

Papéis Avulsos de Zoologia

Museu de Zoologia da Universidade de São Paulo

Volume 50(4):51-68, 2010

www.mz.usp.br/publicacoes

www.revistasusp.sibi.usp.br

www.scielo.br/paz

ISSN impresso: 0031-1049

ISSN on-line: 1807-0205

A REDESCRIPTION OF *ANOMALOGLOSSUS PRADERIOI* (LA MARCA, 1998) (ANURA: AROMOBATIDAE: ANOMALOGLOSSINAE), WITH DESCRIPTION OF ITS TADPOLE AND CALL

PHILIPPE J.R. KOK

ABSTRACT

Anomaloglossus praderioi was originally described as *Colostethus praderioi* by E. La Marca in 1998 on the basis of two male specimens. The present paper provides a redescription of the species on the basis of new material from Maringma Tepui in Guyana and an additional specimen from Sierra de Lema in Venezuela. The redescription includes descriptions of the tadpole and vocalisation. *Anomaloglossus praderioi* is a medium-sized species mainly distinguished from its known congeners in having Fingers I, II and IV equal in length, the tip of Finger IV barely reaching the base of the distal subarticular tubercle on Finger III when fingers are adpressed, Fingers II and III with preaxial keel-like lateral folds, toes basally webbed with folded flaplike fringing except on Toes IV-V, symmetrical cloacal tubercles present, thin pale dorsolateral stripe present from tip of snout to tip of urostyle, ventrolateral stripe inconspicuous, never straight, oblique lateral stripe absent, throat in male grey to very dark grey, almost solid black, with black blotches, throat in female bright orange, almost immaculate. The tadpole is dark brown to black, exotrophic, benthic, LTRF 2(2)/3. The advertisement call consists of long trains of a single note repeated at a rate of 61-76 notes/min with a dominant frequency ranging from 3,562 to 3,856 Hz. The species is reported from eastern Venezuela and western Guyana and inhabits montane medium-canopy forest at elevations between 1,310-1,950 m above sea level.

KEYWORDS: Guiana Shield; Guyana; Pantepui; Redescription; Taxonomy; Venezuela; Vocalisation.

INTRODUCTION

The genus *Anomaloglossus* currently contains 23 species, of which 20 are *cis*-Andean and three are *trans*-Andean. The majority of taxa have restricted distributions in the Guiana Shield. The monophyly of the genus is supported by the presence of the median lingual process (Grant *et al.*, 2006). The few

trans-Andean species are placed in the genus *Anomaloglossus* due to the synapomorphic presence of the median lingual process, but they have not yet been included in quantitative phylogenetic analyses because of lack of material (Grant *et al.*, 2006; Myers & Grant, 2009). *Anomaloglossus* species are fascinating animals displaying interesting diversity in their reproductive biology. Some species have endotrophic

tadpoles [e.g. *A. degranvillei* (Lescure, 1975)], some are phytotelm breeders with partly oophagous larvae [e.g. *A. beebei* (Noble, 1923)], some species deposit tadpoles in small temporary pools with females occasionally supplying trophic eggs [e.g. *A. kaiei* (Kok, Sambhu, Roopsind, Lenglet & Bourne, 2006)], while others sometimes deposit larvae in running water [e.g. *A. tepuyensis* (La Marca, 1998)].

La Marca (1998) originally named *Anomaloglossus praderioi* (see Myers & Donnelly, 2008:143 for comment on date of publication) on the basis of two adult males collected between 1,800–1,950 m elevation on the slopes of Mt. Roraima, Estado Bolívar, Venezuela. The species' name rarely appeared in the literature since the original description (Barrio-Amorós, 1998, 2004; Grant *et al.*, 2006), except in the diagnoses of new congeneric taxa. Besides the few data given in the original description, close to nothing is known about the species.

Grant *et al.* (2006) included *Anomaloglossus praderioi* in their phylogenetic study on the basis of samples from two specimens collected at 1,310 m elevation on the slopes of Mt. Roraima, Cuyuni-Mazaruni District, Guyana. This represented the first and only range extension, although minor and not explicitly stated. Grant *et al.* (2006:120) also briefly commented on the morphological similarities between *A. praderioi* and the Guyanan *A. "degranvillei"* (which is *Anomaloglossus kaiei*), but did not examine the type series of *A. praderioi*.

Unfortunately several *Anomaloglossus* descriptions overlook – or erroneously describe – important diagnostic characters. Many are poorly illustrated and are based on very few specimens. Some descriptions are based on a single immature individual and in many cases colour in life is unknown, which is problematic since some diagnostic colour features may disappear or become less conspicuous in preservative (e.g. dorso-lateral stripe). As in other poorly known taxa, lack of comprehensive morphological data prevents adequate comparison with putative new species. Additional descriptions and a more complete understanding of the morphology of the little-known species are crucial to ensure the identity of new material.

Eleven specimens of *Anomaloglossus praderioi*, as well as 14 tadpoles, were collected during a recent expedition in the eastern Roraima tepui chain in Guyana, and the vocalisation of the species was recorded. Examination of museum material allowed the detection of an additional specimen. On the basis of this new material (listed in Appendix), and comparison with the holotype and the paratype of *A. praderioi*, I present herein a new description of the taxon based

on morphology and call, including the first illustration in colour of the species as well as the first description of its tadpole. A new diagnosis is provided and new observations on the ranges of *A. praderioi* and of the morphologically similar *A. kaiei* are discussed. The IUCN Red List Category of *A. praderioi* is also discussed.

MATERIALS AND METHODS

The newly collected specimens of *Anomaloglossus praderioi* are from the southeastern slope of Maringma Tepui (05°12'16"N, 060°34'39"W, 1,376 m elevation, Fig. 1), Cuyuni-Mazaruni District, Guyana, where 10 adult individuals (nine males, one female), one juvenile, and 14 tadpoles were secured. Specimens were fixed in 10% formalin for several days and transferred to 70% ethanol (adults and juvenile) or preserved in 10% formalin (12 tadpoles) for permanent storage. A piece of liver was extracted from seven specimens prior to fixation and preserved in 95% ethanol for later molecular analyses. Two tadpoles were preserved in 95% ethanol for the same purpose. Specimens were deposited in the collections of the Institut Royal des Sciences Naturelles de Belgique (IRSNB), tissue samples were deposited in the Amphibian Evolution Lab, Biology Department, Vrije Universiteit Brussel (see Appendix for material examined). Colour in life is described from digital photographs and field notes. Sex was confirmed by the presence of vocal slits. All measurements were taken on the preserved



FIGURE 1: Map of the eastern Pantepui region showing the known distribution of *Anomaloglossus praderioi*: **1:** Type locality, Venezuelan slope of Mt. Roraima; **2:** Guyanan slope of Mt. Roraima; **3:** Maringma Tepui, Guyana; **4:** Sierra de Lema, Venezuela. Question marks indicate possible extension of distribution (see text for details). Maps elaborated after a radar image of South America by NASA/JPL/NIMA available at <http://photojournal.jpl.nasa.gov/catalog/PIA03388>.

specimens, to the nearest 0.01 mm and rounded to the nearest 0.1 mm, under a Leica stereo dissecting microscope using an electronic digital calliper or an ocular micrometer.

One additional juvenile specimen, misidentified as *Anomaloglossus parkerae*, was detected in the EBRG collections.

Abbreviations and standard measurements for adults are as follows: (1) snout-vent length (SVL); (2) head length from corner of mouth to tip of snout (HL); (3) head width at level of angle of jaws (HW); (4) snout length from anterior corner of eye to tip of snout (SL); (5) eye to naris distance from anterior corner of eye to posterior margin of naris (EN); (6) internarial distance (IN); (7) eye length (EL); (8) interorbital distance (IO); (9) greatest length of tympanum from its anterior margin to its posterior margin (TYM); (10) forearm length from proximal edge of palmar tubercle to outer edge of flexed elbow (FAL); (11) length of Finger I from proximal edge of palmar tubercle to tip of finger (HAND I); (12) length of Finger II from proximal edge of palmar tubercle to tip of finger (HAND II); (13) length of Finger III from proximal edge of palmar tubercle to tip of finger (HAND III, also equivalent to hand length); (14) length of Finger IV from proximal edge of palmar tubercle to tip of finger (HAND IV); (15) width of disc on Finger III (WFD); (16) foot length from proximal edge of outer metatarsal tubercle to tip of Toe IV (FL); (17) width of disc on Toe IV (WTD); (18) tibia length from outer edge of flexed knee to heel (TIL); (19) upper arm length from anterior insertion with the body to outer edge of flexed elbow (AL). Webbing formulae are those of Savage & Heyer (1967), with modifications proposed by Myers & Duellman (1982) and Savage & Heyer (1997). For ease of comparison, toe webbing is considered basal when it reaches – but does not distinctly surpass – the basal subarticular tubercle on Toes II-V, and moderate when it reaches an area between the basal and the second subarticular tubercle on Toes II-V. Relative lengths of fingers were compared according to Kaplan (1997), using the distance from the proximal edge of the palmar tubercle to the tip of each finger.

Three lots of tadpoles were collected, two from two different small temporary pools (nine individuals total), the other from the back of one male (five individuals). Developmental stages of tadpoles follow Gosner (1960); terminology and oral disc characters follow Altig & McDiarmid (1999). Colour in life is described from field notes. Abbreviations and standard measurements for tadpoles are as follows: (1) total length from tip of snout to tip of tail (TL);

(2) body length from tip of snout to junction of posterior body and tail musculature (BL); (3) tail length from junction of posterior body and tail musculature to tip of tail (TAL); (4) greatest body width (BW); (5) highest body height (BH); (6) head width at level of eyes (HW); (7) tail muscle height at base of tail (TMH); (8) tail muscle width at base of tail (TMW); (9) maximum height of tail (MTH); (10) eye-naris distance (END); (11) naris-snout distance (NSD); (12) internarial distance (IND); (13) interorbital distance (IOD); (14) eye diameter (ED). The oral disc of a 24.5 mm long, stage-39 formalin preserved tadpole was dissected, critical-point dried and coated with gold following the usual protocol (Echeverría, 1997; Kok & Kalamandeen, 2008) for scanning electron microscopy (SEM). Observations and photomicrographs were made with a FEI Quanta-200 environmental scanning electron microscope (ESEM). Ethanol-preserved tadpoles were not included in Table 2 because ethanol caused soft tissue desiccation and body deformation.

Three minutes of advertisement calls were recorded at a distance of less than 1 m from two calling males (one of them collected) using a Sony ECM-MS907 microphone attached to a DAT Sony TCD-D100 recorder using Maxell DM60 digital audiotape. The calls were analysed at a sampling rate of 44,100 Hz using Raven version 1.3 software (Charif *et al.*, 2008). Temporal variables measured included: call duration (= note duration); inter-call interval (beginning of one call to beginning of the next); and call rate (= number of calls per minute). The dominant (emphasized) frequency of the note was measured from a spectral slice taken through the portion of the note with the highest amplitude (using the Blackman window function at a 3 dB filter bandwidth of 120 Hz). Air temperature at the call sites was measured with a Hanna digital pH/thermometer and varied from 19.8-20°C.

Taxonomy follows Grant *et al.* (2006). Institutional acronyms follow Frost (2009).

RESULTS

New description of *Anomaloglossus praderioi* (La Marca, 1998) (Figs. 2-7)

Adult definition and diagnosis: (1) medium-sized *Anomaloglossus* (males 19.5-22.4 mm SVL, female 22.7 mm SVL); (2) body robust; (3) skin on dorsum shagreened to finely granular, more granular

posteriorly, skin on venter smooth to shagreened; (4) Fingers I, II and IV equal in length; (5) tip of Finger IV barely reaching the base of the distal subarticular tubercle on Finger III when fingers adpressed; (6) distal tubercle on Finger IV present; (7) Finger III slightly swollen in males (preaxial keeling distinctly more developed than in females); (8) Fingers II and III with preaxial keel-like lateral folds (*sensu* Myers & Donnelly, 2008); (9) toes basally webbed, with folded flaplike fringing (*sensu* Myers & Donnelly, 2008), except on Toe IV (preaxial only) and Toe V; (10) tarsal keel weakly to distinctly curved, slightly tuberclelike; (11) black arm gland absent in male (*sensu* Grant & Castro-Herrera, 1998, see also Grant *et al.*, 2006), but presence of a glandular supracarpal pad in both sexes (larger in male in which it usually extends further on the forearm); (12) symmetrical cloacal tubercles present; (13) pale paracloacal mark present; (14) thin pale dorsolateral stripe present in both sexes, from tip of snout to tip of urostyle, usually slightly narrower on body than on head (dorsolateral stripe unnoticeable in preserved specimens); (15) ventrolateral stripe inconspicuous, never straight; (16) oblique lateral stripe absent; (17) obvious dichromatism in throat colour, throat of male grey to very dark grey, almost solid black, with black blotches, throat of female bright orange, almost immaculate except for a few lighter blotches and a few melanophores on chin and lower lip; (18) obvious dichromatism in ventral colouration, chest and anterior part of belly in male grey to dark grey with black blotches, posterior part of belly bright orange, belly in female bright orange, immaculate; (19) iris with metallic pigmentation and pupil ring; (20) large intestine extensively pigmented; (21) testes cream, unpigmented; (22) mature oocytes partly pigmented; (23) median lingual process short, tapered (24) maxillary teeth present, small.

Comparison with other species: The following comparisons of some external character states are based both on original descriptions and examination of type specimens (see Appendix for material examined). Examination of comparative type series sometimes revealed discrepancies between type specimens and original descriptions (*e.g.* sex, skin texture, length of Finger I *vs.* II, condition of fringes on fingers and toes), which explains that the following diagnosis may differ from those usually proposed (see Discussion).

Twenty-three species of *Anomaloglossus* are recognized, many of which apparently have restricted ranges. Compared to the nine other *Anomaloglossus* species known to occur in the Eastern Pantepui

District (*i.e.* east of the Rio Caroní, which obviously acts as a biogeographic barrier for *Anomaloglossus* species) in the Guiana highlands of Venezuela and Guyana, *A. praderioi* can easily be distinguished from *A. beebei* by (characters of *A. beebei* in parentheses) larger size (female SVL max 22.7 mm in *A. praderioi* *vs.* 18.7 mm in *A. beebei*), skin on dorsum shagreened to finely granular (granular), ventral skin smooth to shagreened (granular), Fingers I and II equal in length (Finger I < Finger II), Fingers II and III with preaxial keel-like lateral folds (fringes not folded), most toes with folded flaplike fringing (fringes not folded), toes basally webbed (moderately webbed), symmetrical cloacal tubercles present (absent), dorsolateral stripe from tip of snout to tip of urostyle (when present dorsolateral stripe originates from posterior corner of eye), throat in adult male grey to almost black, with black blotches (immaculate yellow), chest and anterior part of belly in male grey to dark grey with black blotches (immaculate yellow), palm dark brown to black (yellowish), distinct dark bands on thigh and shank (absent), dark interorbital band (absent); from *A. breweri* (Barrio-Amorós, 2006) by (characters of *A. breweri* in parentheses) Fingers I and II equal in length (Finger I < Finger II), tip of Finger IV barely reaching base of distal subarticular tubercle on Finger III when fingers adpressed (goes beyond), toes basally webbed (moderately webbed), symmetrical cloacal tubercles present (absent), dorsolateral stripe from tip of snout to tip of urostyle (absent), oblique lateral stripe absent (present, often broken into small spots), throat in adult male grey to almost black, with black blotches (dirty white), belly bright orange in both sexes (dirty white in male, yellow in female); from *A. kaiei* by (characters of *A. kaiei* in parentheses) larger size (female SVL max 22.7 mm in *A. praderioi* *vs.* 19.8 mm in *A. kaiei*), Fingers II and III with preaxial keel-like lateral folds (fringes not folded), dorsolateral stripe from tip of snout to tip of urostyle (always originates from posterior corner of eye), throat in adult male grey to almost black, with black blotches (never deep grey or solid black), chest and anterior part of belly in male grey to dark grey with black blotches (greyish without black blotches); belly bright orange in both sexes (cream in male, orangish yellow in female); from *A. murisipanensis* (La Marca, 1998) by (characters of *A. murisipanensis* in parentheses) Fingers I and II equal in length (Finger I < Finger II), tip of Finger IV barely reaching base of distal subarticular tubercle on Finger III when fingers adpressed (goes beyond), toes basally webbed (moderately webbed), symmetrical cloacal tubercles present (absent), dorsolateral stripe from tip of snout to tip of urostyle

TABLE 1: Morphometric measurements (in mm) of the holotype (ULABG 4196) and the paratype (MHNLS 11272) of *Anomaloglossus praderioi*, new material from Maringma Tepui, Guyana, and an additional specimen from Sierra de Lema, Venezuela. Abbreviations are defined in the text. Mean \pm SD are followed by the range in parentheses.

Character	Holotype, Mount Roraima (male)	Paratype, Mount Roraima (male)	Males from Maringma Tepui (N = 9)	Female from Maringma Tepui (N = 1)	Juvenile from Maringma Tepui (N = 1)	Juvenile from Sierra de Lema (N = 1)
SVL	19.5	22.4	21.2 \pm 0.42 (20.5-21.9)	22.7	15.0	16.7
HL	6.1	6.6	6.9 \pm 0.29 (6.5-7.3)	7.4	5.3	5.0
HW	6.8	6.8	7.3 \pm 0.19 (7.1-7.6)	7.9	5.2	5.8
SL	2.9	3.3	3.5 \pm 0.16 (3.3-3.8)	3.9	2.7	2.6
EN	1.5	1.8	1.8 \pm 0.11 (1.6-1.9)	2.0	1.2	1.5
IN	2.5	2.5	2.8 \pm 0.14 (2.7-3.1)	3.1	2.1	2.3
EL	2.6	2.8	2.7 \pm 0.13 (2.5-2.9)	2.9	1.9	2.5
IO	2.4	2.6	2.7 \pm 0.19 (2.4-3.0)	2.9	1.9	1.9
TYM	1.2	1.0	1.3 \pm 0.11 (1.2-1.5)	1.3	0.9	1.0
FAL	4.3	4.6	4.8 \pm 0.20 (4.4-5.1)	4.9	3.4	3.0
HAND I	3.8	3.9	4.0 \pm 0.19 (3.7-4.3)	4.3	2.5	—
HAND II	3.8	3.9	4.0 \pm 0.16 (3.8-4.3)	4.3	2.5	—
HAND III	5.3	5.4	5.5 \pm 0.17 (5.2-5.8)	5.8	3.5	—
HAND IV	3.8	3.9	4.0 \pm 0.17 (3.8-4.3)	4.3	2.5	—
WFD	0.6	0.6	0.7 \pm 0.07 (0.6-0.8)	0.6	0.4	—
FL	9.0	9.0	9.2 \pm 0.41 (8.6-9.9)	9.8	6.0	6.7
WTD	0.8	0.7	0.8 \pm 0.07 (0.7-0.9)	0.8	0.6	—
TIL	10.3	10.2	10.7 \pm 0.27 (10.3-11.0)	11.9	7.6	8.0
AL	4.4	4.8	5.8 \pm 0.34 (5.5-6.5)	6.4	3.8	3.8

(absent), belly immaculate in female (covered with melanophores), tarsal keel weakly to distinctly curved, slightly tuberclelike (straight, not tuberclelike); from *A. parkerae* (Meinhardt & Parmelee, 1996) by (characters of *A. parkerae* in parentheses) Fingers I and II equal in length (Finger I < Finger II), tip of Finger IV barely reaching base of distal subarticular tubercle on Finger III when fingers adpressed (goes beyond), symmetrical cloacal tubercles present (absent), dorsolateral stripe from tip of snout to tip of urostyle (absent), oblique lateral stripe absent (usually present, often broken into small spots), toes basally webbed (moderately webbed), throat in adult male grey to almost black, with black blotches (orange yellow); from *A. roraima* (La Marca, 1998) by (characters of *A. roraima* in parentheses) skin on dorsum shagreened to finely granular (granular), ventral skin smooth to shagreened (granular), Fingers I and II equal in length (Finger I < Finger II), Fingers II and III with preaxial keel-like lateral folds (fringes not folded), most toes with folded flaplike fringing (fringes not or very feebly folded), feet basally webbed (no webbing); from *A. rufulus* (Gorzula, 1990) in having (characters of *A. rufulus* in parentheses) dorsolateral stripe from tip of snout to tip of urostyle (absent), posterior part of belly never marbled (ventral part entirely marbled); from *A. tepuyensis* by (characters of *A. tepuyensis* in

parentheses) Fingers I and II equal in length (Finger I < Finger II), tip of Finger IV barely reaching base of distal subarticular tubercle on Finger III when fingers adpressed (goes beyond), toes basally webbed (moderately webbed), symmetrical cloacal tubercles present (absent), dorsolateral stripe from tip of snout to tip of urostyle (absent), oblique lateral stripe absent (usually present, often broken into small spots), throat in adult male grey to almost black, with black blotches (never deep grey or solid black, usually grey with white flecking), belly bright orange in both sexes (grey, greenish grey, or greenish yellow); from *A. triunfo* (Barrio-Amorós, Fuentes-Ramos & Rivas-Fuenmayor, 2004) by (characters of *A. triunfo* in parentheses) Fingers I and II equal in length (Finger I < Finger II), tip of Finger IV barely reaching base of distal subarticular tubercle on Finger III when fingers adpressed (goes beyond), toes basally webbed (moderately webbed), symmetrical cloacal tubercles present (absent), dorsolateral stripe from tip of snout to tip of urostyle (absent), oblique lateral stripe absent (present, often broken into small spots), throat in adult male grey to almost black, with black blotches (white).

Adult description: The main differences from the original description are italicized and quoted between brackets; see Table 1 for morphometric measurements

of the holotype (ULABG 4196) and the paratype (MHNLS 11272) of *Anomaloglossus praderioi* compared to new material. Adult males 19.5–22.4 mm SVL, single known adult female slightly larger at 22.7 mm SVL. Dorsal skin shagreened to finely granular, becoming more granular posteriorly and on hind limbs [dorsal skin reported as smooth in the original description (piel de dorso lisa) probably due to an artefact of preservation]; ventral skin smooth to shagreened. A low, more or less distinct, epidermal ridge usually borders the tip of snout dorsally; this ridge is usually more visible in preserved specimens. Dorsal surface of hind limbs granular, with two distinct symmetrical enlarged tubercles located laterally between urostyle and vent in 10 specimens (83%); these tubercles are not easily distinguishable from other surrounding tubercles in the other specimens, possibly due to an artefact of preservation.

Head slightly wider than long, greatest width 34–35% SVL. Snout bluntly pointed in lateral view, extending past lower jaw, truncate to bluntly pointed in ventral and dorsal views. Nares located close to tip of snout, directed posterolaterally; nares visible from front, barely visible from above and below; posterior

rim of naris bordered behind by a crescent-shaped ridge; rim bearing a small tuberclelike prominence posterodorsally, this “bump” usually visible from in front, above and below; internarial distance 38–39% greatest head width. Canthus rostralis slightly rounded; loreal region concave, sloping outward to lip. Interorbital distance as long as eye length, longer than upper eyelid. Snout length 130–134% eye length, 51–52% head length; distance from anterior corner of eye to posterior margin of naris 67–69% eye length. Postrictal tubercles few and inconspicuous. Tympanic membrane inconspicuous, round, concealed posterodorsally by a diffuse supratympanic swelling; tympanic annulus usually visible anteroventrally; tympanum 45–48% eye length.

Forearm shorter than upper arm length, no distinct ulnar fold, but sometimes a row of low tubercles instead. Hand moderate, its length 26% SVL, 73–75% greatest head width. Relative length of fingers III > IV = II = I. Fingers unwebbed. Discs of fingers expanded, disc on Finger I widest. Fingers II and III with preaxial keel-like lateral folds (*sensu* Myers & Donnelly, 2008), distinctly more developed in males, which have a slightly swollen Finger III (Fig. 2A–B) [*Finger III reported as not swollen in male in the original*



FIGURE 2: *Anomaloglossus praderioi*, showing ventral views of hand and foot. **A:** Left hand (left) and left foot (right) of a female specimen (IRS NB 14404, 22.7 mm SVL). **B:** Left hand (left) and left foot (right) of a male specimen (IRS NB 14403, 20.9 mm SVL). Black arrows highlight sexual dimorphism in preaxial third finger keeling, showing a slightly swollen third finger in male. Scale bars are 2 mm.

description (dedo III de la mano en machos no engrosado), probably because female was not available and thus comparison impossible].

Palmar tubercle large, rounded; thenar tubercle smaller, elliptical; one or two round to ovoid subarticular tubercles (one each on Fingers I and II, two each on Fingers III and IV, with distal tubercle on Finger IV less conspicuous). No distinct outer metacarpal fringe. Tip of Finger IV barely reaching the base of distal subarticular tubercle on Finger III when fingers adpressed (Fig. 2A-B) [although this is not shown on fig. 8 in the original description the same condition applies to the holotype]. No fleshy supracarpal fold atop wrist, but presence of a glandular supracarpal pad in both sexes (larger in male in which it usually extends further on the forearm).

Hind limbs robust, moderately long, with heel of adpressed leg reaching posterior corner of eye to snout; tibia 50-52% SVL. Relative lengths of adpressed toes IV > III > V > II > I; first toe short, usually reaching the base of subarticular tubercle of second toe. Toe discs expanded (moderately on Toe I), subequal or slightly larger than finger discs. Feet basally webbed; toes with folded flaplike fringing (*sensu* Myers & Donnelly, 2008), except on Toe IV (preaxial only) and Toe V. Webbing formula I (2-2)-2⁺ II (2-1 3/4)-3⁺ III (3-3)-(4-4⁺) IV 4 3/4-(3-3⁺) V (Fig. 2A-B).

Inner metatarsal tubercle small, elliptical; outer metatarsal tubercle small, round, about half the size of the inner. One to three round to ovoid subarticular tubercles (one each on Toes I and II, two each on Toes III and V, and three on Toe IV, with distal tubercle on Toe IV the smallest and least conspicuous). No examined specimen has a medial metatarsal tubercle. A weak outer metatarsal fold from proximal subarticular tubercle on Toe V to outer metatarsal tubercle. A slightly tuberclelike tarsal keel weakly to distinctly curved at proximal end, usually extending proximolaterad from preaxial edge of inner metatarsal tubercle, not distinctly continuous with the fringe along the outer edge of the first toe (Fig. 2A-B) [reported as short, straight and not tuberclelike nor swollen in the original diagnosis (pliegue tarsal corto, recto, no terminado ni en engrosamiento ni en tubérculo), but as short, straight, conspicuous with posterior margin slightly swollen (conspicuo, corto, con borde posterior recto y ligeramente engrosado) in the description of the holotype; this character is variable among the specimens examined].

Maxillary teeth present, small. Tongue longer than wide, free posteriorly, with rounded margin; median lingual process short, tapered. Vocal slits bilateral, large, extending from edge of tongue to angle of jaw.

Colour in life: Dorsal ground colour varies from light greyish brown to reddish brown or dark brown, usually with one to three dark brown to black triangular, diamond-shaped or diffuse hourglass markings from interorbital to presacral region. Upper surface of arm light brown to yellowish or orangish brown; upper surfaces of leg light greyish brown to dark grey with dark brown to black transverse bands on thigh, shank and foot; in most living specimens one of the transverse bands is larger and more conspicuous than others, which can sometimes be absent or barely visible (Figs. 3A-B, D-F; 4A-C; 5A). Adult males with grey to very dark grey throat, almost solid black, with black blotches, throat colour extending onto chest and anterior part of belly [the original diagnosis – based on two male specimens – mentions that there is no marking on the chest, although the throat is covered by punctuate melanophores (sin marcas sobre el pecho, aunque hay una punteadura fina de melanóforos que cubren toda la garganta), but later in the text, describing the colour of the male holotype in life La Marca mentioned that throat, chest and anterior part of belly are black with small white spots (garganta, pecho, parte anterior y lados del vientre, de color negro con manchitas blancas)]; posterior part of belly bright orange (Figs. 3C; 4A'-C'). Adult female with bright orange throat, almost immaculate except a few lighter blotches and a few melanophores on chin and lower lip; belly bright orange (Fig. 3C). Juvenile with light grey throat; belly yellowish, bright orange on its posteriormost part (Fig. 5A'). Flanks light grey to light reddish brown (males) or yellowish brown (female), usually with some small white or sky blue flecks more concentrated on the lower part, not forming a straight ventrolateral stripe (*sensu* Grant *et al.*, 2006). However, some inconspicuous yellowish elongate spots may occur and can be interpreted as a broken stripe¹. Oblique lateral stripe absent. Distinct thin pale dorsolateral stripe present in both sexes and in the juvenile, extending from tip of snout to tip of urostyle, usually slightly narrower on body than on head [this character was overlooked in the original description (sin banda dorsolaterales claras y oscuras) because it was exclusively based on preserved specimens, see below]. A wide dark brown band of variable width present below the dorsolateral stripe, extending from tip of snout laterally around the body and above the vent, containing most of the tympanum and usually tapering posteriorly from axilla. Upper lip light to

1. The ventrolateral stripe condition is not very contributive in diagnosing *Anomaloglossus* species since it seems intraspecifically variable and its occurrence is subject to interpretation. In known species in which it is detectable it is always broken and/or poorly defined.

dark grey, suffused with melanophores and sometimes with a few sky blue flecks in males, yellow with few melanophores in female. A black stripe extends from posterior margin of eye to axilla region and is usually underlined by a white to light grey (males) or bright yellow line (female); a white or light grey (males) or yellow spot (female) at arm insertion. Usually a black stripe on anterior and posterior edges of upper arm, tapering from arm insertion to forearm; dark area on upper surface of wrist. Undersurfaces of arm and thigh bright to dark orange, undersurface of shank

yellowish brown with black flecks and spots (more extensive in males). Pale, creamish brown, paracloacal marks present. Toes and digits with sky blue dots in both sexes. Palms and soles dark brown to black. Iris metallic reddish bronze in males, metallic bronze in female, with fine dark brown reticulation in both sexes (Figs. 3-4).

Colour in preservative: After 18 months in preservative, the dorsal ground colour of the *Maringma* specimens varies from light or pinkish grey to dark greyish

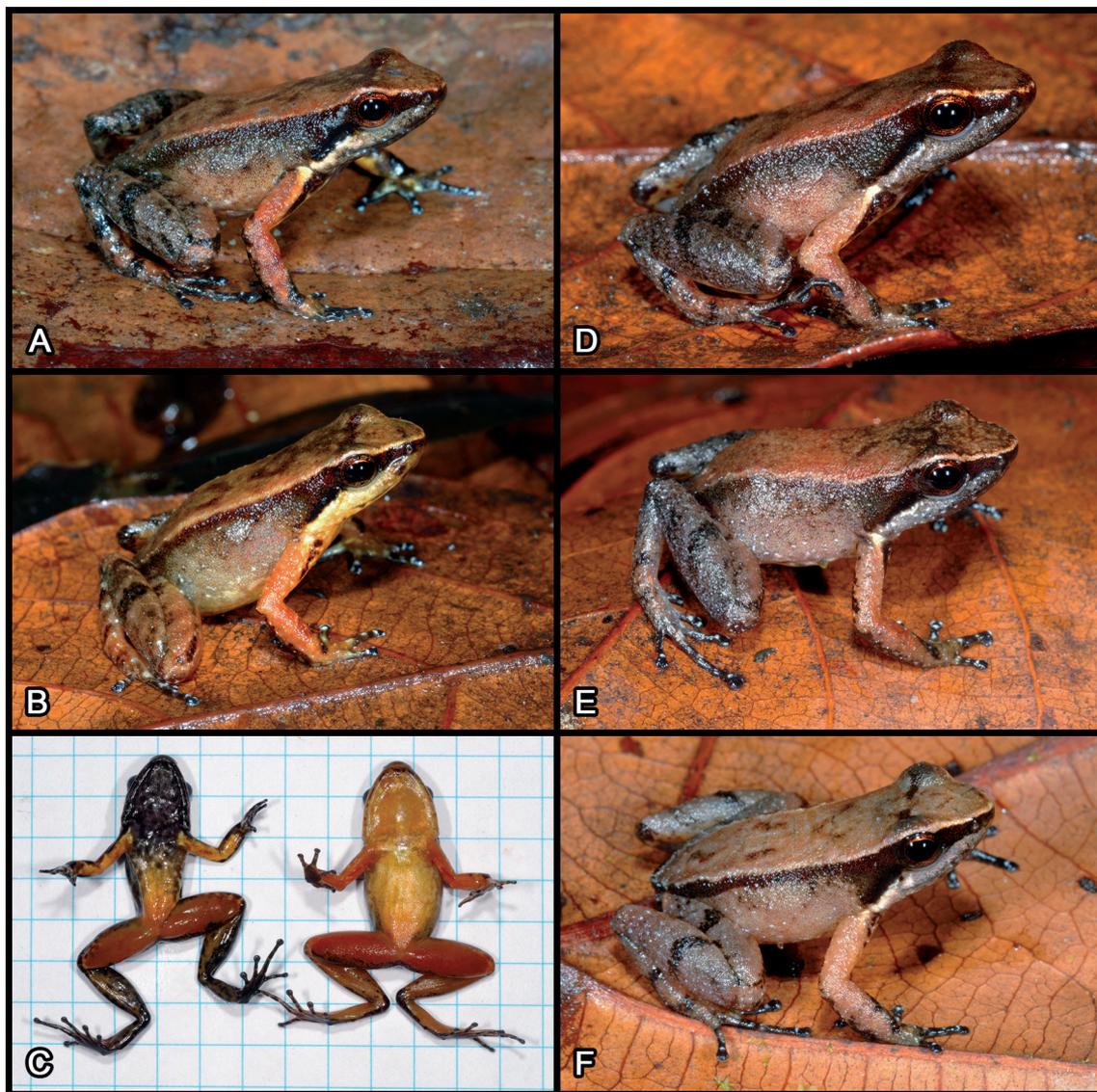


FIGURE 3: *Anomaloglossus praderioi*, showing intrapopulation variation in colour in life and strong sexual throat and ventral dichromatism. **A:** Dorsolateral view of IRSNB 14403, male 20.9 mm SVL. **B:** Dorsolateral view of IRSNB 14404, female 22.7 mm SVL. **C:** Ventral views of male (left, IRSNB 14403) and female (right, IRSNB 14404). **D:** Dorsolateral view of IRSNB 14405, male 20.9 mm SVL. **E:** Dorsolateral view of IRSNB 14406, male 21.3 mm SVL. **F:** Dorsolateral view of IRSNB 14408, male 21.2 mm SVL.

brown, with one to three dark brown to black triangular, diamond-shaped or diffuse hourglass markings from interorbital to presacral region. Upper surface of arm varies from cream to greyish brown, upper surface of leg varies from cream to dark grey, all dark markings remain well visible. Flanks are light to dark grey, usually with some white flecks on the lower part or rarely with a few elongate spots, which in a few dark males can be interpreted as an inconspicuous broken ventrolateral stripe (see footnote above). Although the dorsolateral line completely disappeared in all specimens (unnoticeable even under magnification), the

wide dark brown band of variable width extending from tip of snout laterally around the body and above the vent is still distinct. The orange ventral colouration faded to creamish white, males still have noticeably darker throat, chest and anterior belly, usually with conspicuous black spots [*the original diagnosis – based on two male specimens – mentions that there are no markings on the chest, although the throat is covered by punctuate melanophores* (sin marcas sobre el pecho, aunque hay una punteadura fina de melanóforos que cubren toda la garganta), *but later in the text, describing the colour of the male holotype in preservative La*

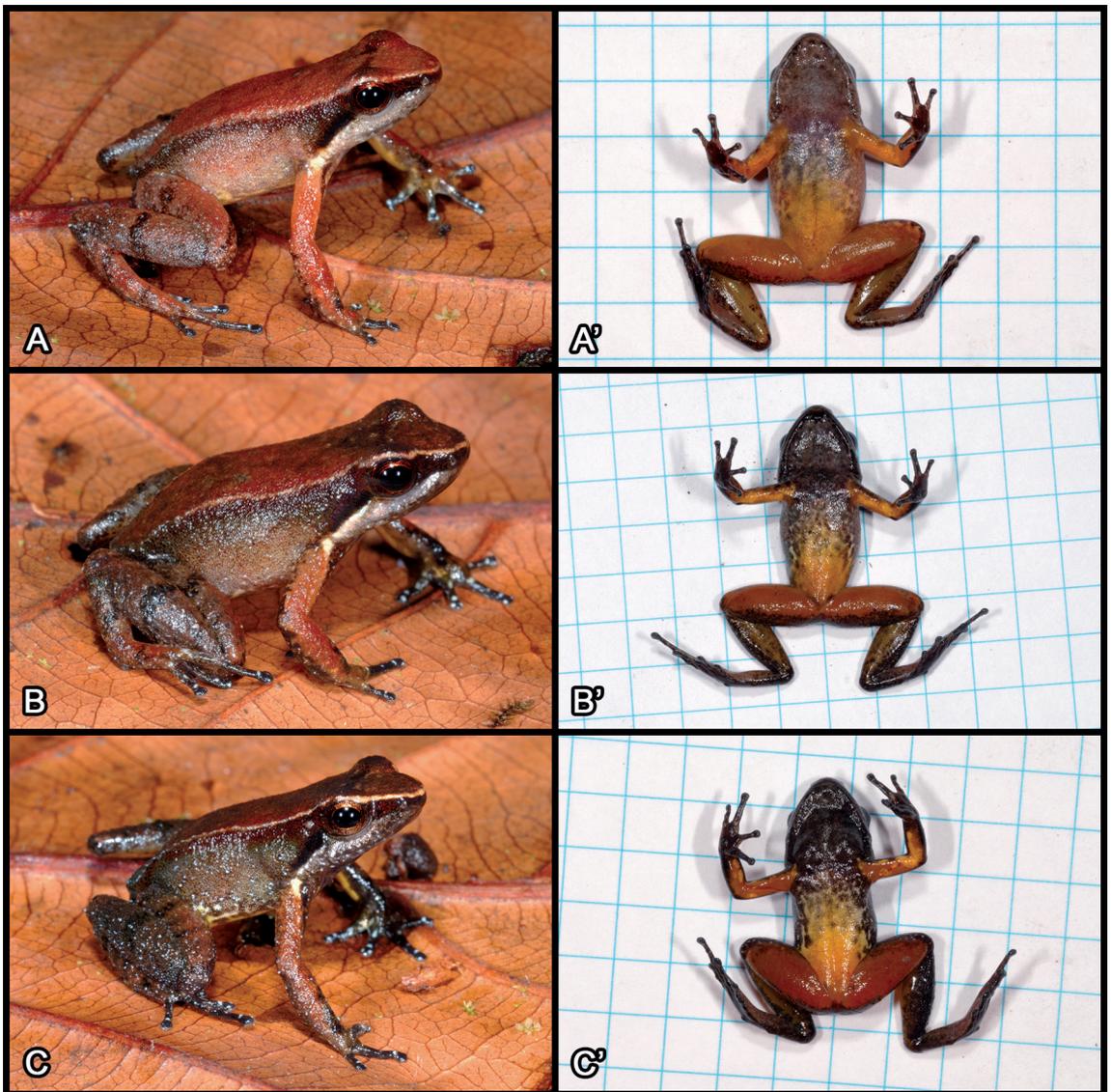


FIGURE 4: *Anomaloglossus praderioi*, showing intrapopulation variation in dorsal and ventral colour in males in life. **A:** Dorsolateral view of IRSNB 14409, 21.1 mm SVL. **A':** Ventral view of the same specimen. **B:** Dorsolateral view of IRSNB 14410, 21.6 mm SVL. **B':** Ventral view of the same specimen. **C:** Dorsolateral view of IRSNB 14407, 20.5 mm SVL. **C':** Ventral view of the same specimen.

Marca stated that throat, chest and anterior part of belly are dark with irregular small spots (el patrón pardo oscuro con manchitas irregulares del fondo se repite en la garganta, pecho y parte anterior del vientre); examination of the type series indicates that in preservative the holotype of A. praderioi has distinctly darker chest and anterior belly, and the paratype has chest and most of belly very dark]; throat of female creamish white with a few melanophores on chin and lower lip. Pale paracloacal marks still visible, palms and soles black (Fig. 6). The holotype (13 years in preservative), the paratype (20 years in preservative) and the specimen from Sierra de Lema (14 months in preservative) conform well to this description.

Tadpole description: The following description – except oral disc – is based on an *Anomaloglossus praderioi* tadpole in stage 28 (IRSNB 14415a, Fig. 7A) that was collected in a small temporary pool. All values are in millimetres. See Table 2 for additional measurements and descriptive statistics for 14 meristic characters based on 11 tadpoles of stages 26–39.

Type 4 tadpole (Orton, 1953), extrophic, benthic ecomorphological guild (Lannoo *et al.*, 1987; Altig & Johnson, 1989). Total length 22.4; body length 8.8 (39.3% total length), tail length 13.6 (60.7%). Body ovoid and depressed; highest body width 5.3, highest body height 4.2; snout bluntly rounded in dorsal and lateral views. Naris very small, circular, directed anterodorsally, opening 1.0 from tip of snout; distance from naris to anterior margin of eye 0.7; internarial distance 1.5, 30.6% head width at level of eyes. Eyes dorsal and directed laterally; eye diameter 0.8; interorbital distance 1.7, 34.7% head width at level of eyes. Spiracle sinistral, tube free, opening directed posterodorsally; tube length 1.0; tube transverse width 0.4; distance from tip of snout to spiracular opening 3.5, 39.8% body length. Vent tube 1.0, dextrally attached to ventral fin, opening directed dextrally. Developing hind limb bud 0.4 in length, 0.2 in width. Caudal musculature robust, highest at junction of body and tail, deeper than fins, tapering to tail terminus, terminating slightly anterior to tail tip; tail muscle width at base of tail 1.8, tail muscle

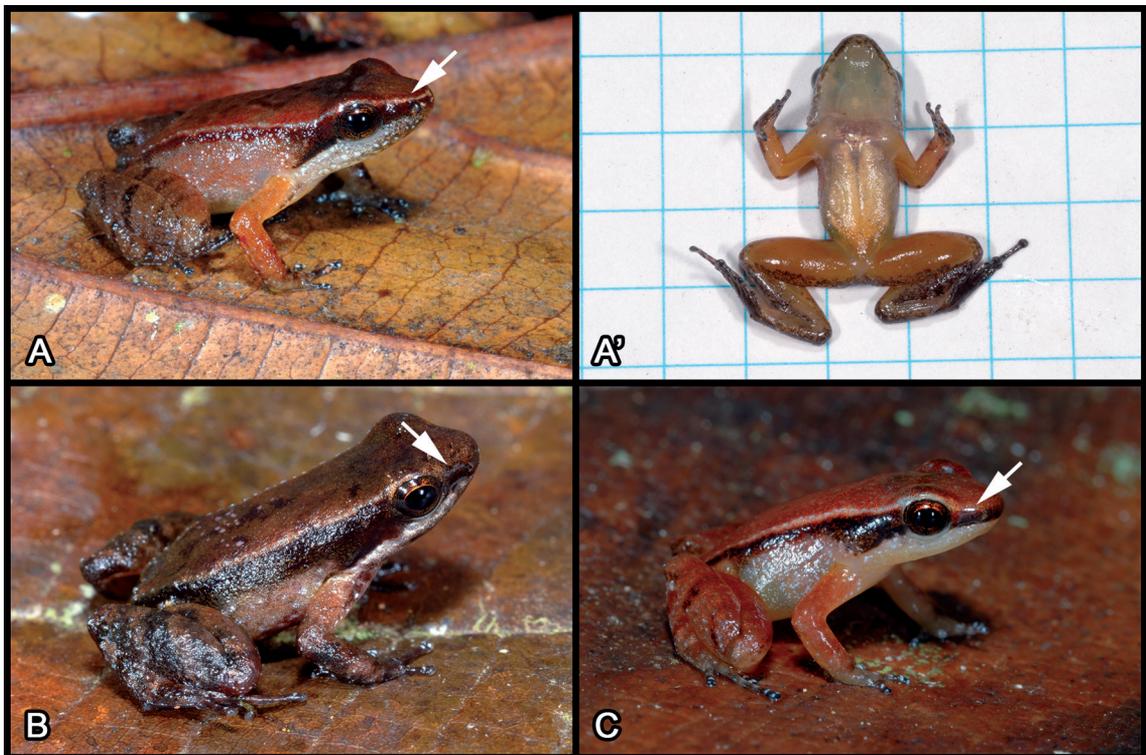


FIGURE 5: Comparison between *Anomaloglossus praderioi* and the sympatric, morphologically similar, *A. kaiei*. **A:** Dorsolateral view of a juvenile *A. praderioi* (IRSNB 14411, 15.0 mm SVL). **A':** Ventral view of the same specimen. **B:** Dorsolateral view of an adult male *A. kaiei* from the southeastern slope of Maringma Tepui at 1,060 m elevation (IRSNB 14417, 19.5 mm SVL). **C:** Dorsolateral view of a juvenile *A. kaiei* from the surrounding of Wayalayeng village, eastern base of Maringma Tepui at 678 m elevation (IRSNB 14418, 13.2 mm SVL). Arrows highlight presence/absence of dorsolateral line between tip of snout and eye, a character that readily distinguish between the species.

height at base of tail 1.8. Upper fin originates at junction of body and tail, equal in height to lower fin, except in the first quarter of tail where it is distinctly lower; upper fin almost straight in its first quarter before increasing in height to about midlength; upper tail fin height 0.9, lower tail fin height 0.9, at midtail. Lateral-line system not detectable.

Oral disc description is based on an *Anomaloglossus praderioi* tadpole in stage 39 (IRSNB 14416b, Fig. 7B-C). Oral disc located anteroventrally, emarginated on left side only (aberrant condition, other tadpoles have oral disc emarginated on both sides); transverse width 2.0 (35.7% body width, 44.6% head width); border of disc surrounded with ca. 72 marginal papillae, ca. 30 on posterolateral margins of anterior labium, ca. 42 on entire posterior labium; gap in papillae on anterior labium ca. 1.3; all papillae small, tapered, blunt-tipped, subequal, ca. 0.08; submarginal papillae present on posterior labium, where papillae are arranged in two more or less distinct rows;

lower jaw sheath V-shaped, narrower than upper jaw sheath; each side of upper sheath sigmoid; both upper and lower sheaths serrated; medial serrations blunt-tipped, lateral ones pointed; serrations extend entire length of sheaths, but do not include lateral processes (Fig. 7B). Labial tooth row formula 2(2)/3; labial teeth numerous, moderately long, strongly curved, bearing ca. 15 cusps (Fig. 7C); tooth row A-1 complete, slightly longer than A-2; tooth row A-2 interrupted medially; lower tooth rows complete, shorter than A-1; tooth row P-1 slightly longer than P-2 and P-3, which are subequal.

Colour of tadpole in life: Dark brown to black with scattered lighter flecks on sides; caudal musculature and upper fin with scattered black flecks; lower fin translucent.

Colour of tadpole in preservative: Background colour brown to dark brown. Venter translucent with some

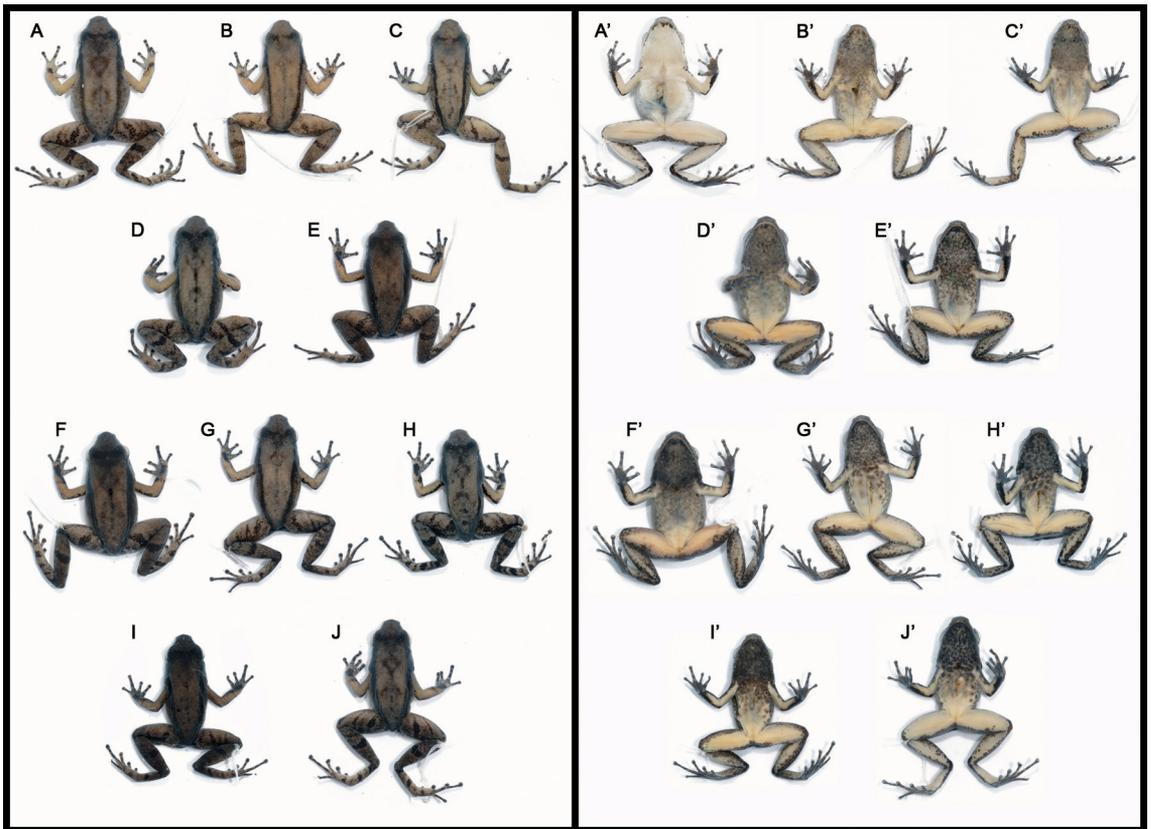


FIGURE 6: *Anomaloglossus praderioi*, showing intrapopulation variation in dorsal (left) and ventral (right) pattern in preservative. A-A': IRSNB 14404, female 22.7 mm SVL. B-B': IRSNB 14409, male 21.1 mm SVL. C-C': IRSNB 14408, male 20.9 mm SVL. D-D': IRSNB 14413, male 21.9 mm SVL. E-E': IRSNB 14410, male 21.6 mm SVL. F-F': IRSNB 14412, male 21.4 mm SVL. G-G': IRSNB 14406, male 21.3 mm SVL. H-H': IRSNB 14403, male 21.2 mm SVL. I-I': IRSNB 14407, male 20.5 mm SVL. J-J': IRSNB 14405, male 20.9 mm SVL.

TABLE 2: Morphometric measurements (in mm) of tadpoles of *Anomaloglossus praderioi*. Abbreviations are defined in the text. Mean \pm SD are followed by the range in parentheses. * tadpole lost before complete measurements were taken.

Character	Stage 26 (N = 5)	Stage 27 (N = 3)	Stage 28 (N = 1)	Stage 31 (N = 1)*	Stage 39 (N = 2)
TL	16.1 \pm 0.5 (15.5-16.8)	19.2 \pm 2.8 (17.5-22.4)	21.1	26.5	24.9 \pm 0.4 (24.5-25.3)
BL	5.2 \pm 0.1 (5.0-5.3)	7.0 \pm 1.8 (5.3-8.8)	8.6	—	7.9 \pm 0.2 (7.7-8.1)
TAL	11.0 \pm 0.4 (10.5-11.5)	12.2 \pm 1.4 (10.8-13.6)	12.5	—	17.0 \pm 0.2 (16.8-17.2)
BW	3.0	4.7 \pm 0.6 (4.2-5.3)	5.6	—	5.6
BH	2.2 \pm 0.1 (2.1-2.4)	3.5 \pm 0.6 (3.0-4.2)	4.2	—	4.1
HW	2.7 \pm 0.1 (2.6-2.9)	4.2 \pm 0.6 (3.7-4.9)	4.6	—	4.7 \pm 0.1 (4.5-4.8)
TMH	1.4	1.6 \pm 0.2 (1.5-1.8)	1.8	—	2.6 \pm 0.2 (2.4-2.8)
TMW	1.3	1.5 \pm 0.3 (1.3-1.8)	1.8	—	2.5
MTH	2.4	3.5 \pm 0.6 (3.0-4.1)	4.0	—	4.4 \pm 0.2 (4.2-4.5)
END	0.5 \pm 0.09 (0.3-0.5)	0.6 \pm 0.1 (0.5-0.7)	0.8	—	0.9 \pm 0.05 (0.8-0.9)
NSD	0.6 \pm 0.05 (0.5-0.6)	0.8 \pm 0.2 (0.7-1.0)	1.0	—	0.7
IND	0.9 \pm 0.1 (0.8-1.0)	1.2 \pm 0.3 (1.0-1.5)	1.4	—	1.6 \pm 0.1 (1.5-1.7)
IOD	1.0 \pm 0.09 (0.8-1.0)	1.4 \pm 0.3 (1.2-1.7)	1.5	—	1.5 \pm 0.05 (1.4-1.5)
ED	0.5 \pm 0.06 (0.5-0.6)	0.7 \pm 0.06 (0.7-0.8)	0.7	—	1.2 \pm 0.1 (1.1-1.3)

scattered melanophores. Caudal musculature and upper fin with scattered dark brown flecks, lower fin mostly immaculate (Fig. 7A).

Ontogenetic changes: Changes in body size are summarized in Table 2. There is no remarkable ontogenetic change, the lateral line system is still difficult

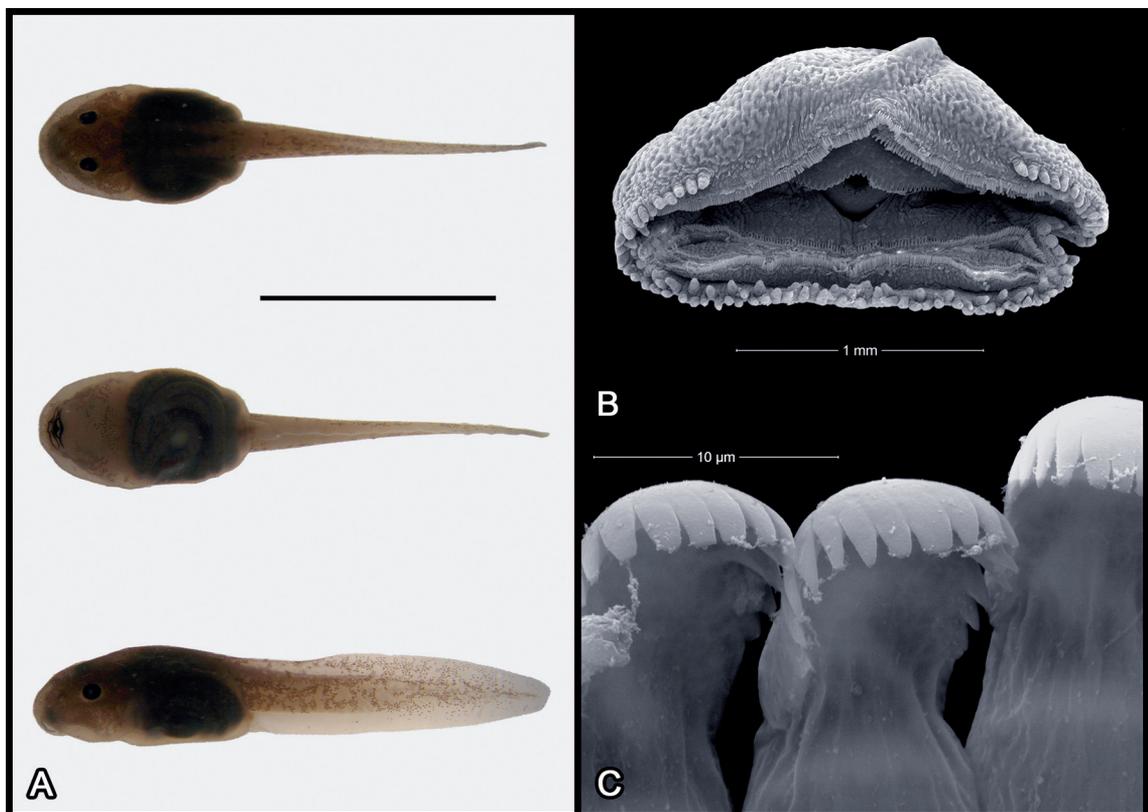


FIGURE 7: Tadpole of *Anomaloglossus praderioi*. **A:** Dorsal, ventral and lateral views of IRSNB 14415a, a stage-28 tadpole in preservative. Scale bar is 10 mm. **B:** Photomicrograph of the oral disc of IRSNB 14416b, a stage-39 tadpole (130x magnification), teeth row A-2 mostly hidden by A-1. **C:** Photomicrograph of labial teeth of the same specimen (13000x magnification).

TABLE 3: Measurements of acoustic parameters for two males *Anomaloglossus praderioi*. Mean \pm SD are followed by the range in parentheses. Temperature varied from 19.8-20°C.

Individual	Call rate (calls/min)	Note duration (s)	Inter-call interval (s)	Dominant frequency (Hz)
IRSNB 14410, calling alone	69.7 \pm 4.64 (65-76)	0.045 \pm 0.002 (0.043-0.049)	0.838 \pm 0.2 (0.554-1.153)	3856
Unvouchered specimen, calling antiphonally with other males in the background	63.3 \pm 2.05 (61-66)	0.042 \pm 0.001 (0.041-0.043)	1.112 \pm 0.2 (0.730-1.502)	3562

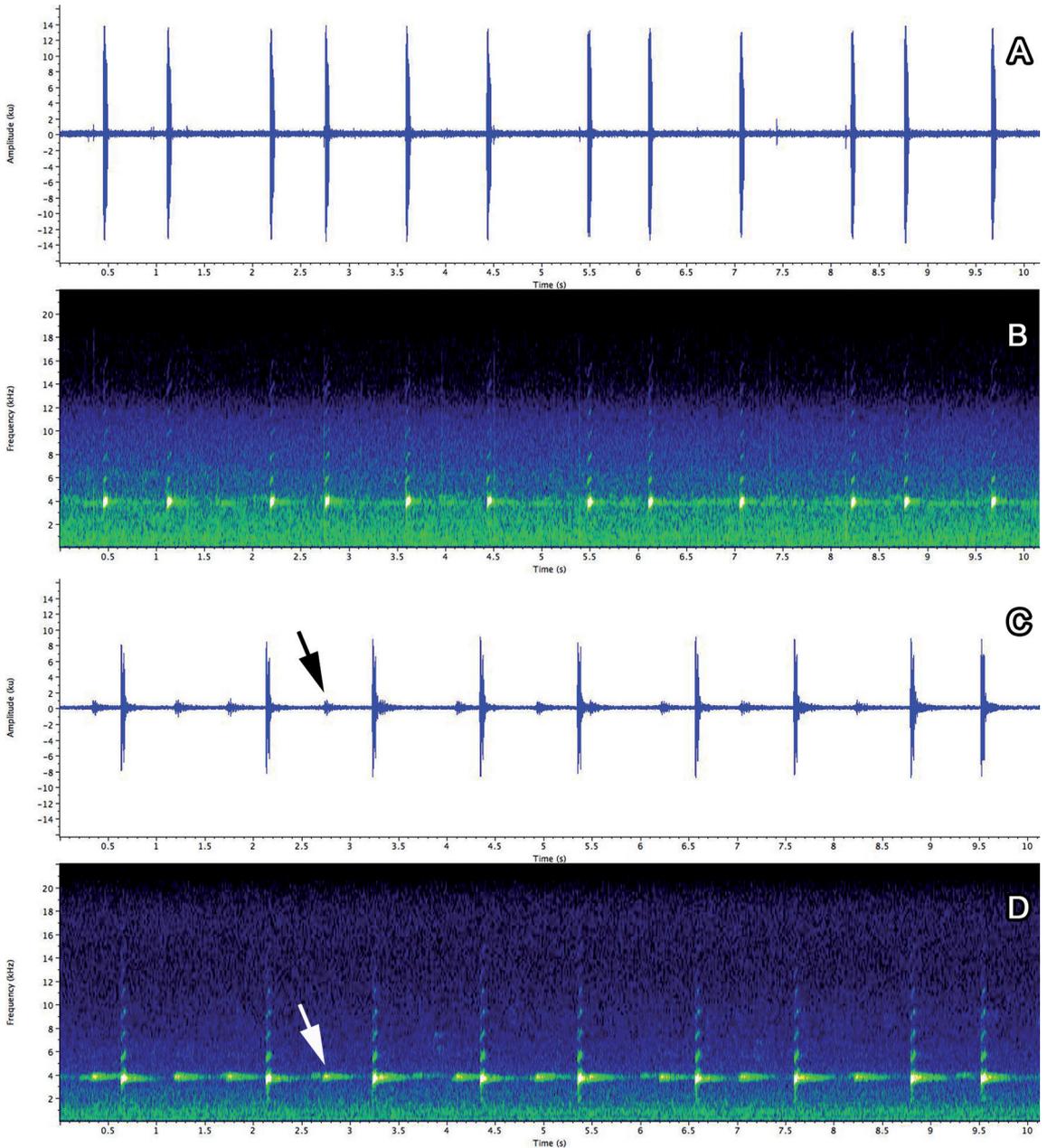


FIGURE 8: Vocalisation of *Anomaloglossus praderioi*. **A:** Oscillogram. **B:** Spectrogram (recording of IRSNB 14410). **C:** Oscillogram. **D:** Spectrogram (recording of an unvouchered specimen). Arrows indicate another male calling antiphonally. Temperature varied from 19.8-20°C.

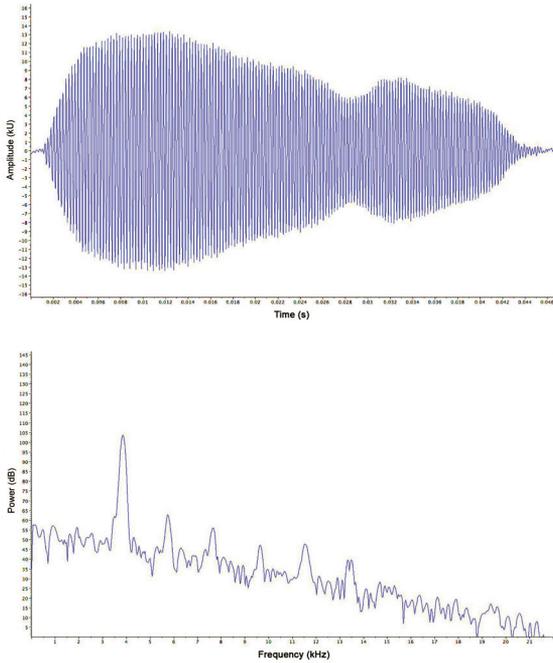


FIGURE 9: Vocalisation of *Anomaloglossus praderioi*. Expanded oscillogram of the first note in Fig. 8A-B showing slight amplitude modulation (top) and spectral slice of the same note (bottom). Temperature varied from 19.8–20°C.

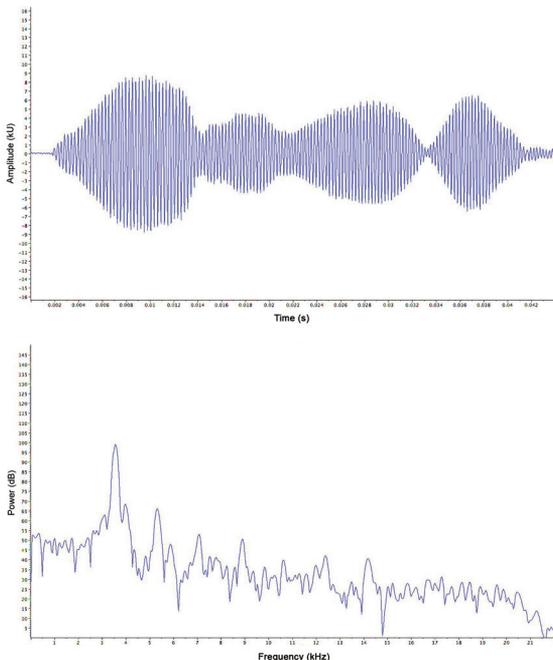


FIGURE 10: Vocalisation of *Anomaloglossus praderioi*. Expanded oscillogram of the first note in Fig. 8C-D showing strong amplitude modulation (top) and spectral slice of the same note (bottom). Temperature varied from 19.8–20°C.

to detect in stage-39 tadpoles, in which a short, discontinued infraorbital branch originating from near upper labium is barely visible. A very short superior trunk branch is barely visible as well. Distal lower fin is slightly more pigmented in stage-28 and stage-39 tadpoles. Number of rows of marginal papillae on posterior labium is variable (from one in most stages-26-28 tadpoles to two in stage-39 tadpoles). Size of A-2 gap is variable and apparently not related to age.

Comparison with other known Anomaloglossus tadpoles occurring in the Eastern Pantepui District: The tadpole of *A. praderioi* is immediately distinguished from that of *A. beebei* in being dark brown to black (pale yellow to golden in *A. beebei*), and benthic (arboreal in *A. beebei*, which breeds exclusively in bromeliads phytotelmata). Most benthic *Anomaloglossus* tadpoles are very similar and difficult to distinguish, especially in preservative. Although similar to the tadpoles of *A. parkerae* and *A. tepuyensis*, the tadpole of *A. praderioi* differs from those species in having the first quarter of the upper fin straight before increasing in length to about midlength (*vs.* upper fin gradually increasing in length from tail-body junction), a character apparently common to all non-riparian species. The tadpole of *A. kaiei* is also very similar, sharing the same upper fin characteristic, but is distinctly smaller at equal stages (*e.g.* range of total length in stage-27 tadpoles 12.6–16.4 in *A. kaiei vs.* 17.5–22.4 in *A. praderioi*) and has maximum tail height always lower than body height (*vs.* subequal to slightly higher).

Advertisement call: The following description is based on a sample of 20 advertisement calls from two males



FIGURE 11: Habitat of *Anomaloglossus praderioi* on the southeastern slope of Maringma Tepui, Guyana, at 1,370 m elevation.

(10 calls per male), IRSNB 14410 and an unvouchered specimen, both individuals recorded on the southeastern slope of Maringma Tepui, on 24 November 2007 between 14h30-15h00, air temperature 19.8-20°C. IRSNB 14410 was calling alone (Fig. 8A-B), whereas the unvouchered specimen was calling antiphonally with other males in the background (Fig. 8C-D).

Temporal structure: The advertisement call of *Anomaloglossus praderioi* consists of long trains of a single, variably pulsed note (Figs. 8-10). Amplitude modulations (pulses) are variably evident in the oscillograms and range from two to four (Figs. 9-10). The call rate varies between 65-76 (IRSNB 14410) and 61-66 calls/min (unvouchered individual) based on a 3 min period. The mean call duration for the two males is 0.045 ± 0.002 and varies from 0.041 to 0.049 s. The inter-call interval is not uniform and has a mean of 0.960 ± 0.248 and a range of 0.554-1.502 s. A slight decrease in call rate and note duration, and an increase in inter-call interval and amplitude modulation are noticeable in the unvouchered specimen (see Table 3), which was calling antiphonally with other males in the background at the same air temperature (Fig. 8, Fig. 9 vs. 10).

Spectral structure: Six to seven harmonics are developed, with the fundamental frequency dominating (mean: 3,709, range: 3,562-3,856 Hz) (Figs. 9-10). The distribution of sound energy decreases progressively through the higher harmonics. The dominant frequency is slightly modulated upwards.

Comparison with other Anomaloglossus calls: Only one *Anomaloglossus* species for which calls are known produces a single note per call: *A. degranvillei*, which does not occur in the Pantepui region but in French Guiana and Suriname and likely in adjacent Brazil (Frost, 2009). The call of *A. degranvillei* can notably be distinguished from that of *A. praderioi* by lower call rate (42 vs. 61-76 in *A. praderioi*), higher dominant frequency (4,280-4,640 vs. 3,562-3,856 in *A. praderioi*), and in having the dominant frequency located in the second harmonic (in the fundamental harmonic in *A. praderioi*).

Distribution and natural history: *Anomaloglossus praderioi* is currently known from two localities in eastern Venezuela: at 1,374 m elevation in the Sierra de Lema (currently the western and northernmost known locality), and between 1,800-1,950 m elevation on the slopes of Mt. Roraima (type locality), and two localities in Guyana: at 1,310 m elevation on the

slopes of Mt. Roraima, and at 1,376 m elevation on the slopes of Maringma Tepui (currently the eastern and southernmost known locality) (Fig. 1). *Anomaloglossus praderioi* seems thus restricted to undisturbed forests at elevations between 1,310-1,950 m and is probably restricted to the eastern part of the Eastern Pantepui District (see Discussion). It is expected to be discovered in suitable habitat along the Pakaraima Mountains range in Guyana and northern Brazil as well as in the eastern part of the Sierra de Lema and the Sierra de Rinocote in Venezuela.

Anomaloglossus praderioi occurs in undisturbed montane medium-canopy forest with abundant epiphytes and mosses and rich undergrowth (Fig. 11). The species is locally abundant and was never found syntopic with the sympatric *A. kaiei*, which never occurs above 1,060 m elevation. All specimens were collected during the day, on the ground, never closely associated with water bodies. Males emitted vocalisations the entire day. Courtship was not observed and oviposition site is unknown. A male was found carrying five tadpoles on his back; tadpoles are deposited in small temporary pools.

DISCUSSION

Poor and/or inaccurate original descriptions not only prevent correct identification of new material, but also impede new species descriptions. The problem is of course exacerbated when authors do not examine holotypes and faithfully follow original descriptions as a basis for diagnosing new species (see a striking example in Kok & Rivas Fuenmayor, 2008). The genus *Anomaloglossus* is particularly affected by this problem because many species have been described on the basis of few preserved specimens – sometimes a single immature individual (e.g. *A. murisipanensis*, *A. roraima*) with no additional material available. Important diagnostic characters, such as dorsolateral lines, may be lost in preserved specimens: the original description of *A. praderioi* mentions that the species lacks dorsolateral lines, which is true in preservative, but these lines are conspicuous in living specimens.

I recently had the opportunity to examine type series of most *Anomaloglossus* from the Pantepui region (northeastern South America) in the context of a taxonomic redefinition of the species, which confirmed the presence of a median lingual process in all of them and revealed significant discrepancies between some type specimens and original descriptions. Inconsistencies concerned wrong determination of sex, wrong

evaluation of age, and inaccurate descriptions of important diagnostic characters such as skin texture, length of Finger I vs. II, and condition of fringes on fingers and toes. New descriptions of these taxa on the basis of newly collected material are in great demand to avoid misidentifications, confusing diagnoses, and descriptions of synonyms. Since examining type series might be problematic (most museums refuse now to lend type material), good redescriptions and redefinitions of species are invaluable (e.g. Myers & Donnelly, 2008). Descriptions of new *Anomaloglossus* species without examining comparative type material should not be prevented, but the greatest caution should be exercised.

An additional problem in the genus *Anomaloglossus* is the great intraspecific variability in some taxa and the apparent occurrence of cryptic species that are morphologically almost impossible to distinguish (e.g. *A. baebatrachus* and *A. stepheni*), especially in preservative. Ideally, redescriptions – and new taxa descriptions – should include tadpole, call, and data on natural history. Phylogenetic analyses are also critical, and probably necessary to support species identity and detect cryptic taxa.

I examined a series of *Anomaloglossus* sp from Mt. Wokomung and Mt. Ayanganna, Guyana (ROM specimens, see Appendix) that are superficially very similar to *A. praderioi* and possibly conspecific. However, I decided to not include this material collected about 100 km east of the type locality (see Fig. 1) in the present work because specimens from these populations differ from *A. praderioi* in discrete morphological characters and probably belong to a cryptic undescribed taxon. Pending additional morphological and molecular evidence I currently consider these populations as *Anomaloglossus* cf. *praderioi*. Grant *et al.* (2006:121) reached a similar conclusion notably finding 8.3 % uncorrected pairwise distance between Cytochrome *b* sequences of a specimen from Mt. Ayanganna [called “Ayanganna” in Grant *et al.* (2006)] and two specimens of *A. praderioi* from near the type locality.

Due to its relatively wide range and apparently healthy populations occurring in pristine habitat (especially in Guyana), I suggest that *Anomaloglossus praderioi* be classified as “Least Concern” (LC) in accordance with the criteria of IUCN (2001). However, because of possible chytridiomycosis outbreak, known Venezuelan populations should be monitored.

The range of *Anomaloglossus kaiei* is here reported to be broader than was previously known (see Kok, 2008). It occurs from Kaieteur National Park to the slopes of Maringma Tepui, at elevations between

150-1,060 m. The species is also present on the slopes of Mt. Wokomung. If some *Anomaloglossus* probably do have restricted distributions, some other species are widespread, and lowland and “tepui slopes” species should be expected to be more widespread than previously thought.

RESUMEN

Anomaloglossus praderioi fue originalmente descrito como *Colostethus praderioi* por E. La Marca en 1998 con dos ejemplares machos. El presente artículo ofrece una redescrición detallada de la especie basada en nuevos ejemplares de Maringma Tepui, en Guyana y ejemplares adicionales de la Sierra de Lema, en Venezuela. La redescrición incluye la vocalización y descripción del renacuajo. *Anomaloglossus praderioi* es de tamaño mediano y se distingue principalmente de sus congéneres por los siguientes caracteres: los dedos I, II y IV con igual longitud; punta del dedo IV apenas llega a la base del tubérculo subarticular distal del dedo III, cuando estos son colocados juntos; dedos II y III con la quilla preaxial y pliegues laterales; dedos de los pies palmeados basalmente, excepto en los dedos IV-V; simétricos tubérculos cloacales presentes; franja delgada dorsolateral de color pálido, la cual va desde la punta del hocico hasta la punta de urostilo; banda ventrolateral inconspicua, nunca recta; banda lateral oblicua ausente. Macho con garganta de color gris a gris muy oscuro, casi negro uniforme. En hembras la garganta es de color naranja brillante, casi inmaculada. La larva es castaño oscuro a negro, de hábitos exotróficos y bentónicos, LTRF 2 (2)/3. La llamada de advertencia consiste de largas series de una nota sencilla repetida a un ritmo de 61-76 notes/min con una frecuencia dominante que va desde 3,562 a 3,856 Hz. La especie queda registrada para el sureste de Venezuela y oeste de Guyana, habitando bosques montanos con cobertura media en elevaciones entre los 1,310-1,950 m s.n.m.

PALABRAS-CLAVE: Escudo de Guayana; Guyana; Pantepui; Redescrición; Taxonomía; Venezuela; Vocalización.

ACKNOWLEDGMENTS

I thank the following curators and collection managers for their assistance and access to collections under their care: F.J. Bisbal, E. Camargo, R. Rivero, J. Sánchez (EBRG), E. La Marca (ULABG), M. Salazar (MBUCV), and J.C. Señaris (MHNLS). R.W.

Murphy, R.D. MacCulloch and A. Lathrop (ROM) lent specimens under their care; R.D. MacCulloch and A. Lathrop shared unpublished data. I am indebted to C.L. Barrio, E. Camargo, O. Lasso, and G. Rivas and his family for their help in many ways and for accommodation during my stay in Venezuela. For field assistance in Guyana, I thank P. Benjamin, C. Perry and H. Aaron, chief of the village of Wayalayeng, C.J. Cole (AMNH) and an anonymous reviewer provided useful comments; G. Rivas translated the abstract into Spanish. This study received partial financial support from the Belgian Directorate-General of Development Cooperation with additional partial support from the King Léopold III Fund for Nature Exploration and Conservation. Help and support of the Prime Minister of Guyana, the Honorable Samuel Hinds, and the personnel of the Guyana Embassy in Brussels are warmly acknowledged. Permission to conduct this study in indigenous lands in the Pakaraima Mountains of Guyana was granted by the Guyanese Ministry of Amerindian Affairs. Research permit (160107BR068) and export permit (191207SP018) were issued by the Guyana EPA.

REFERENCES

- ALTIG, R. & JOHNSON, G.F. 1989. Guilds of anuran larvae: relationships among developmental modes, morphologies and habitats. *Herpetological Monographs*, 3:81-109.
- ALTIG, R. & McDIARMID, R.W. 1999. Body plan. In: McDiarmid, R.W. & Altig, R. (Eds.), *Tadpoles: the Biology of Anuran Larvae*. Chicago. University of Chicago Press, p.24-51.
- BARRIO-AMORÓS, C.L. 1998. Sistemática y Biogeografía de los anfibios (Amphibia) de Venezuela. *Acta Biologica Venezuelica*, 18(2):1-93.
- BARRIO-AMORÓS, C.L. 2004. Amphibians of Venezuela: systematic list, distribution and references; an update. *Revista de Ecología Latino Americana*, 9:1-48.
- CHARIF, R.A.; WAACK, A.M. & STRICKMAN, L.M. 2008. *Raven Pro 1.3 User's Manual*. Cornell Laboratory of Ornithology, Ithaca, NY, USA.
- ECHEVERRÍA, D.D. 1997. Microanatomy of the buccal apparatus and oral cavity of *Hyla minuta* Peters, 1872 larvae (Anura, Hylidae), with data on feedings habits. *Alytes*, 15:26-36.
- FROST, D.R. 2009. *Amphibian Species of the World: an Online Reference*. Version 5.3 (12 February 2009). American Museum of Natural History, New York, USA. Available at: <http://research.amnh.org/herpetology/amphibia/index.php>. Access in: March 2009.
- GOSNER, K.L. 1960. A simplified table for staging anuran embryos and larvae with notes on identification. *Herpetologica*, 16:183-190.
- GRANT, T. & CASTRO-HERRERA, F. 1998. The cloud forest *Colostethus* (Anura, Dendrobatidae) of a region of the Cordillera Occidental of Colombia. *Journal of Herpetology*, 32:378-392.
- GRANT, T.; FROST, D.R.; CALDWELL, J.P.; GAGLIARDO, R.; HADDAD, C.F.B.; KOK, P.J.R.; MEANS, D.B.; NOONAN, B.P.; SCHARGEL, W.E. & WHEELER, W.C. 2006. Phylogenetic systematics of dart-poison frogs and their relatives (Amphibia: Athesphatanura: Dendrobatidae). *Bulletin of the American Museum of Natural History*, 299:1-262.
- IUCN, 2001. *IUCN Red List Categories and Criteria*. Version 3.1. IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK.
- KAPLAN, M. 1997. A new species of *Colostethus* from the Sierra Nevada de Santa Marta (Colombia) with comments on intergeneric relationships within the Dendrobatidae. *Journal of Herpetology*, 31:369-375.
- KOK, P.J.R. 2008. *Anomaloglossus beebei*. In: IUCN 2009. *IUCN Red List of Threatened Species*. Version 2009.1. Available at: <http://www.iucnredlist.org>. Access in: March 2009.
- KOK, P.J.R. & KALAMANDIEN, M. 2008. *Introduction to the Taxonomy of the Amphibians of Kaieteur National Park, Guyana*. Abc Taxa, Brussels.
- KOK, P.J.R. & RIVAS FUENMAYOR, G. 2008. *Typhlophis ayarzaguenai* Señaris, 1998 is a junior synonym of *Typhlophis squamosus* (Schlegel, 1839). *Amphibia-Reptilia*, 29:555-558.
- LA MARCA, E. 1998 "1996". Ranas del género *Colostethus* (Amphibia: Anura: Dendrobatidae) de la Guyana Venezolana con la descripción de siete especies nuevas. *Publicaciones de la Asociación de Amigos de Doñana*, 9:1-64.
- LANNOO, M.J.; TOWNSEND, D.S. & WASSERSUG, R.J. 1987. Larval life in the leaves: arboreal tadpole types, with special attention to the morphology, ecology and behaviour of the oophagous *Osteopilus brunneus* (Hylidae) larva. *Fieldiana Zoology*, 38:1-31.
- MYERS, C.W. & DONNELLY, M.A. 2008. The summit herpetofauna of Auyantepui, Venezuela: report from the Robert G. Golet American Museum-Terramar Expedition. *Bulletin of the American Museum of Natural History*, 308:1-147.
- MYERS, C.W. & DUELLMAN, W.E. 1982. A new species of *Hyla* from Cerro Colorado, and other tree frog records and geographical notes from western Panama. *American Museum Novitates*, 2752:1-32.
- MYERS, C.W. & GRANT, T. 2009. *Anomaloglossus confusus*, a new Ecuadorian frog formerly masquerading as "*Colostethus*" *chocoensis* (Dendrobatoidea: Aromobatidae). *American Museum Novitates*, 3659:1-12.
- ORTON, G.L. 1953. The systematics of vertebrate larvae. *Systematic Zoology*, 2:63-75.
- SAVAGE, J.M. & HEYER, W.R. 1967. Variation and distribution of the tree-frog genus *Phyllomedusa* in Costa Rica, Central America. *Beiträge zur Neotropischen Fauna*, 5:111-131.
- SAVAGE, J.M. & HEYER, W.R. 1997. Digital webbing formulae for anurans: a refinement. *Herpetological Review*, 28:131.

Recebido em: 03.09.2009

Aceito em: 21.01.2010

Impresso em: 31.03.2010

APPENDIX

Specimens Examined

Anomaloglossus beebei: Guyana, Potaro-Siparuni District, Kaieteur National Park, IRSNB 13721-26, 13728-53, ULABG 6817 (ex IRSNB 13727), IRSNB 13754 (tadpoles), IRSNB 13779-81 (tadpoles).

Anomaloglossus breweri: Venezuela, Estado Bolívar, Aprada Tepui, Cueva del Fantasma, MHNLS 17044 (holotype), MHNLS 17045-46 (paratypes).

Anomaloglossus kaiei: Guyana, Potaro-Siparuni District, Kaieteur National Park, IRSNB 1938 (holotype), IRSNB 1939-64 (paratypes), IRSNB 14420-57, IRSNB 13755-78 (tadpoles), ROM 42999; Cuyuni-Mazaruni District, Wayalayeng, IRSNB 14922-24, Maringma Tepui, IRSNB 14925-31, Mount Wokomung, ROM 43321, ROM 43327, ROM 43330, ROM 43333.

Anomaloglossus murisipanensis: Venezuela, Estado Bolívar, Murisipan-Tepui, MHNLS 11385 (holotype)

Anomaloglossus parkerae: Venezuela, Estado Bolívar, Sierra de Lema, Salto El Danto, MHNLS 2901, MHNLS 11088-89.

Anomaloglossus praderioi: Guyana, Cuyuni-Mazaruni District, Maringma Tepui, IRSNB 11403-13, IRSNB 14414-16 (tadpoles); Venezuela, Estado Bolívar, Mount Roraima ULABG 4196 (holotype), MHNLS 11272 (paratype), Sierra de Lema, EBRG 5569.

Anomaloglossus cf. *praderioi*: Guyana, Cuyuni-Mazaruni District, Mount Wokomung, ROM 43320, ROM 43322-26, ROM 43328-29, ROM 43331-32, ROM 43896, Mount Ayanganna ROM 39639.

Anomaloglossus roraima: Venezuela, Estado Bolívar, Mount Roraima, ULABG 4197 (holotype).

Anomaloglossus rufulus: Venezuela, Estado Bolívar, Amuri-Tepui, Chimantá Massif, MHNLS 10361 (holotype).

Anomaloglossus tepuyensis: Venezuela, Estado Bolívar, Auyantepui, ULABG 2557 (holotype), Cucurital River, MHNLS 14404-05, Purumay River, MHNLS 14924-25, MHNLS 14940-41, MHNLS 15687, Quebrada Atapere, MHNLS 15924, MHNLS 17359-60, MHNLS 17383, Quebrada Tucutupan, MHNLS 17401, Quebrada Rutapa, MHNLS 17361.

Anomaloglossus triunfo: Venezuela, Estado Bolívar, Cerro Santa Rosa, Serranía del Supamo, EBRG 4756 (holotype), EBRG 4757-59 (paratypes).