



A new dendrobatid frog (Anura: Dendrobatidae: *Anomaloglossus*) from the Orinoquian rainforest, southern Venezuela

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Abstract

A new species of *Anomaloglossus* is described from the Venezuelan Guayana; it is the 21st described species of *Anomaloglossus* from the Guiana Shield, and the 15th from Venezuela. This species inhabits rainforest on granitic substrate on the northwestern edge of the Guiana Shield (Estado Amazonas, Venezuela). The new species is distinguished from congeners by sexual dimorphism, its unique male color pattern (including two bright orange parotoid marks and two orange paraocloacal spots on dark brown background), call characteristics and other morphological features. Though to the new species is known only from the northwestern edge of the Guiana Shield, its distribution may be more extensive, as there are no significant biogeographic barriers isolating the type locality from the granitic lowlands of Venezuela.

Key words: Amphibia, Dendrobatidae, *Anomaloglossus*, Venezuela, Guiana Shield

Resumen

Se describe una nueva especie de *Anomaloglossus* de la Guayana venezolana, que es la vigesimoprimera descrita del Escudo Guayanés, y la decimoquinta para Venezuela. Habita selva pluvial baja sobre substrato granítico y se conoce de dos localidades en el extremo noroeste del Escudo Guayanés (Estado Amazonas, Venezuela). La nueva especie se distingue de sus congéneres por la coloración única de los machos (incluyendo dos manchas parotoideas y dos manchas para-cloacales de color naranja vivo sobre fondo marrón oscuro), coloración sexualmente dicromática en vida, características del canto y algunos rasgos morfológicos. Aunque es aparentemente endémico del extremo noroeste del Escudo de Guayana, podría estar mucho más expandido ya que no existe ninguna aparente barrera biogeográfica para extenderse a través de zonas bajas graníticas de Venezuela.

Introduction

The genus *Anomaloglossus* (Grant *et al.* 2006) is allocated in the family Dendrobatidae, in the subfamily Aromobatinae (Santos *et al.* 2009), which also includes the genera *Aromobates*, *Mannophryne*, *Rheobates*, and *Allobates*. *Anomaloglossus* are distinguished from all other dendrobatids by the presence of a median lingual process (MLP). The MLP (*sensu* Grant *et al.* 1997) of *Anomaloglossus* has a similar morphology to a structure in Old World ranoids and is probably convergent. Biogeographically, *Anomaloglossus* is mostly distributed in the Guiana Shield with few trans-Andean representatives.

The Guiana Shield is an enormous portion of northeastern South America (~1.520.000 km²), comprising the area to the south and east of the Orinoco River watershed and to the east and north of the Río Negro and lower Amazon River Basins (Hoogmoed 1979; Hallowell & Reynolds 2005). This region harbors a large number of known living taxa (15000 species of vascular plants, 1004 birds, 282 mammals, 269 amphibians,

and 295 reptiles) and it has a relative high level of endemism within each group (40% of the vascular plants, 54% of amphibians, 30% of reptiles) (Hallowell & Reynolds 2005).

Venezuelan Guayana represents the northwestern section of the Guiana Shield, with an area of 453,950 km² (~30% of the Shield). Biogeographically, this area is well known by its high table mountains (tepui), which make this landscape unique in the Neotropic realm. Venezuelan Guayana also has large areas of mid and low elevation (*sensu* Gorzula & Señaris 1998), connecting its biota with the surrounding Orinoquian and Amazonian lowland savannas and rainforests. The lowlands are indeed the most biodiverse, but few works on this diversity have been published (Hoogmoed & Gorzula 1979; Lescure & Marty 2000, Donnelly *et al.* 2005, Kok & Kalamandeen 2008). Puerto Ayacucho (capital of the Estado Amazonas in Venezuela) and its surroundings have been only sporadically explored herpetologically. The senior author (CLBA) has explored the area repeatedly, reporting only anecdotally a few species (Barrio-Amorós 1998; Barrio-Amorós & Molina, 2006). The only dendrobatid known from the Puerto Ayacucho region is *Dendrobates leucomelas* Steindachner, 1864. During two expeditions, we discovered a new species of *Anomaloglossus* at Tobogán de la Selva, near Puerto Ayacucho.

The genus *Anomaloglossus* is a diverse component of the Guiana Shield fauna, with many endemics circumscribed to restricted areas, usually one or several proximate tepuis. Of 21 species of cis-Andean *Anomaloglossus*, 14 are known from Venezuela (Barrio-Amorós 2004, Barrio-Amorós *et al.* 2004; Barrio-Amorós 2006, Barrio-Amorós & Brewer-Carías, 2008, Grant *et al.* 2006). We describe herein the 15th *Anomaloglossus* from Venezuela, an unusually colored new species from granitic substrate rainforest on the northwestern edge of the Guiana Shield.

Material and methods

All specimens examined are deposited in the following collections: Colección de Vertebrados, Universidad de los Andes, Mérida (CVULA); Museo de la Estación Biológica de Rancho Grande, Maracay (EBRG); Colección de Herpetología del Museo de Biología de la Universidad Central de Venezuela, Caracas (MBUCV); Museo de Historia Natural La Salle, Caracas (MHNLS). The diagnosis follows Barrio-Amorós & Santos (2009) while the description follows Barrio-Amorós (2006). Comparative data were taken from La Marca (1996), Kok *et al.* (2006a), Myers & Donnelly (2008) and Barrio-Amorós & Brewer (2008). The toe webbing formula follows the system of Myers & Duellman (1982). We assign the species described herein to *Anomaloglossus* due to the presence of a MLP, following Grant *et al.* (2006). Gender and maturity were determined by dissection (i.e., the presence of testes or oviducts), and secondary sexual characters (presence or absence of vocal slits or observation of calling males). All measurements (in mm) were taken with a digital caliper to the nearest 0.1 mm. Measurements reported are only from adult frogs including SVL: snout-vent length, straight length from tip of snout to vent; SL: shank length from outer edge of flexed knee to heel; FL: foot length from proximal edge of outer metatarsal tubercle to tip of T IV; HeL: head length from tip of snout to the posterior border of skull (posterior edge of prootic, noted through the skin); HW: head width between angle of jaws; EN: distance of anterior edge of eye to nostril; ED: horizontal eye diameter; TD: horizontal tympanum diameter; F3D: disc width of F III; T4D: disc width of T IV; 1FiL: length of F I from inner edge of thenar tubercle to tip of disc; 2FiL: length of F II from inner edge of thenar tubercle to tip of disc. Fingers and toes are abbreviated F and T.

Advertisement calls from a single male were recorded at 24.5 °C on a rainy morning with a Sony WM DC6 Professional Walkman with a Sennheiser ME80 condenser microphone. Calls were recorded at distances of 1–3 m from the individual and the temperature from the substrate was collected immediately after the call recording. Calls were digitized using Soundedit Macromedia, 1995, and analyzed using Soundruler 0.9.6.0.

Results

The new species is allocated in the family Dendrobatidae, subfamily Aromobatinae sensu Santos et al. (2009), based on its molecular phylogenetic relationships (J. C. Santos, unpublished data) and its high external similarity to other aromobatine frogs. It is assigned to *Anomaloglossus* as it presents the MLP, which is the only known synapomorphy of the genus.

Anomaloglossus verbeeksnyderorum sp. nov.

Holotype. MHNLS 19649, an adult male from Tobogán de la Selva, Municipio Atures, Estado Amazonas, Venezuela, 5° 23'N, 67° 34'W, 56 masl, 5.4109°N, 67.6197°W, collected by C. Braver and C.S. Jones.

Paratopotypes. five adult females, MHNLS 19644-48, and two adult males MHNLS 19650-51, with the same data as the holotype; five adult females CVULA 7136-7140, and one adult male CVULA 7141, from the type locality on 19 of June, 2007 by O. Jovanovic, G. Safarek and Z. Cernelic.

Diagnosis. (1) Skin smooth on dorsum, without tubercles in preservative; smooth on belly. (2) Paired dorsal scutes present on digits. (3) Distal tubercle on F IV present but indistinct. (4) F IV length reaching distal half of distal subarticular tubercle of F III. (5) F I equal to slightly longer than F II. (6) Digital discs present. (7) Fingers discs weakly expanded. (8) Finger fringes little evident, thick and low. (9) Metacarpal ridge absent. (10) F III not swollen in adult males. (11) Carpal pad absent. (12) Male excrescences on thumb absent. (13) Thenar tubercle small, oval. (14) Black arm gland in adult males absent. (15) Tarsal keel weakly curved, thick. (16) Toe discs moderately expanded. (17) Toes moderately webbed. (18) Metatarsal fold present, low. (19) External coloration dark brown (males) and pale brown (females) with parotoid and paraclacal marks whitish in preservative, orange in life; thighs dorsally reddish brown cross barred; dorsolateral and ventrolateral stripes absent; oblique lateral stripe continuous or broken, to midbody or the posterior edge of the arm. (20) Gular-chest markings absent. (21) Dermal collar absent. (22) Male throat coloration pale with a profusion of melanophores; female throat coloration free or nearly free of melanophores. (23) Male abdomen color pattern immaculate, yellow in life. (24) Female abdomen color immaculate white, free of melanophores. (25) Iris coloration reddish bronze with a dark red pupil ring. (26) Large intestine unpigmented. (27) Testis white. (28) Median lingual process present, small, round. (29) Tympanum inconspicuous to distinct, tympanic annulus present. (30) Vocal sac not distinct. (31) Teeth present on the maxillary arch. (32) Size small, males 17.8 to 19.5 mm (n=4, mean 18.8±0.7), females 16.9 to 22.3 mm (n=9, mean 19.3±1.8)

Comparison with other species. *Anomaloglossus verbeeksnyderorum* is easily distinguished from congeners due to its particular coloration (characters of *A. verbeeksnyderorum* in parentheses). No other *Anomaloglossus* has any orange mark on the parotoid and paraclacal areas. Only three other *Anomaloglossus* are known to be yellow ventrally, as is the male of *A. verbeeksnyderorum*. Of these, *Anomaloglossus breweri* has protuberant tubercles on the posterior back (absent), and male coloration is similar to females (dichromatic); this species appears to be endemic to Aprada, an isolated tepui 550 km to the east. *Anomaloglossus moffetti* is a larger, more robust species up to 27 mm (up to 22.3 mm), characterized by the absence of fringes on the fingers (low and thick), an indistinct tympanum (barely distinct to distinct), irregular and diffuse spotting on chest (absent), and apparently endemic to Sarisariñama tepui, 390 km to the East of Tobogán de la Selva. *Anomaloglossus kaiei* also has yellow ventral coloration, though on females (only on males), smaller size, up to 19.8 mm (up to 22.3 mm), and pale dorsolateral stripes (absent). In preservative, no other *Anomaloglossus* has the peculiar dorsal pattern, in which always are easily seen two striking parotoid light marks. *Anomaloglossus ayarzaguenai* has a F I shorter than II (equal to slightly longer); and a uniform brown color pattern with small dark brown spots (two parotoid and two para-clacal marks).

We compare the new species with the rest of cis-Andean *Anomaloglossus* in order to provide a comprehensive comparison set.

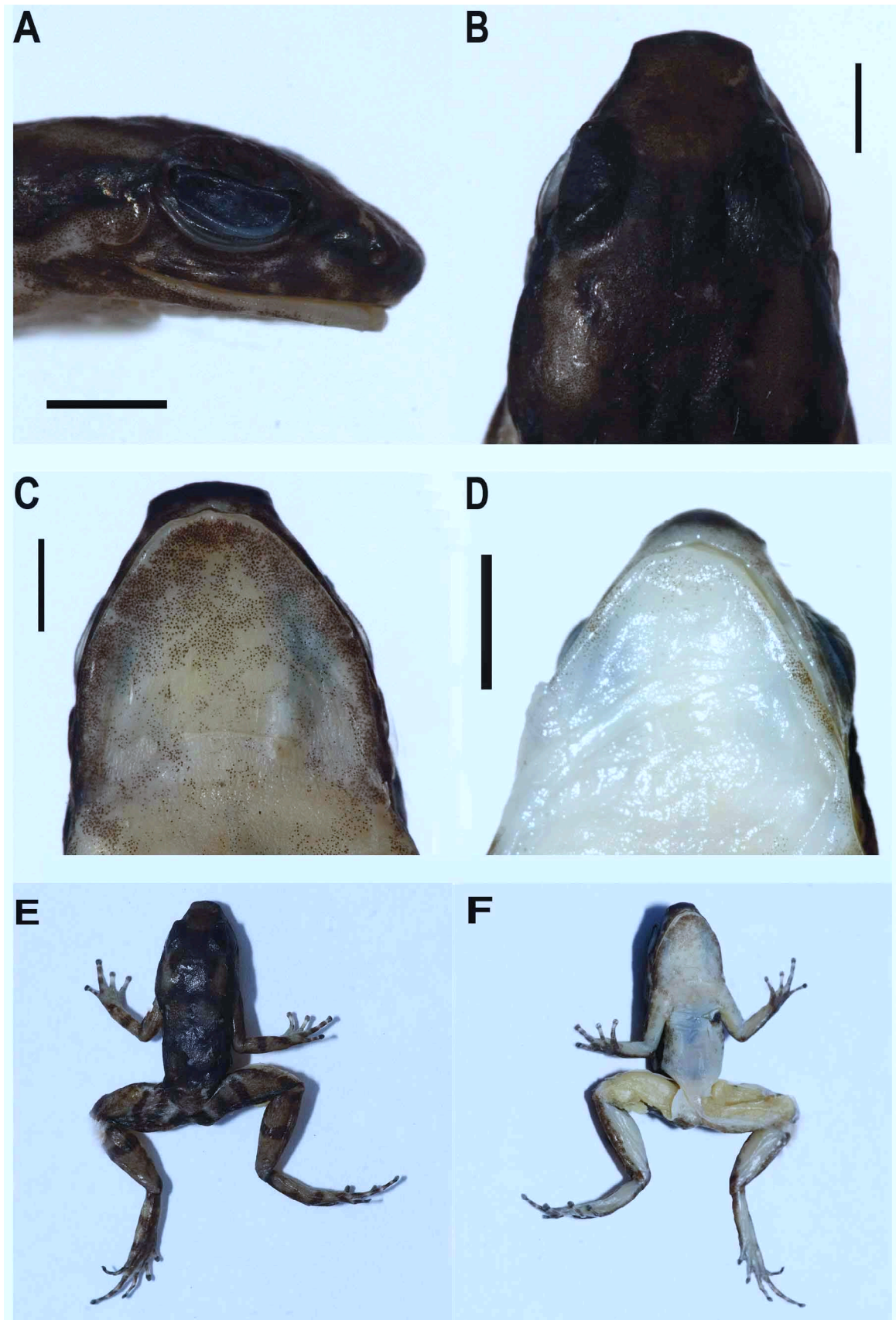


FIGURE 1. *Anomaloglossus verbeeksnnyderorum* sp. nov. A. Left profile of the head of the holotype (MHNLS 19649). B. Dorsal view of the head of the holotype (MHNLS 19649). C. Ventral view of the head of the holotype (MHNLS 19649). D. Ventral view of female paratopotype MHNLS 16944 showing the sexual dichromatism explained in the text. Scale equals 2 mm. E. Dorsal view of the holotype (MHNLS 19649). F. Ventral view of the holotype (MHNLS 19649).

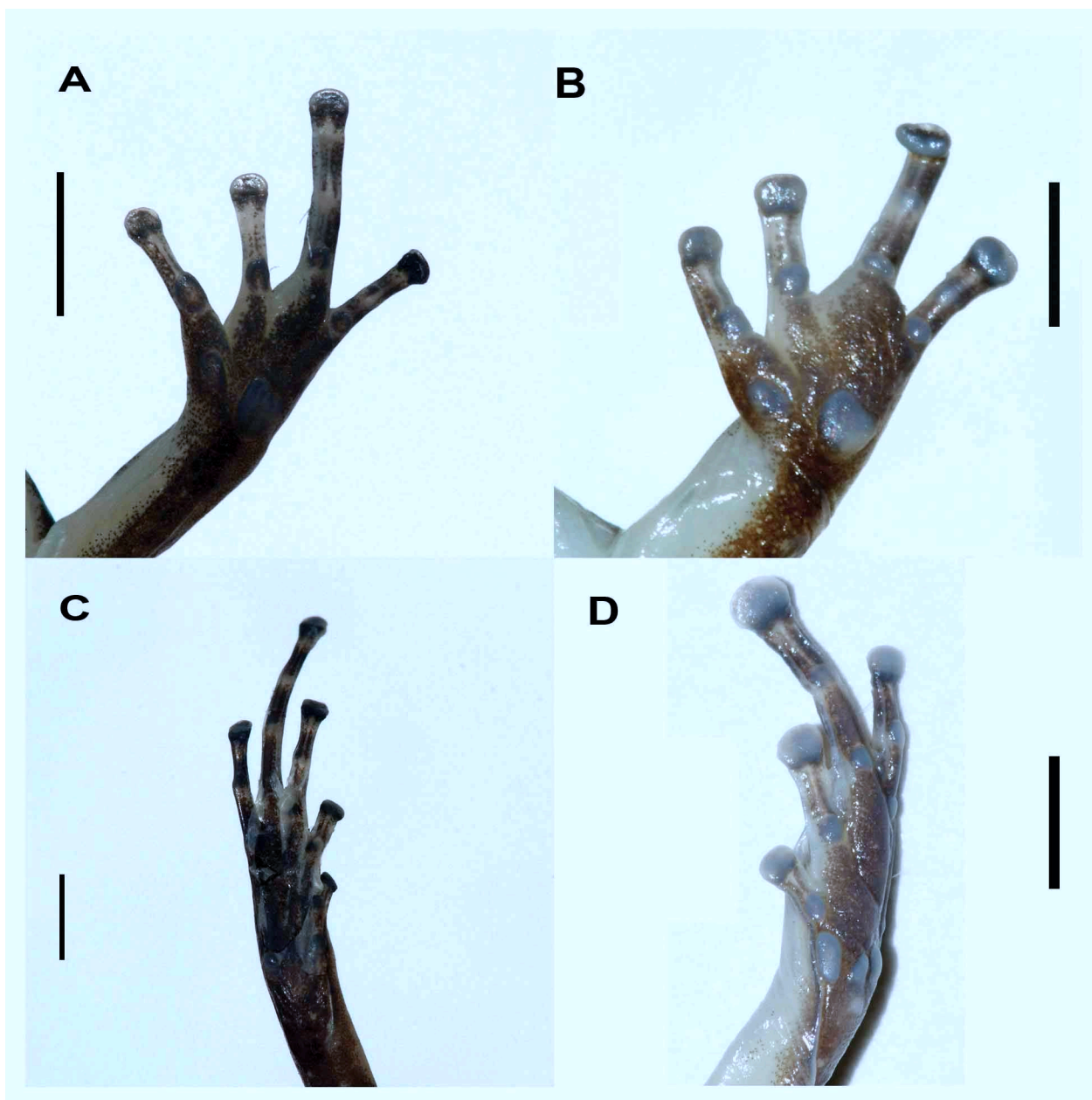


FIGURE 2. Hands and feet of *Anomaloglossus verbeeksnyderorum* sp. nov. A. Palmar view of the left hand of the holotype (MHNLS 19649). B. Palmar view of the left hand of the female paratopotype MHNLS 16944. C. Sole view of the right foot of the holotype (MHNLS 19649). D. Sole view of the left foot of the paratotype (MHNLS 19644), showing a median metatarsal tubercle. Note that there are only four toes instead five. See explanation on the text. Scale equals 2 mm.

Anomaloglossus degranvillei has F I shorter than II (equal to slightly longer), oblique lateral stripe absent (present), a post tympanic white bar (absent) and ventral surfaces brown with white spots (whitish or yellowish). *Anomaloglossus guanayensis* has Finger I shorter than II (equal to slightly longer), anal sheath present (absent), chest marks not forming a collar, dark ventral coloration (immaculate white or yellow). *Anomaloglossus murisipanensis* has F I shorter than F II (equal to slightly longer), oblique lateral stripe absent (present), dark ventral colouration (immaculate white or yellow). *Anomaloglossus parimae* has F I shorter than F II (equal to slightly longer), melanophores profuse on the chest (absent). *Anomaloglossus parkerae* has F I shorter than F II (equal to slightly longer), oblique lateral stripe absent (present), sexual dimorphism in ventral pattern absent (present). *Anomaloglossus shrevei* is a much larger frog, up to 36 mm (up to 22.3) with a truncate snout in dorsal view (round), and F I is shorter than II (equal to slightly longer). *Anomaloglossus*

tamacuarensis has anal tubercles (absent) and F III slightly swollen in males (not swollen). *Anomaloglossus tepuyensis* is a larger frog, up to 26.5 mm (22.3), has the F I shorter than F II (equal to slightly longer), fingers with keel-like lateral folds (finger fringes barely evident), dorsal skin granular (smooth). *Anomaloglossus triunfo* is a smaller frog, up to 20 mm (up to 22.3) with a triangular metacarpal tubercle (rounded), F I distinctly longer than II (equal to slightly longer) and an indistinct tympanum (distinct). *Anomaloglossus wothuja* has a nearly truncated snout in dorsal view (round), granular dorsal skin (smooth) and no consistent dorsal pattern (two parotoid and two para-cloacal orange marks). Finally the new species is easily distinguished from those *Anomaloglossus* having scanty toe webbing, *A. beebei*, *A. kaiei*, *A. praderioi* and *A. roraima* (toe webbing moderately developed).

Description of holotype. Dorsal and ventral skin smooth in preservative; without tubercles on the posterior part of the dorsum. Dorsal skin forming a well-defined rounded, posteriorly projecting flap above vent, opened at the upper level of thighs; no anal tubercles.

Head longer than wide, HW 33.6 % of SVL. Snout subacuminate in profile (Fig 1A), truncate in dorsal and ventral views (Figs 1B and 1C respectively). Nares situated near the tip of the snout and directed slightly anterolaterally, visible from the front, and barely visible from the dorsum and below. Canthus rostralis rounded; loreal region slightly concave. Interorbital region width slightly wider than upper eyelid width. Snout slightly longer than eye diameter; EN 64% of ED. Tympanum large, 40% of ED, distinct only its inferior half; its posterodorsal half hidden beneath the superficial slip of the *M. depressor mandibulae*; positioned close behind eye and low, close to the angle of jaws. Maxillary teeth present. Tongue longer than wide, triangular, notched posteriorly, posterior half free; vocal slits present, large. MLP very small, round, as long as wide, positioned on the anterior third of the tongue.

Hand length small, 27.4 % of SVL. Relative lengths of adpressed fingers III>IV>I>II (Fig 2A); F I slightly longer than F II. Discs of all fingers barely expanded; F III disc 1.2 times width of distal end of adjacent phalanx. Base of palm with large, nearly round, median palmar tubercle; oval inner thenar tubercle on base of F I; one subarticular tubercle on F I and F II, and two on F III and F IV, distal tubercles small; all tubercles low, round. Fringes only appreciable on F II, thick and low.

Hind limbs of moderate length; shank 46.6 % of SVL. Relative lengths of adpressed toes IV>III>V>II>I (Fig 2C); TI reaching, when adpressed, half subarticular tubercle of TII. Toe discs moderately expanded; T IV disc 1.6 times width of distal end of adjacent phalanx. Feet moderately webbed, the web distally continuous with a thick fringe on all toes, including external edges of T I and T V. Toes moderately webbed; webbing formula I 1½-2½ II 1 2/3-3 III 2½-3 2/3 IV 4-2½ V. One to three non protuberant subarticular tubercles on toes as follows: one on T I and T II, two on T III and T V, and three on T IV. Sole with two distinct metatarsal tubercles, a round outer metatarsal tubercle, and a 1/3 longer elliptical inner metatarsal tubercle. A thick tarsal keel, straight and weakly curved distally, ending at mid length of tarsus, proximally continuous with the narrow fringe on free (preaxial) edge of T I. Metatarsal fold present, low.

Color in preservative. dorsally dark brown with two conspicuous parotoid pale brown elongate marks (comma shape), and two symmetrical scapular pale brown round marks (Fig 1E). Rostral area pale brown. Both flanks are dark brown, with long white oblique lateral stripes, reaching the posterior edge of the arm. Upper lips dark brown with a few irregular small whitish spots; tympanic area pale brown. Arms and limbs are pale brown, bar crossed by dark brown. Two symmetrical white paracloacal marks surrounded by black. Ventral surfaces are white at simple view; under magnification, melanophores are concentrated on the throat, especially on the chin and along the edges of the lower mandible; melanophores are more scarce on the chest, and missing on the belly (Fig 1F). Palms and soles are dark brown.

Color in life. The only available photo of a living male is that of an uncollected specimen. In all individuals seen was evident, however, the characteristic color described herein. *Anomaloglossus verbeeksnyderorum* males (Fig 3A) differ from all known species in the genus by showing some bright marks, mostly on the parotoid area (orange), upper arm (orange), post tympanic area (white and orange); paracloacal area (orange), inguinal region and oblique lateral stripe (yellow), and some bluish small spots on the flanks, upper lip, and fingers. Also the upper surfaces of hind limbs are dull orange, barred with dark brown. The rest of dorsum is dark brown with darker brown canthal, supratympanic and interorbital stripes; ventrally males

are bright yellow. Females (Fig 3B) are more according to dull colored *Anomaloglossus*, as they are dorsally light brown to greyish, with dark brown marks; the parotoid and paracloacal areas are dull orange, and the axilar region can be yellowish. The fingers have bright bluish white rings beside the finger discs; ventrally they are white.

Measurements of holotype (in mm). SVL: 19.3; SL: 9.0; FL: 8.8; HeL: 8.0; HW: 6.5; EN: 1.6; ED: 2.5; TD: 1.0; F3D: 0.6; T4D: 0.6 1FiL: 3.0; 2FiL: 2.7. See Table 1 for measurements of the type series.

TABLE 1. Measurements (in mm) of adult males and females of *Anomaloglossus verbeeksnnyderorum*. Abbreviations are defined in the materials and methods section. Values are means \pm standard deviation; maximum and minimum values are in parentheses.

Character	Males (n= 4)	Females (n= 9)
SVL	18.8 \pm 0.7 (17.8–19.5)	19.3 \pm 1.8 (16.9–22.3)
SL	8.5 \pm 1.1 (7–9.5)	9.1 \pm 0.6 (8–9.8)
FL	8 \pm 0.8 (7.2–8.9)	8.4 \pm 0.8 (6.8–9.5)
HeL	8.1 \pm 0.5 (7.6–8.8)	8.3 \pm 1.0 (7–9.6)
HW	6.7 \pm 0.5 (6–7.3)	7.0 \pm 0.5 (6.2–7.6)
ED	2.2 \pm 0.1 (2.1–2.4)	2.3 \pm 0.3 (1.9–2.7)
TD	1 \pm 0.1 (0.9–1.1)	1.1 \pm 0.2 (0.8–1.4)
F3D	0.5 \pm 0.1 (0.4–0.6)	0.6 \pm 0.1 (0.5–0.8)
T4D	0.6 \pm 0.1 (0.5–0.8)	0.7 \pm 0.1 (0.5–0.8)
1FiL	3 \pm 0.2 (2.8–3.3)	3 \pm 0.3 (2.5–3.4)
2FiL	2.7 \pm 0.3 (2.4–3)	2.8 \pm 0.3 (2.5–3.4)

Variation. The only difference between males and females in preservative is the throat coloration, immaculate white on females, with few melanophores on the chin edge (Fig 1D), and dirty white to greyish on males, with a profusion of melanophores observed with magnification (Fig 1C). Size is not very significant (mean SVL of males 18.8 \pm 0.7 mm; mean SVL of females 19.3 \pm 1.8 mm). The shape of the snout is also variable; truncate (Fig 1C) to round (Fig 1D). The shape of the fingers can be slender (Fig 2A) or robust (Fig 2B).

Although in the type series there is not an individual that presents warts or flat tubercles on the posterior part of the body or on the thighs, as is usual for *Anomaloglossus*, a few flat warts can be appreciated in Fig 3A. The paracloacal marks are most patterned and bright on males (Fig 3A) than on females (Fig 3B).

Little variation is observed in dorsal coloration of females. The back can be light to dark brown, with irregular darker marks, barely distinct on dark specimens (MHNLS 19646, MHNLS 19648, CVULA 7139, for instance), and conspicuous on lighter specimens (CVULA 7137–38). The marks are usually a dark interorbital bar pointing backwards, two symmetric dark and round spots on the occipital area, and an inverted W behind the head (CVULA 7140). All specimens have the hind limbs bar-crossed, being better marked on males.

On the left foot of MHNLS 19644 there is a median metatarsal tubercle, half size of inner metatarsal tubercle; the outer metatarsal tubercle is much bigger than on right side; and there is another smaller median tubercle just below the median one. The left foot lacks one toe naturally, apparently T IV) (see remarks; Fig 2D).

Vocalization. A single call was recorded at 24.5 °C the morning of the 19th of June, 2007. The complete train call has 152 pulsed notes (Fig 4A, 4B), lasting 17.14 sec. Nine notes are produced per second (Fig 4C, 4D). The dominant frequency is at 4405 Hz while the fundamental is at 3921 Hz. 25 consecutive notes were chosen at random on the spectrogram to determine note duration and inter-note interval. Note duration and inter-note interval were measured, respectively, 0.067 \pm 0.003; 0.064–0.072 sec, and 0.044 \pm 0.003; 0.0042–0.0048 sec. (mean \pm SD and range, respectively).

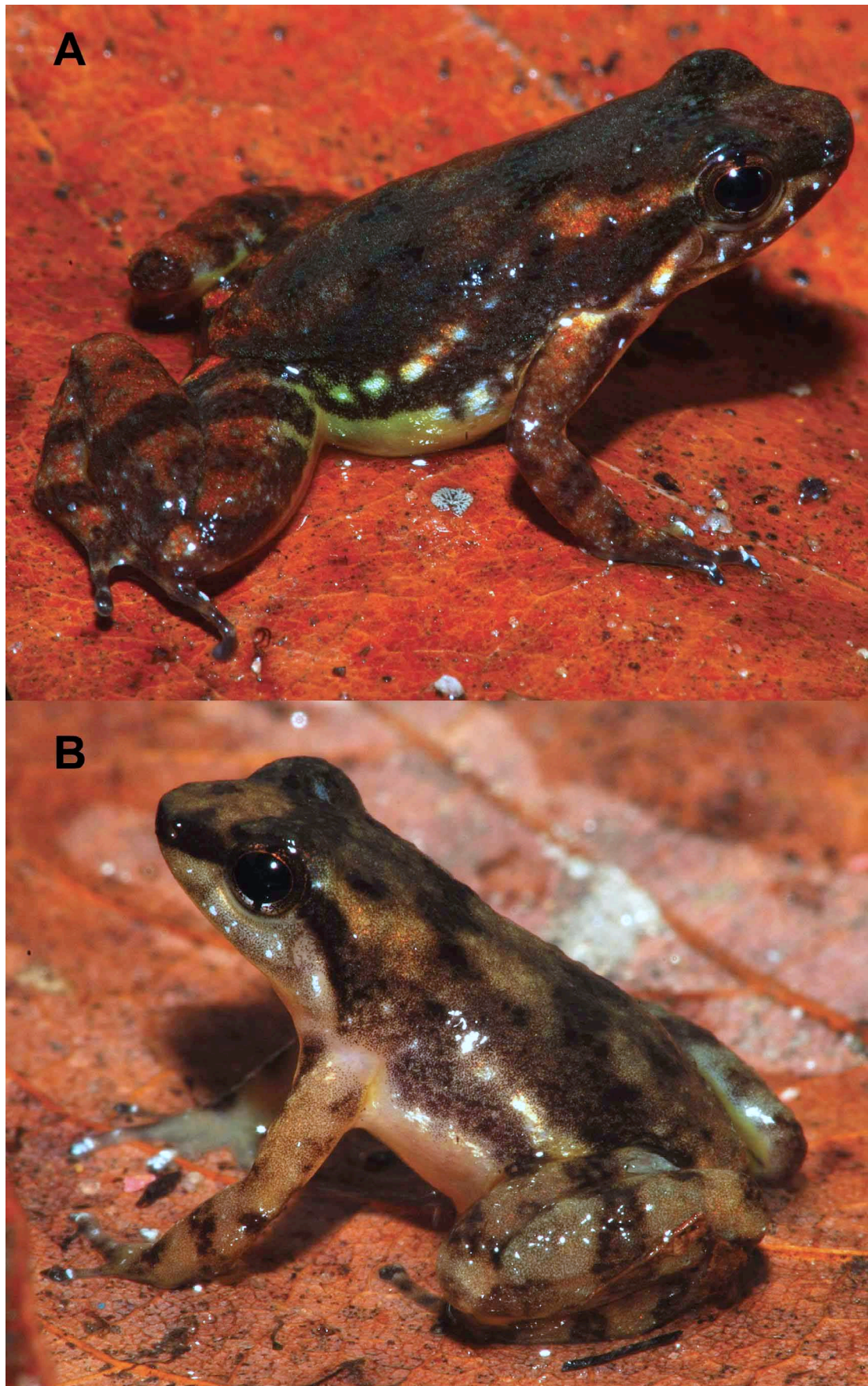


FIGURE 3. *Anomaloglossus verbeeksnyderorum* **sp. nov.** in life. A. Male. B. Female. Specimens not collected. Photo by Zelimir Cernelic.

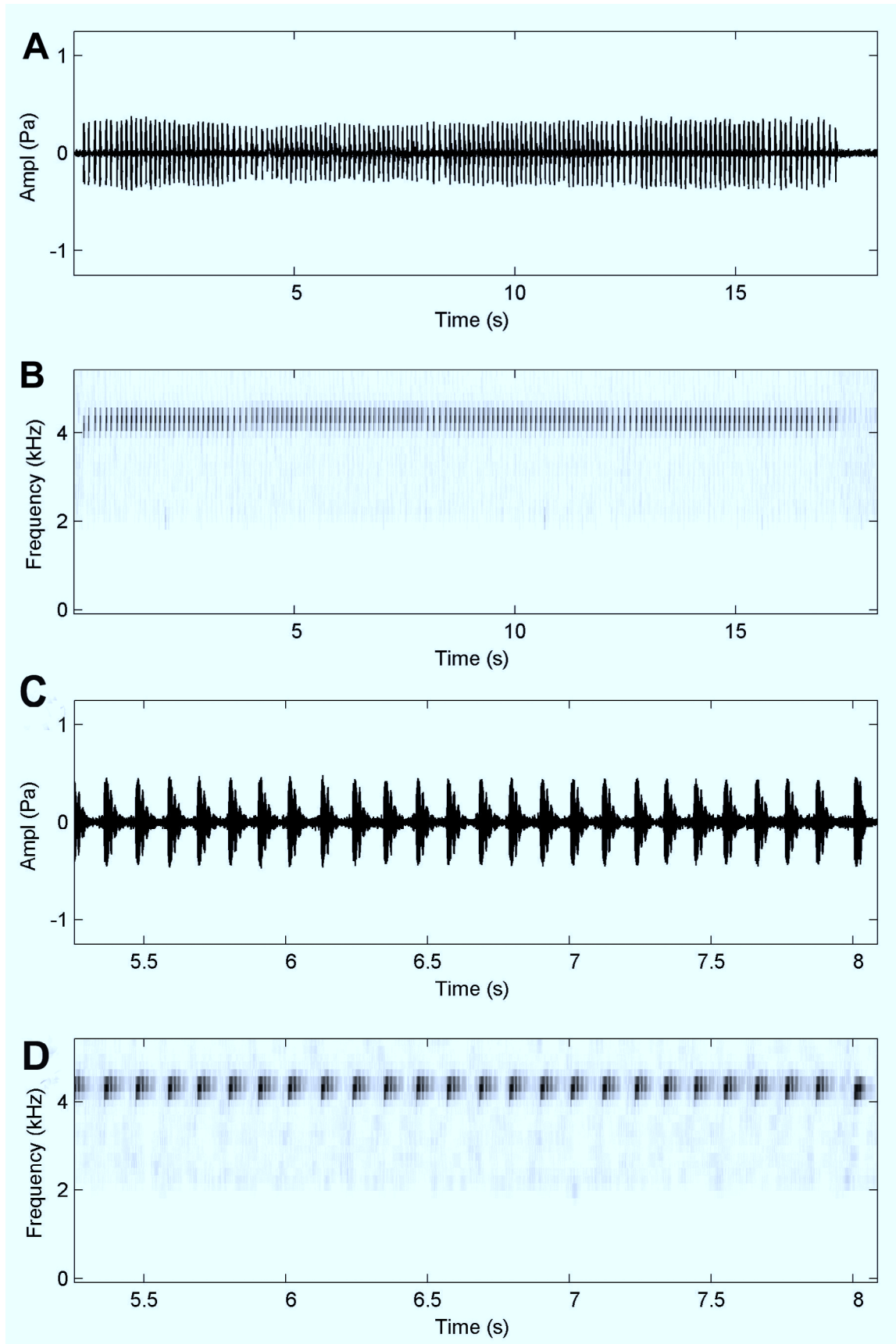


FIGURE 4. *Anomaloglossus verbeeksnyderorum* sp. nov. A. Audiospectrogram and B. oscillogram of a complete trill call with 152 notes. 24.5 °Celsius. C. audiospectrogram and D. oscillogram of an amplified random section of the complete call sequence.

Call comparisons. Only five *Anomaloglossus* advertisement calls are known. Grant et al. (1997) describe the call of *Anomaloglossus atopoglossus*; Myers & Donnelly (1997) that of *A. tamacuarensis*; Myers & Donnelly (2008) *A. tepuyensis*, and Kok et al. (2006a, 2006b) *A. kaiei* and *A. beebei*. For comparison we note (in parentheses) the pertinent call characters of *A. verbeeksnyderorum*. *Anomaloglossus atopoglossus* produces calls with 12–14 notes (152), with note call duration of 0.7–0.9 sec (0.06 sec), and a frequency from 4160 to 4240 Hz (3921–4405 Hz). *Anomaloglossus tamacuarensis* call consists of a long train of double notes (single notes) given at three per second, resulting in six notes per second (9), with a frequency of 3840 Hz (3921–4405 Hz). The call of *A. tepuyensis* is a short trill of 14–22 notes (152), with 4–7 notes per second (9), with frequency varying from 3270 to 3580 Hz (3921–4405 Hz). *Anomaloglossus kaiei* does not have a trill, but instead a repetitive and unmodulated call with a note duration of 0.03 and inter-note duration of 0.1 sec (0.06; 0.04 sec) and a dominant frequency of 4850 Hz (3921–4405 Hz). Finally, the described call of *A. beebei* is a series of whistled trills made from 2 to 5 modulated notes (continuous trill), with a frequency of 4640 Hz (3921–4405 Hz), and 7 (10) calls per second.

Distribution. Known from its type locality and a nearby site (Cerro el Tigre, near Tobogán de la Selva, together a single spot in the map, Fig 5), where the species was heard calling in sympatry with *Dendrobates leucomelas*. There is no reason to believe that the new species does not occur throughout lowland rainforest on granitic substrate at least through the north-western Amazonas and Bolívar states in Venezuela. The area has been little explored, existing a continuum of habitat both to the NE and S.

Natural history. *Anomaloglossus verbeeksnyderorum* has only been seen active on rainy days. Of the many times that the stream at Tobogán de la Selva was visited (from 1995 to 2007, at least once a year), only in two instances was the species apparent, in both cases during and after rains. The type series was found active on the ground of an immense sandstone slab under rainforest on 22 April 2005 (Fig 6). Around midday, after a rain in the morning, males were calling, and most individuals were seen along the slab, hiding rapidly under boulders when we approached. The animals were also seen and heard on 19 and 20 of June 2007 inside the forest although never more than 20 m away from the stream.

Other herpetofauna observed along the creek inside the forest were (during the day) *Dendrobates leucomelas*, *Synapturanus salseri*, *Gymnophthalmus sp.*, *Plica pansticta*, *Corallus hortulanus*, *Bothrops atrox*; and (at night) *Pristimantis vilarsi*, *Leptodactylus lithonaetes*, *Leptodeira annulata*, *Oxyrhopus melanogenys*, *Sibon nebulata* and *Paleosuchus palpebrosus*.

Etymology. *verbeeksnyderorum* is genitive plural that we apply to honor the Verbeek and Snyder families from Dallas, Texas, who won the auction made by the Amphibian Ark during the “2008 Year of the Frog” campaign. The funds donated went directly to the “*Atelopus* Project” managed by Fundación AndígenA (www.andigena.org) in Mérida, Venezuela, for field investigation and conservation efforts aimed at protecting Andean amphibian species.

Remarks. Median metatarsal tubercles are not uncommon in dendrobatids (e.g. *Allobates undulatus* Myers & Donnelly 2001; *Anomaloglossus triunfo* and *A. wothuja*, Barrio-Amorós et al. 2004; *Anomaloglossus moffetti* Barrio-Amorós & Brewer-Carías 2008). Malformations on fingers and toes are also common in stream dwelling species (*Mannophryne cordilleriana* from the Andes, *M. riveroi* and *M. aff. venezuelensis* from Peninsula de Paria, and *Aromobates n. sp.* from Serranía de Perijá, for example; CLBA pers. obs.). Apart from the paratopotype MHNLS 19644, no other specimen in the type series has a median metatarsal tubercle. The state of the left foot of MHNLS 19644 is quite unusual (Fig 2D). There is no evidence that a toe has been lost (no malformation is evident) and it is difficult to discern which toe is lacking; Fingers I and II have their typical characters, it seems that F III is naturally missing.

Hand and foot malformations were also found in two other specimens of the type series (MHNLS 19648 and CVULA 7139). MHNLS 19646 had broken skin on the left thumb, only a phalanx is present. MHNLS 19648 has F III and F IV of the right hand broken. CVULA 7139 shows an evident reduction of T I of the left foot, and T I on the right foot is, as in the holotype, missing. In this specimen it is clear that the missing digit is the thumb as the inner metatarsal tubercle is hypertrophied, and a small disc appears to have developed from that tubercle.

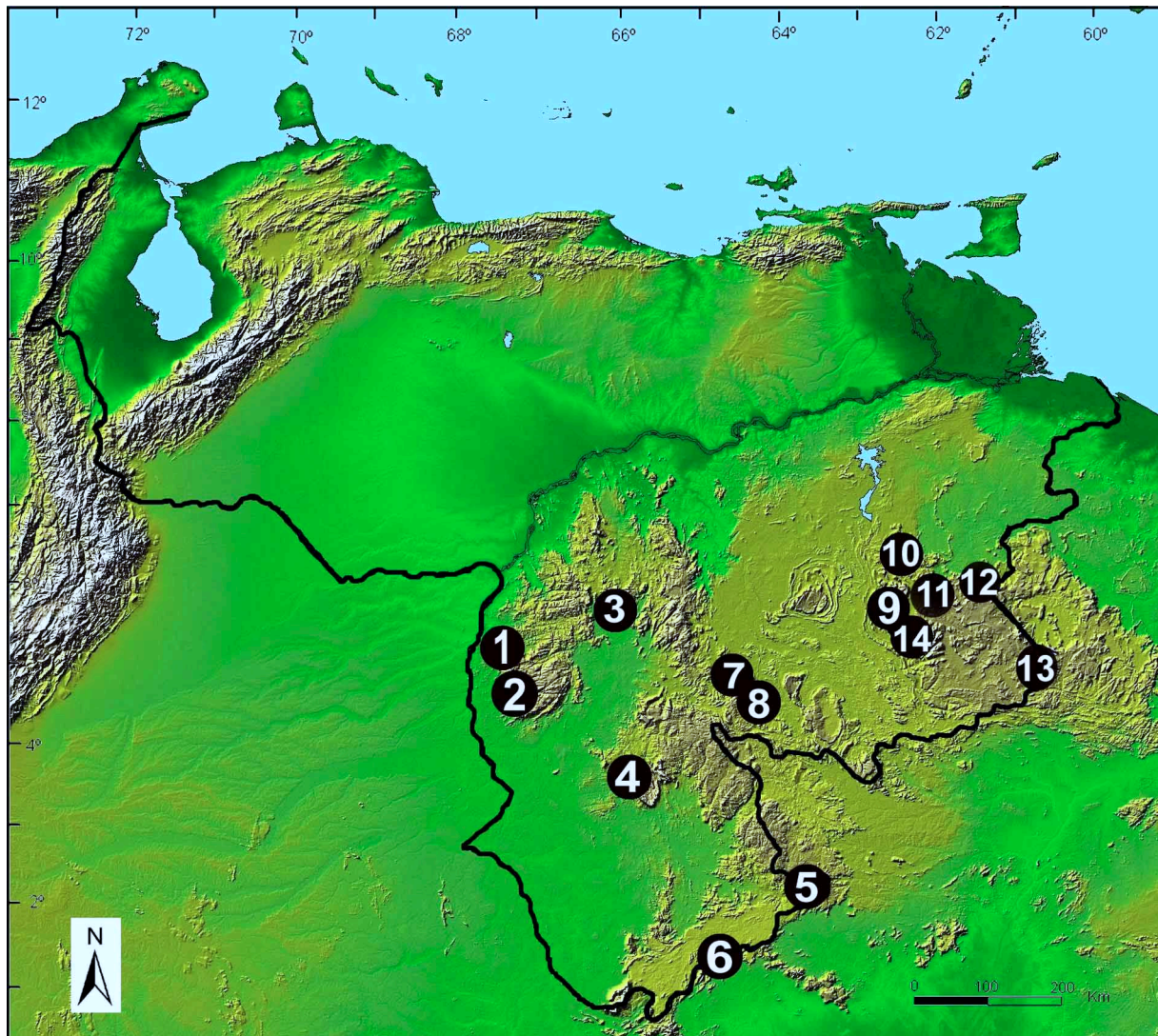


FIGURE 5. Distribution of the genus *Anomaloglossus* in Venezuela. 1. *A. verbeeksnyderorum* **sp. nov.** type locality. 2. *A. wothuja*. 3. *A. guanayensis*. 4. *A. shrevei*. 5. *A. parimae*. 6. *A. tamacuarensis*. 7. *A. ayarzagüenai*. 8. *A. moffetti*. 9. *A. tepuyensis*. 10. *A. triunfo*. 11. *A. murisipanensis*. 12. *A. parkerae*. 13. *A. praderioi* and *A. roraima*. 14. *A. breweri*.

Discussion. The Median Lingual Process (MLP) is diagnostic of the genus *Anomaloglossus* yet it has been reported from *Anomaloglossus atopoglossus*, *A. lacrimosus*, *A. parkerae*, *A. shrevei*, *A. tepuyensis* and *A. tamacuarensis* (Grant *et al.* 1997; Myers and Donnelly 1997). The presence of an MLP in other described species from Venezuelan Guayana by La Marca (1996), *A. ayarzagüenai*, *A. guanayensis*, *A. murisipanensis*, *A. parimae*, *A. praderioi* and *A. roraima*, were not yet been verified. In the original proposition of *Anomaloglossus*, Grant *et al.* (2006) assumed the occurrence of an MLP in all species but with no direct confirmation on the presence of MLP was provided. We examined several species housed at the MHNLS, and can confirm that MLP is present in the following species: *A. ayarzagüenai* (small and rounded on MHNLS 12950-51); *A. guanayensis* (small and rounded in MHNLS 10798); *A. murisipanensis* (moderately sized and pointed in MHNLS 11385); *A. praderioi* (very small on MHNLS 11272). Grant *et al.* (2006) interpreted the MLP as independently derived in *Anomaloglossus*. *Anomaloglossus verbeeksnyderorum* and *A. wothuja* are the most proximate members of the genus to those from trans-Andean species, being at about 1000 km from the Valle del Cauca in Colombia, type locality of *A. atopoglossus*; although this does not imply close phylogenetic relationship.

In terms of conservation, the distribution and abundance of the new species is not yet well known and we doubt that it is a threatened species, given that the habitat continuum is enormous. We propose a status of data deficient (DD) under the terms of the IUCN (Stuart *et al.* 2008).

The knowledge of amphibian diversity in remote locations of the Guiana Shield is growing thanks to ongoing explorations and a general growth of interest in biodiversity (Hallowell & Reynolds 2005). We are confident that the Guiana Shield remains one of the poorest known regions in the world, and that much more investigation is needed to understand relationships among its biota.



FIGURE 6. Natural habitat of the type locality of *Anomaloglossus verbeeksnyderorum* sp. nov., Tobogán de la Selva, Estado Amazonas, Venezuela.

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Appendix I. Specimens examined

- Anomaloglossus ayarzaguenai*: MHNLS 12950-51 (paratypes) (central sector of Cerro Jaua); Estado Bolívar, Venezuela
- Anomaloglossus beebeyi*: KU 69708 (Rupununi, N Acarahy Mts, W New River); Guyana.
- Anomaloglossus breweri*: MHNLS 17044 (holotype) and MHNLS 17045-47 (paratypes) (Cueva del Fantasma, northwestern slope of Aprada tepui, 05° 27' N, 62° 27' W, 660 m); Estado Bolívar, Venezuela.
- Anomaloglossus degranvillei*: KU 220993-97 (Marowijne, central Lely Mts, headwaters of Djoeka creek); Suriname.
- Anomaloglossus guanayensis* (MHNLS 10708) (holotype) (Alto Río Parguaza, Serranía de Guanay); Estado Bolívar, Venezuela
- Anomaloglossus parkerae*: MBUCV 6642 (3 specimens) (Salto El Danto, La Escalera, Sierra de Lema); Estado Bolívar, Venezuela.
- Anomaloglossus moffetti*: EBRG 4645–51 (southern slope of Sarisariñama-tepui, Camp IV, 4°29' N, 64°8' W, elev. 1108 m); Estado Bolívar, Venezuela.
- Anomaloglossus murisipanensis*: MHNLS 11385 (holotype) (Murisipan-tepui, 2350 m); Estado Bolívar, Venezuela.
- Anomaloglossus praderioi*: MHNLS 11272 (paratype) (Monte Roraima, 1800 m, Gran Sabana); Estado Bolívar, Venezuela.
- Anomaloglossus shrevei*: MBUCV 6687-8 (Cerro Duida, 1000 m); MHNLS 13910-11 (Cuerpo Circular, Alto Orinoco); Estado Amazonas, Venezuela.
- Anomaloglossus tepuyensis*: EBRG 2694, EBRG 2701-2 (Auyan-tepui, camp 4., 5°58'N-62°33'W, 1600 m); CVULA 7286-87 (Auyan-tepui, El Peñón, 1700 m); Estado Bolívar, Venezuela.
- Anomaloglossus triunfo*: EBRG 4756-4759; CVULA 6521-26; MBUCV 6585, 6667 (Cerro Santa Rosa, Serranía del Supamo); Estado Bolívar, Venezuela.
- Anomaloglossus verbeeksnyderorum*: see type series.
- Anomaloglossus wothuja*: MBUCV 6689-90; EBRG 4760-61 (Base of Cerro Sipapo, Tobogán del Cuao); Estado Amazonas, Venezuela.