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A new species of *Amazophrynella* (Anura: Bufonidae) from southern Amazonia

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Abstract

A new species of the genus *Amazophrynella* is described from southern Amazonia, Brazil. The new species is characterized by its medium size for the genus (15.2–19.3 mm SVL in males, 20.2–25.7 mm SVL in females), snout rounded in dorsal view, acute in lateral view, presence of subrostral crest not converging anteriorly, finger I shorter than finger II, and by dorsal and ventral coloration. The reproductive behavior of the new species is similar to other *Amazophrynella* with pigmented and numerous eggs that are probably laid in temporary ponds.

Key Words: Amphibia, Bufonidae, Anura, Amazon

Introduction

The formerly known Neotropical genus *Dendrophryniscus* Jiménez de la Espada, 1871, was until recently consisted of ten small species distributed in Amazonia and the Atlantic forest in Colombia, Ecuador, Peru, Guiana and Brazil (Frost, 2011). Recently, the systematic of *Dendrophryniscus* was studied by Fouquet et al. (2012a, b) based on both molecular and morphological data and they erected the genus *Amazophrynella* to accommodate the Amazonian species. Thus, eight species of *Dendrophryniscus* were recognized, all of them inhabiting the Atlantic Forest domain in southeastern and southern region of Brazil (*D. berthallutzae* Izecksohn, 1994, *D. brevipollivatus* Jiménez de la Espada, 1871, *D. carvalhoi* Izecksohn, 1994, *D. leucomystax* Izecksohn, 1968, *D. oreites* Recoder, Teixeira Jr, Cassimiro, Camacho and Rodrigues, 2010, *D. organensis* Carvalho-e-Silva, Mongin, Izeckson, and Carvalho-e-Silva, 2010, *D. proboscideus* (Boulenger, 1882) and *D. stawarskyi* Izecksohn, 1994). In Amazonia, two species of *Amazophrynella* were therefore recognized (*A. bokermanni* Izecksohn, 1993, and *A. minuta* Melin, 1941).

Herein, we describe a new species of *Amazophrynella* that inhabits Amazonian forests south of the Amazon River in the states of Mato Grosso, Rondônia and Amazonas, Brazil.

Material and Methods

Specimens examined and used for comparisons are deposited at the Coleção Zoológica de Vertebrados da

Universidade Federal de Mato Grosso, Cuiabá, Brazil and at the at the Instituto Nacional de Pesquisas da Amazônia (INPA-H), Manaus, Brazil and are listed in the Appendix. Additionally, we examined color photographs of the syntypes of *Amazophrynella minuta* deposited at Naturhistoriska Museet, Göteborg, Sweden (NHMG).

Measurements (mm) were taken with digital callipers to the nearest 0.1 mm and follow Cruz and Fusinato (2008). The following measurements were made: SVL (snout-vent length); HL (head length); HW (head width); IND (internarinal distance); ESD (eye-snout distance); END (eye to nostril distance); ED (eye diameter); IOD (interorbital distance); UEW (upper eyelid width); THL (thigh length); TL (tibia length); TAL (tarsal length); FL (foot length). Webbing formulae follow Savage & Heyer (1997).

Results

Amazophrynella vote sp. nov.

(Figure 1)

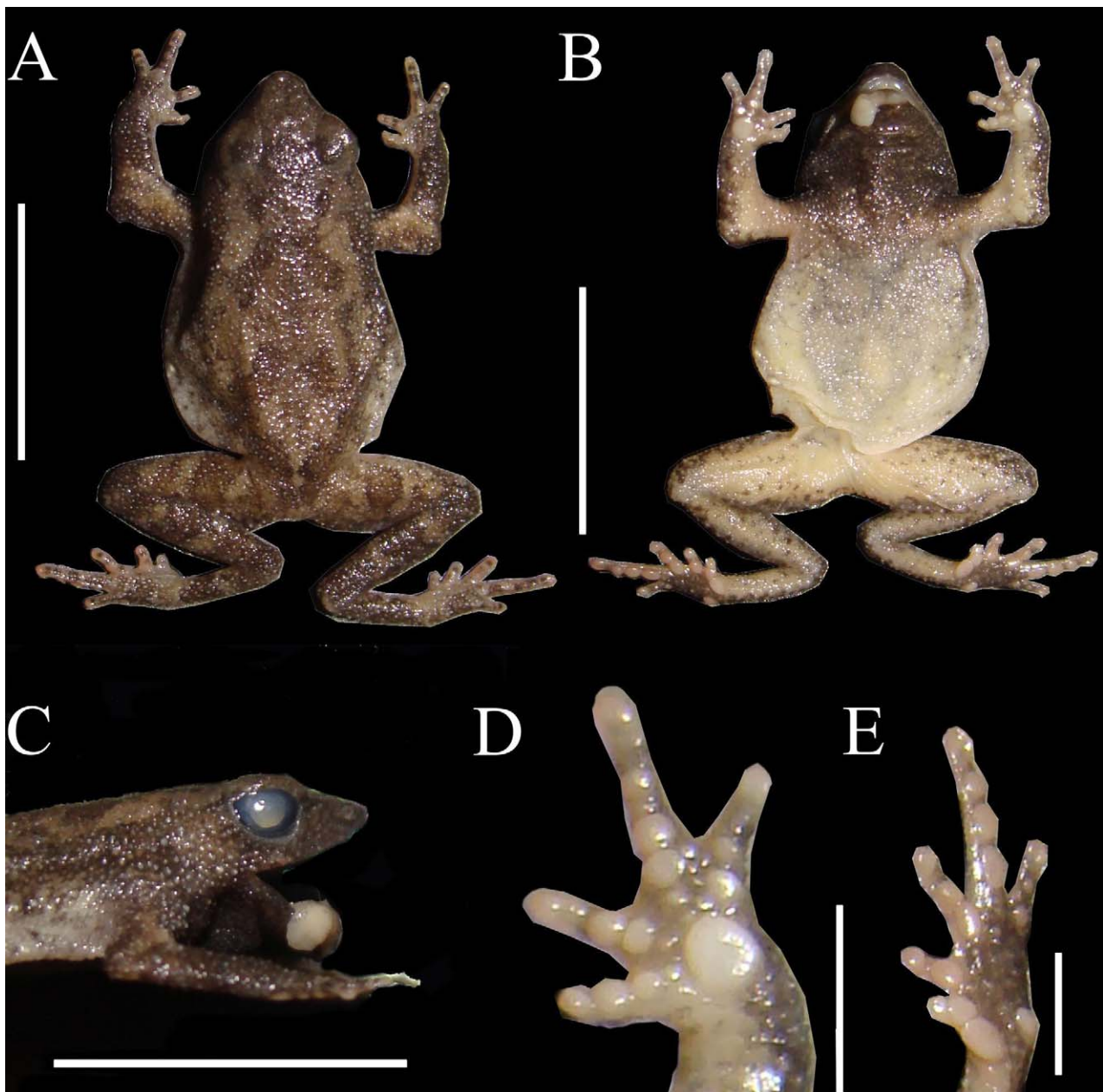


FIGURE 1. Holotype of *Amazophrynella vote* sp. nov. (UFMT-A 11138): A. Dorsal view, scale=10mm; B. Ventral view, scale=10mm; C. Lateral view of the head, scale=10mm; D. Ventral view of left hand, scale=2mm; E. Ventral view of left foot, scale=2mm.

Holotype. UFMT-A 11138, adult male, collected on Fazenda São Nicolau (09°50'43.3"S, 58°13'10.6"W), municipality of Cotriguaçu, Mato Grosso state, central Brazil, on 10 December 2009, by Domingos J. Rodrigues.

Paratopotypes. UFMT-A 11136, 11145–11150, 11152–11155 (adult females), UFMT-A 6914, 11137, 11139–11144, 11151, 11156–11157 (adult males) collected between 8–15 December 2009 by Ricardo A. Kawashita-Ribeiro.

Paratypes. UFMT-A 4412 (adult male), UFMT-A 4401, 4407–4411 (juveniles not sexed), collected on Fazenda Maracatiá (09°10'45"S, 60°37'50"W), municipality of Aripuanã, Mato Grosso state, Brazil, between 08/11/2006 to 08/06/2007 by Robson W. Ávila and Ricardo A. Kawashita-Ribeiro; UFMT-A 7852–7853 (juveniles), collected on Mineração Dardanelos, municipality of Aripuanã, Mato Grosso state, on 01/10/2008 by Joseana Freitas and Drausio H. Morais; INPA-H 12256 and 12331 (juveniles), INPA-H 12255, 12342–12343, 12366 (adult females) and INPA-H 12267 (adult male), collected on Cachoeirinha, Rio Madeira, municipality of Manicoré, Amazonas state, Brazil, between 10 to 22/09/2004 by Camila Ferrara, Rafael Bernhard and Miguel T. U. Rodrigues; INPA-H 12326 (adult female), collected on Lago do Açai, Rio Aripuanã, municipality of Novo Aripuanã, Amazonas state, Brazil, on 10/09/2004 by Camila Ferrara and Rafael Bernhard; INPA-H 21558 (adult male), collected on Parque Estadual do Guariba, municipality of Manicoré, Amazonas state, Brazil, on 8/11/2008 by Davi Pantoja; INPA-H 27412, 27417–27419, 27421–27423, 27425–27426 (juveniles), collected on Parque Nacional Nascentes do Lago Jari, Tapauá municipality, Amazonas state, Brazil, on 16/08/2010 by Vinícius Tadeu de Carvalho, Henrique Luiz Condrati and Shanna Bittencourt; UFMT-A 13680–13681 (juveniles), collected on Reserva Biológica Jaru, Ji-Paraná municipality, Rondônia state, Brazil, by Christine Strüßmann.

Diagnosis: The new species is unambiguously embedded in the genus *Amazophrynella* (Fouquet et al., 2012a) given it possesses the following characters: small size, hind limbs well developed, absence of paratoid glands, tympanum, vocal slits and cranial crests, skin finely granulose, and presence of longitudinally elliptical subarticular tubercles on hands. The new species is characterized by: 1) medium size for the genus (15.2–19.3 mm SVL in males, 20.2–25.7 mm SVL in females); 2) snout rounded in dorsal view, acute in lateral view; 3) subrostral crest present, not converging anteriorly; 4) finger I shorter than finger II; 5) dorsum covered with tubercles; 6) color in life light brown; 7) ventral color pattern reddish brown, with presence of small white dots and brown spots and absence of large blotches or ocelli.

Comparisons with other species: *Amazophrynella vote* sp. nov. is promptly distinguished from the two other *Amazophrynella* nominal species by the absence of a bright ventral pattern with larger blotches and ocelli. Furthermore, the new species can be differentiated from the two nominal Amazonian species by the following characters (those of the compared species in parenthesis): from *A. bokermanni* by smaller SVL with males reaching 19.3 mm and females 25.7 mm SVL (maximum SVL of males and females 22 and 28 mm respectively; Izeckson, 1993b), subrostral crest not converging anteriorly (converging anteriorly), head longer than wide (equal size), tibia length/SVL 0.46 ± 0.02 , ranging from 0.41–0.5 (0.50 ± 0.01 , range 0.48–0.54), and finger I shorter than finger II in males (finger I longer than finger II in males of *A. bokermanni*) and for the pale ventral coloration with absence of large blotches and ocelli (venter bright colored with presence of blotches and ocelli; Figure 2B); from *A. minuta* by slightly larger SVL (males 15–18 mm and females 17–24 mm SVL of *A. minuta*; Rodriguez and Duellman, 1994), eyes larger, representing 40% of head length (eye diameter/head length 30%; Figure 3a), snout rounded in dorsal view (pointed snout – Melin, 1941; Rodriguez and Duellman, 1994; Figure 3a), reddish brown coloration with absence of larger blotches in ventral surfaces (venter bright orange with larger blotches; Figure 2C and Figure 3c), absence of spiny tubercles on dorsum and limbs (prickly warty skin on upper surfaces, especially on the sides and limbs; Melin, 1941; Figure 3b) and absence of a triangular swelling laterally on neck (laterally on the neck a triangular swelling; Melin, 1941; Figure 3a).

Description of the holotype. Body robust, head triangular, longer than wide, representing 35.2% of the SVL; snout rounded in dorsal view, acute in lateral view; nostrils lateral, situated near the tip of the snout; internarial distance about the same size of eye diameter and upper eyelid width, smaller than eye-to-nostril distance; tympanum absent; tongue lanceolate. Forearms robust; hand with slender and not fringed fingers, fingers free; finger tips slightly enlarged; nuptial pad not observed; relative length of fingers $I < II < IV < III$; subarticular tubercles single, rounded; inner metacarpal tubercle small, about the same size of subarticular tubercles; outer metacarpal tubercle rounded, large; supernumerary tubercles present, small; Thigh length about the same size of tibia length, representing 43% of SVL each one; tarsal length about 27% of SVL. Foot with slender toes, basally webbed with toe tips slightly enlarged; web vestigial between toes; relative length of toes $I < II < V < III < IV$; subarticular tubercles rounded, larger than that of fingers; inner metatarsal tubercle elliptical, large; outer metatarsal tubercle small, rounded. Dorsal surfaces, including arms and legs covered by rough tubercular skin; ventral surfaces covered by granular tubercles.

Measurement of the holotype (in millimeters): SVL 17.5, HL 6.2, HW 5.4, IND 1.6, ESD 2.8, END 2.1, ED 1.6, IOD 5.3, UEW 1.5, THL 7.5, TL 7.7, TAL 4.8, FL 5.9.

Coloration. In life, the dorsal color pattern is light brown, sometimes with a distinct thin vertebral line. Color of the flanks light brown, with many small whitish punctuations that extend in lips, arms and legs (Figure 2A). Dorsal coloration of arms and legs with black bands with transversal dark brown bars. Iris golden. The venter is reddish brown, with dark spots irregularly distributed. The throat and chest are dark brown. Limbs predominantly reddish brown, except from the palms and soles that are dark brown (Figure 2A). In preservative, dark colors are almost the same as described in life. The reddish ventral coloration became pale brown (Figure 1).

Variation. There is a sexual dimorphism, with females attaining greater SVL (Table 1). Adult males have a pigmented throat. Some specimens from Aripuanã municipality and Parque Nacional Nascentes do Lago Jari have the dorsal coloration light gray instead of light brown as noted in the specimens from Cotriguaçu municipality and from Manicoré municipality (Figure 4). The vertebral line is present in about 50% of the specimens beginning at the level of eyes and extending until the cloaca.

TABLE 1. Measurements (mm) of male (including holotype) and female specimens in the type series of *Amazophrynella vote* sp. nov. Means are ± 1 standard deviation, ranges are in parentheses. Abbreviations are defined in the material and methods section.

Character	Male (n = 14)	Female (n = 17)
SVL	16.4 $\pm$ 1.3 (15.2–19.3)	22.7 $\pm$ 1.6 (21.4–25.7)
HL	6.1 $\pm$ 0.4 (6.0–7.1)	7.6 $\pm$ 0.5 (7.0–8.9)
HW	5.1 $\pm$ 0.4 (4.7–6.1)	6.7 $\pm$ 0.4 (5.8–7.2)
IND	1.5 $\pm$ 0.2 (1.1–1.8)	1.7 $\pm$ 0.2 (1.3–2.0)
ESD	2.7 $\pm$ 0.2 (2.3–3.2)	3.4 $\pm$ 0.2 (3.1–3.8)
END	1.9 $\pm$ 0.2 (1.7–2.4)	2.2 $\pm$ 0.2 (1.8–2.4)
ED	1.6 $\pm$ 0.1 (1.5–2.1)	1.9 $\pm$ 0.1 (1.6–2.1)
IOD	5.0 $\pm$ 0.3 (4.5–5.5)	6.2 $\pm$ 0.2 (5.9–6.7)
UEW	1.5 $\pm$ 0.2 (1.2–1.8)	1.9 $\pm$ 0.2 (1.6–2.4)
THL	7.1 $\pm$ 0.7 (6.2–8.5)	10.1 $\pm$ 0.9 (9.1–11.9)
TL	7.6 $\pm$ 0.7 (6.7–9.1)	10.1 $\pm$ 0.9 (9.3–11.4)
TAL	4.8 $\pm$ 0.4 (4.3–5.9)	6.4 $\pm$ 0.3 (5.8–6.9)
FL	5.8 $\pm$ 0.5 (5.3–7.1)	8.4 $\pm$ 0.5 (7.5–9.1)

Natural history. Active individuals were collected by day in leaf litter near water bodies inside sazonal flooding forests in Aripuanã and Cotriguaçu municipalities. Individuals from Colniza municipality were collected in marsh areas near small streams in primary forests. The specimens were found in November 2006, June 2007 and October 2008 in Aripuanã municipality, November 2007 in Colniza and December 2009 in Cotriguaçu municipality. Amplexus (axilar) and oviposition were observed in captive specimens in December 2009 (rainy season) at Fazenda São Nicolau at Cotriguaçu municipality. The pigmented eggs were laid in gelatinous strands (Figure 5), is similar to that observed in the *A. minuta* group of Izeckson (1993a, b) and in populations of *A. cf. minuta* from Ecuador (Duellman and Lynch, 1969), which includes *A. minuta*, *A. bokermanni* and *Dendrophryniscus leucomystax*.

Conservation. The populations of *Amazophrynella vote* sp. nov. at Mato Grosso state are under a strong pressure from Hydroelectric Power Plants, selective logging and mineral exploration in localities like Aripuanã municipality. However, recent conservation initiatives, such as the creation of reserves like the "Igarapés do Juruena" State Park on the Colniza municipality and Fazenda São Nicolau at Cotriguaçu municipality could help in the maintenance of populations. Specimens from Rondônia and Amazonas state were collected in conservation units, such as the Reserva Biológica de Jaru at Ji-Paraná municipality, and Parque Estadual do Guariba at Manicoré municipality, Parque Nacional Nascentes do Lago Jari at Tapauá and Beruri municipalities.

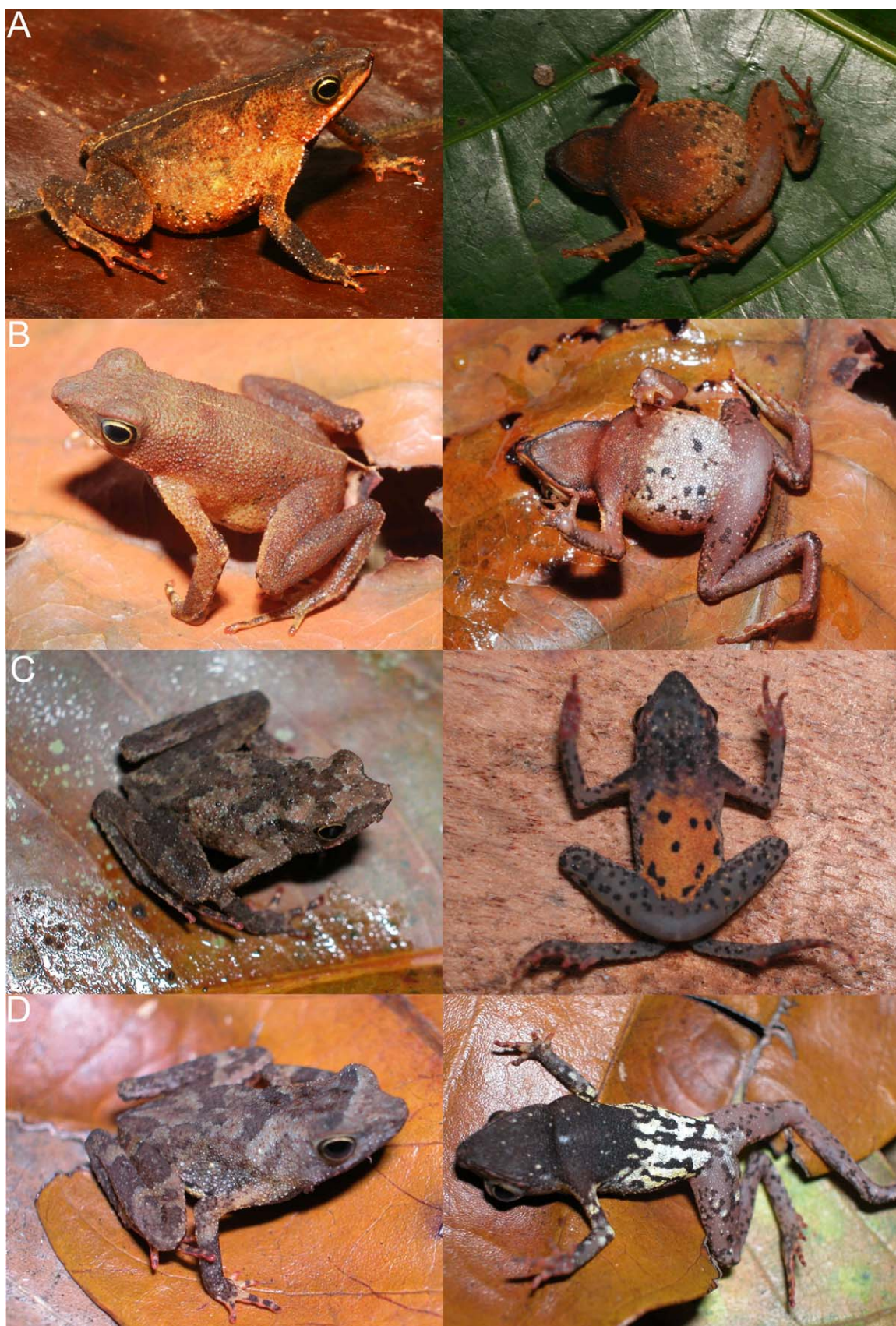


FIGURE 2. Dorsal (left) and ventral (right) view of a live male specimens of: A. *Amazophrynella vote* sp. nov. from Cotriguaçu municipality, Mato Grosso state, Brazil; B. *Amazophrynella bokermanni* from Juruti municipality, Pará state, Brazil; C. *Amazophrynella minuta* from Rio Yaquerana, Peru (Peru-Brazil border; 06°19'03"S 73° 09'28"W); D. *Amazophrynella* aff. *minuta* from Manaus, Amazonas state, Brazil.

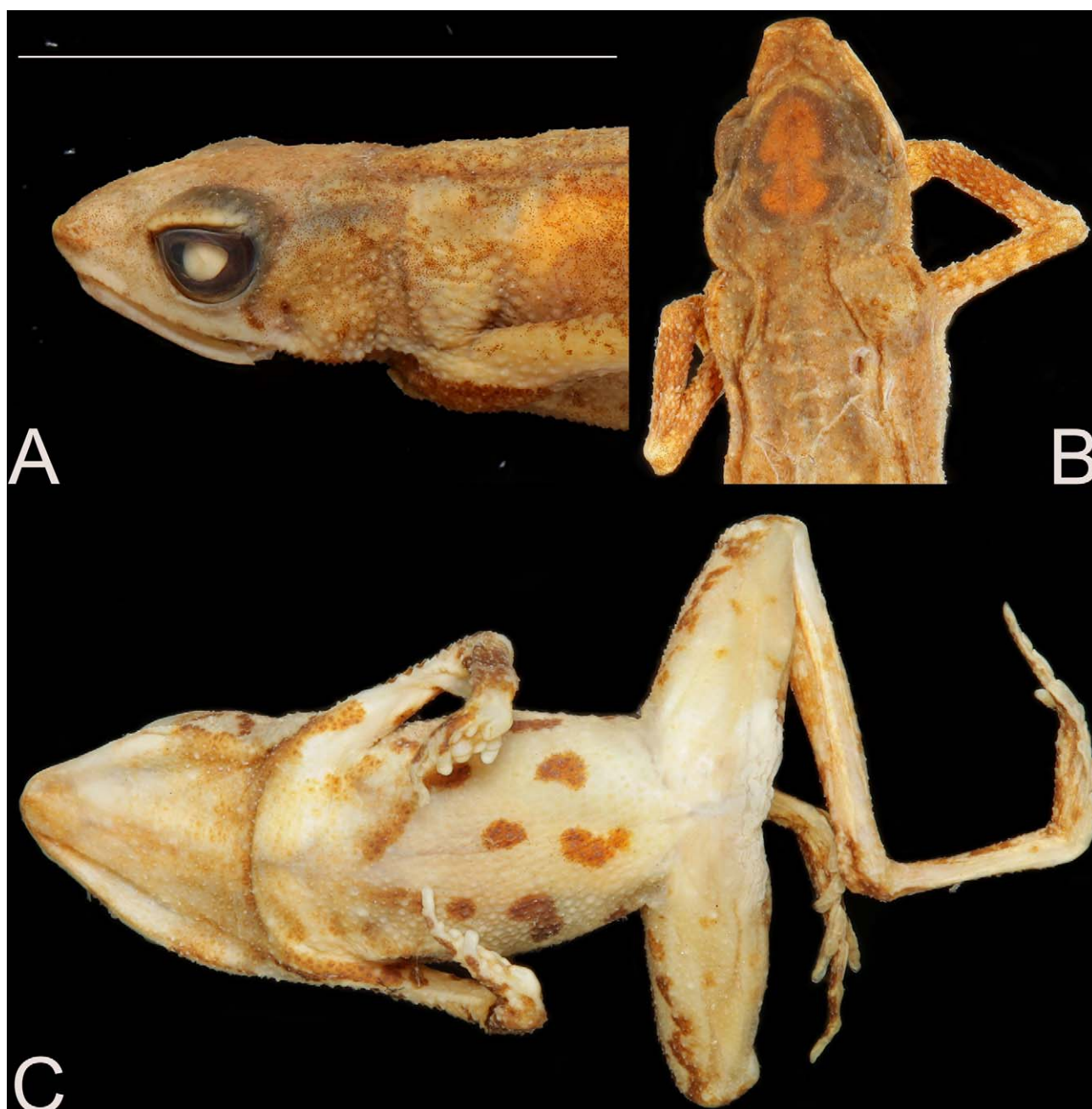


FIGURE 3. Syntypes of *Amazophrynella minuta*: A) Lateral view of the head (NHMG 465), scale=10mm; B. Dorsal view of the head (NHMG 464); C. Ventral view (NHMG 463). Photographs by Anders Larsson (Göteborg Natural History Museum).

Distribution. *Amazophrynella vote* sp. nov. is known from three localities at northern Mato Grosso: Aripuanã municipality, Parque Estadual Igarapés do Juruena at Colniza municipality and Fazenda São Nicolau at Cotriguaçu municipality. At the Amazonas state, the new species can be found at four municipalities: Tapauá, Beruri, Manicoré and Novo Aripuanã Canutama. The species is also known at eastern Rondônia state, at the municipality of Ji-Paraná (Figure 6).

Etymology. The specific epithet “vote” is a regional expression in Mato Grosso state indicating astonishment or disgust. The meaning depends on the intonation of voice, and was used several times by the local people when we said that the specimens were adults, rather than juveniles. The species epithet is used as invariable name in apposition to the genus name.



FIGURE 4. Color variation at the populations of *Amazophrynella vote* sp. nov. A) dorsal view of specimens from Aripuanã municipality (left) and Juruena municipality (right); B) Parque Nacional Nascentes do Lago Jari, Tapauá municipality; C) Igarapé Açuã Canutama municipality, Purus river drainage.



FIGURE 5. An amplexant couple of *Amazophrynella vote* sp. nov. from Cotriguaçu municipality, Mato Grosso state, Brazil.

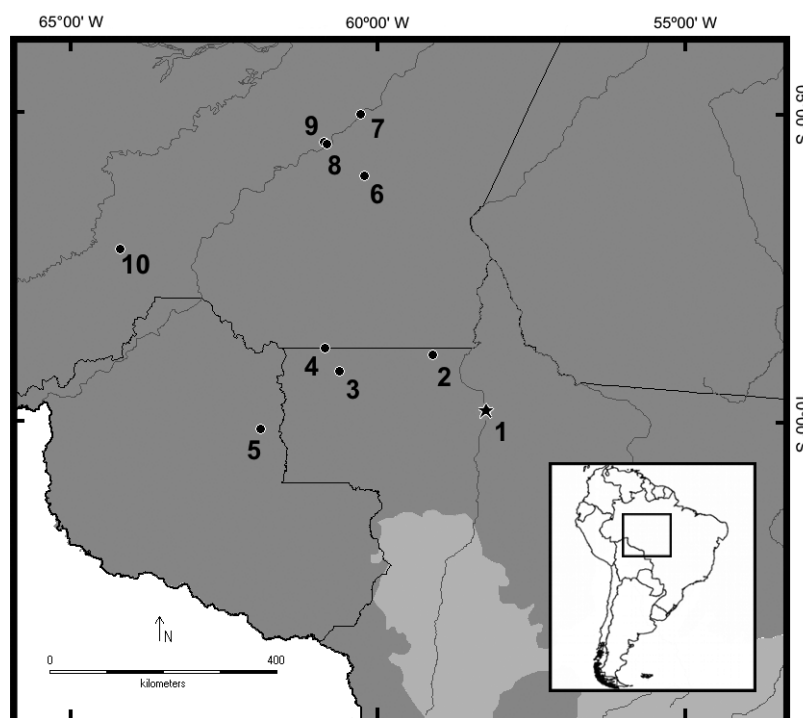


FIGURE 6. A geographic distribution *Amazophrynella vote* sp. nov. (Circles). Star represents the type locality. Municipalities: 1—Cotriguaçu; 2—Colniza, 3—Aripuanã; 4—Parque Estadual do Guariba, Manicoré; 5—Reserva Biológica de Jarú, Ji-Paraná; 6—Lago Açaí, Novo Aripuanã; 7—Parque Estadual do Matupiri, Manicoré; 8—Cachoeirinha, Manicoré; 9—Parque Nacional Nascentes do Lago Jari, Tapauá; 10—Igarapé Açuã Canutama municipality.

Discussion

Even with the description of *Amazophrynella vote* sp. nov. there are only 3 nominal species in a pan amazonian genus of small bodied frog. Such low diversity is at odd with many works that have unveiled cryptic diversity especially in small terrestrial dull colored vertebrates in Amazonia (Fouquet et al., 2007; Padial and De la Riva, 2009).

In fact, the diversity of *Amazophrynella* in the Amazonian region has already been suggested to be underestimated, since several populations that expressed strong differences in morphology, coloration and reproductive behavior are treated under the name *A. minuta* (see Caldwell, 1996; Fouquet et al., 2007; Fouquet et al., 2012a).

Amazophrynella minuta was described by Melin (1941) as *Atelopus minutus* from five specimens collected at Missão Taracua São Gabriel da Cachoeira municipality, upper river Uaupés at the Amazonas state in a very succinct way. This lack of precision led several authors to identify morphologically distinct populations as *A. minuta*, although many of the characteristics described by Melin can be considered as sufficient for specific differentiation, such as the presence of swelling on neck and the prickly warty skin (characteristics that could be confirmed after the examination of photographs taken by Anders Larsson from the type specimens deposited at the Göteborg Natural History Museum - MHNG 462-465). For example, Caldwell and Araújo (2005) discussed size and color differences of specimens from the Rio Curuá-Una, at the Brazilian state of Pará with those examined by Rodriguez and Duellman (1994) and Duellman and Mendelson (1995) from Peruvian specimens of Iquitos and Teniente Lopez, respectively. According to the original description, *A. minuta* has an orange venter with black spots (Melin, 1941). This characteristic was found in the Peruvian specimens of Rodriguez and Duellman (1994) and Duellman and Mendelson (1995) and also from Pico da Neblina (VTC personal observation) at São Gabriel da Cachoeira municipality (distant about 170km from the type locality) and from Yaquerana River at the Peru-Brazil border (Figure 2C) (Gordo et al, 2005). Recently, Fouquet et al. (2012a) demonstrated that there a lot of discrepancy in molecular data of many populations under the name *A. minuta*. Therefore, specimens from Manaus

region, including those figured on the work of Lima et al. (2005) from Reserva Biológica Adolpho Ducke, the specimens examined by Caldwell and Araújo (2005) with a black spotted whitish belly from Rio Curuá-Una in the Pará state, as well as the Ecuadorian specimens of Duellman (1978) with a reddish lavender venter could also represent new species.

We therefore argue that further studies are necessary to delineate species and evaluate the diversity within *Amazophrynella*, with a special need on the examination of more material of *A. minuta* from its type locality.

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APPENDIX I. Specimens examined

Amazophrynella bokermanni—INPA-H 349, 405, Rio Mapuera, Pará State.

Amazophrynella aff. *minuta*—INPA-H 6983-6984, 6987 - Manaus, Amazonas State; 18126-18129, 18131, 18133—São Sebastião do Uatumã, Amazonas State.

Amazophrynella minuta—NHMG 462-465, syntypes, Taracúá, Rio Uaupés, Amazonas State.