcars absent (Fig. 8).

Colour in life

Dorsal ground colour creamy brown with a dark interorbital bar and brown spots on the flanks. Arms and legs with creamy white to golden reticulation. Ventral colouration creamish on belly and reddish on arms, legs and throat. Iris golden (Fig. 9).

Colour in preservative

Dorsal ground colour uniform tan, dorsolaterally brown, triangular darker marks on the dorsal face of the arms; ventral colouration white, throat slightly pink; two distinct lip bars below each eye, a dark interorbital bar and a dark canthal bar; a darker band from the posterior edge of the tympanum to arm insertion; three distinct crossbones on the forearms and the shanks; anterior thigh surfaces distinctly crossbanded, posterior surface uniform tan; iris dark, not very distinct (Fig. 10).

Measurements

(given in mm) SVL: 34.7; TiL: 16.5; FeL: 18.7; HeL: 12.0; HW: 13.0; Ind: 2.9; UEW: 4.4; IOD: 3.8; EN: 4.0; ED: 3.9; TD: 1.3; FD: 2.1; 4TD: 1.5; ETS: 5.6; 1FiL: 4.5; 2FiL: 5.2; TaL: 10.1; FL: 14.9.

Habitat

The single specimen of *E. tepuiensis* was collected at night at "FUDECI Camp 3" (Fig. 2), 5°54'N 63°28'W, 780 m a.s.l., under a rock at the edge of a tributary of the Río Carapo.

Remarks

The Venezuelan species of the *unistrigatus* group with a dark W-shaped mark on the dorsum are *E. anotis*, *E. memorans*, *E. rozei* and *E. vanadisae*. Of these species *E. tepuiensis* is most similar to *E. memorans*, the only one of the four that occurs in the Guiana region. It can be distinguished from *E. memorans* by its dorsal skin texture, the absence of tubercles marking the shape of the W-shaped dorsal dark marking and the presence of scattered tubercles above and below the supratympanic fold.

DISCUSSION

In Venezuela, the greatest diversity of *Eleutherodactylus* (47.5 %) occur in the Andes region, followed by the Guiana Shield (30.0 %) and the Cordillera Central near the coast (22.5 %) (*E. johnstonei* was excluded because it is introduced) (Table 1, IUCN *et al.* 2006). Their distribution and biology are poorly known, 20 of the 40 species being listed as "Data Deficient" by IUCN. Among the Guiana Shield species, only *E. marmoratus*, *E. pulvinatus*, *E. vilarsi* and *E. zeuctotylus* are common and have broad distributions. The remaining Venezuelan Guiana Shield species are only known from tepuis and their ranges are estimated at only 10 to 317 km² by IUCN. The only exception appears to be *E. cantitans*, which has a larger range (2470 km²).

Tepuis within the Guiana Shield are difficult to reach and expeditions are expensive (Barrio-Amorós and Molina 2006). Species inventories are rare and little information is available about the species taxonomy and biology, which makes taxonomic and biogeographic comparisons difficult.

Mägdefrau *et al.* (1991) mentioned that some species from the Guaiquinima tepui remained unidentified. In addition to the three spp described above, there are two additional undescribed *Eleutherodactylus* species, one adult and one subadult *E. vilarsi*, one juvenile *Eleutherodactylus* that could not be identified and two *Allophryne ruthveni*. These specimens are housed in the SMNS collection. Barrio-Amorós and Molina (2006) recently redescribed *E. vilarsi* and noted an elevational range of 100 -1230 m. *Allophryne*

TABLE 1. Geographic realm, IUCN status and range (in km²) of the 40 known Venezuelan *Eleutherodactylus*. / = not listed by IUCN *et al.* (2006); * introduced to Venezuela from the Lesser Antilles.

TABLA 1. Ocurrencia geográfica, categoría de conservación en UICN y distribución (en km²) de 40 especies venezolanas de *Eleutherodactylus*. / = no listado por IUCN *et al.* (2006); * introducido de las Antillas a Venezuela.

Venezuelan Andes			Cordillera Central			Venezuelan Guiana Shield		
SPECIES	IUCN	RANGE	SPECIES	IUCN	RANGE	SPECIES	IUCN	RANGE
<i>E. anolirex</i>	NT	2811	<i>E. anotis</i>	DD	75	<i>E. aracamuni</i>	/	/
<i>E. boconoensis</i>	CR	21	<i>E. bicumulus</i>	VU	2466	<i>E. avius</i>	DD	31
<i>E. briceni</i>	VU	756	<i>E. incertus</i>	DD	110	<i>E. cantitans</i>	DD	2470
<i>E. colostichos</i>	VU	372	<i>E. johnstonei*</i>	LC	26473	<i>E. cavernibardus</i>	DD	71
<i>E. ginesi</i>	EN	367	<i>E. reticulatus</i>	DD	325	<i>E. marahuaka</i>	VU	10
<i>E. kareliae</i>	NT	397	<i>E. riveroi</i>	DD	313	<i>E. marmoratus</i>	LC	893504
<i>E. lancinii</i>	EN	442	<i>E. rozei</i>	DD	407	<i>E. memorans</i>	DD	51
<i>E. lentiginosus</i>	DD	477	<i>E. stenodiscus</i>	DD	33	<i>E. pulvinatus</i>	LC	222426
<i>E. melanoproctus</i>	DD	2137	<i>E. terraebolivaris</i>	LC	4029	<i>E. pruinatus</i>	DD	292
<i>E. mondolfii</i>	DD	1742	<i>E. turumiquirensis</i>	EN	1003	<i>E. vilarsi</i>	LC	1679257
<i>E. nicefori</i>	LC	2543				<i>E. yaviensis</i>	DD	317
<i>E. paramerus</i>	EN	75				<i>E. zeuctotylus</i>	LC	733122
<i>E. pedimontanus</i>	DD	3070						
<i>E. pleurostriatus</i>	DD	383						
<i>E. prolixodiscus</i>	LC	22429						
<i>E. telefericus</i>	DD	19						
<i>E. tubernasus</i>	DD	6062						
<i>E. vanadisae</i>	NT	1051						
<i>E. yustizi</i>	DD	6931						

ruthveni is a lowland species reaching a maximum elevation of 300 m a.s.l. (IUCN *et al.* 2006). Our material increases the maximum elevations of *E. vilarsi* and *A. ruthveni* to 1520 m and 980 m a.s.l., respectively.

Compared with the adjacent lowlands, summits of tepuis support fewer amphibian and reptile species. As noted by Donnelly and Myers (1991, p. 50) "it seems that amphibian and reptilian species endemic to only one or a few tepuis may be at least as commonplace as highland species that are more widely distributed" and "there probably are also lowland elements at all but the highest tepui elevations. Inasmuch as the lowland distributions of Guyanan amphibians and reptiles are not well known, it usually is impossible to know if a lowland occurrence on a tepui is strictly relictual or if the species still occurs in the surrounding lowlands." Although Guaiquinima Tepui reaches a maximum elevation of 1680 m a.s.l., the new species described herein were collected between 780 m and 980 m a.s.l. According to Mägdefrau *et al.* (1991) and Donnelly and Myers (1991) the anuran and reptilian faunas appear to be mainly composed of widespread lowland species; this may be due to the high percentage of lowland floral elements on the summit of Guaiquinima Tepui (Steyermark and Dunsterville 1980). However, the herpetofauna of the Guiana table mountains remain poorly known (McDiarmid and Donnelly 2005, MacCulloch *et al.* 2007). Since the specimens described in this study were collected, no further amphibian collections have been made at Guaiquinima Tepui, so further expeditions are expected to offer more insights in the herpetofauna of this special area.

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Appendix

Material examined

- Eleutherodactylus conspicillatus*.**- Brazil: Colonia, MNHN 1986.1755; Peru: "Colonia" 1979.1-16; 1979.23; 1979.28; 1979.7892-7895; Yuvinetó, MNHN 1979.17-21.
- Eleutherodactylus chiastonotus*.**- French Guiana: MNHN 1978.152 (Paratype); Crique Gabrielle (Roura) MNHN 1978.153 (Paratype); Crique Grégoire, Fleuve Sinnamary MNHN 1978.154-155 (Paratypes); Eaux Clément, Montagne Patawa (Roura) MNHN 1978.156 (Paratype); Mont Attachi-Bacca (Haut Maroni) MNHN 1978.157-158 (Paratypes); Base du Mont Galbao (Saül) MNHN 1978.159-164 (Paratypes); Trois Sauts (Haut Oyapock) MNHN 1978.165-167 (Paratypes); Village Zidok (Haut Oyapock) MNHN 1979.7847-7848; 1979.7850-7853; Camp Poivre (Montagne St. Marcel) MNHN 1979.7849; Saut Mais (Saül) MNHN 1979.7856-7857; 1979.7861; 2 km S Pic Matecho (Saül) MNHN 1979.7859; 5 km N Saut Mais (Saül) MNHN 1979.7860; Piste de Ste Elie MNHN 1979.7866; 1979.7868-7870; Haut Oyapock MNHN 1979.7871; 3,5 km S Pic Matecho MNHN 1980.1455-1456; Cacao MNHN 1985.49; Massif des Emerillons MNHN 1985.50-51; Piste Carber Mais, km 10 MNHN 1995.1798.
- Eleutherodactylus marmoratus*.**- French Guiana, Arataye MNHN 1980.1459; Montagnes de la Trinité MNHN 1985.34; Sommet Tabulaire MNHN 1985.62; Mont Galbao MNHN 1988.6654-6655.
- Eleutherodactylus achatinus*.**- Ecuador, Santo Domingo de los Colorados ZFMK 36634, 42752-53, 42755.
- Eleutherodactylus crassidigitus*.**- Panama, Rio Blanco del Norte (Prov. Coclé) ZFMK 46666-67, 46675, 46677-678.
- Eleutherodactylus longirostris*.**- Ecuador, Rio Sapayo ZFMK –H. 28497.
- Eleutherodactylus raniformis*.**- Ecuador, Rio Palenque ZFMK 60723.
- Eleutherodactylus terraebolivaris*.**- Venezuela, Cerro Avila near Caracas SMNS 8022-1 to 8022-7.
- Eleutherodactylus unistrigatus*.**- Ecuador, Paramós near Quito ZFMK 47377; Ecuador 60 km south of S Quite, 4000 m, Paramó ZFMK 45764
- Eleutherodactylus vilarsi*.**- Venezuela, Guaiquinima-Tepui SMNS 8007-1, 8007-2.