

A new species of *Proceratophrys* Miranda-Ribeiro (Amphibia: Anura: Cycloramphidae) from the Chapada Diamantina, State of Bahia, northeastern Brazil

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Abstract

We describe a new species of *Proceratophrys*, allied to *P. schirchi*, from the northern sector of the Espinhaço mountain range, within a semiarid region in central State of Bahia known as Chapada Diamantina. The new species inhabits seasonal semi-deciduous forests (usually known as dry forests) that cover the mountainous relief of the Serra de Jacobina, a regional designation of the Espinhaço mountain range in northeastern Brazil. *Proceratophrys minuta* **sp. nov.** most resembles *P. schirchi* by combination of small palpebral appendages, general external morphology, and by its restriction to Atlantic Forest remnants. It is diagnosed from all congeners by the combination of small body size (snout–vent length, males 20.4–25.2 mm, females 28.3–31.9 mm), absence of rostral appendage, short palpebral appendages with the central prominent, dorsum adorned with sinuous longitudinal ridges outlining a spear-shaped ornamentation like a hastate-shaped leaf (with flaring pointed lobes at eyes and spear point at urostyle), and other six morphological characteristics. We also describe the tadpole of *P. minuta* **sp. nov.**, and compare its color and external morphology with other tadpoles of *Proceratophrys* described in the literature.

Key words: Alsodinae, *Proceratophrys minuta* **sp. nov.**, *Proceratophrys schirchi*, taxonomy, Serra de Jacobina

Resumo

Descrevemos uma nova espécie de *Proceratophrys*, semelhante a *P. schirchi*, proveniente do setor norte da Serra do Espinhaço, em região semiárida no centro do Estado da Bahia conhecida como Chapada Diamantina. A nova espécie habita florestas estacionais semideciduais (usualmente conhecidas como florestas secas) que cobrem o relevo montanhoso da Serra de Jacobina, designação regional da Serra do Espinhaço no nordeste do Brasil. *Proceratophrys minuta* **sp. nov.** mais se assemelha a *P. schirchi* pela combinação de apêndices palpebrais pequenos, aspecto geral da morfologia externa e por sua restrição a remanescentes de Floresta Atlântica. É diagnosticado de todos os congêneres pela combinação do tamanho corpóreo pequeno (comprimento rostro-cloacal, machos 20,4–25,2 mm, fêmeas 28,3–31,9 mm), ausência de apêndice rostral, apêndices palpebrais curtos e com o central proeminente, dorso adornado com cristas longitudinais sinuosas delineando ornamentação lanceolada semelhante à folha hastada (com lobos divergentes e pontiagudos junto aos olhos e ponta da lança junto ao uróstilo) e outras seis características morfológicas. Também descrevemos o girino de *P. minuta* **sp. nov.** e comparamos sua cor e morfologia externa com outros girinos de *Proceratophrys* descritos na literatura.

Introduction

The Neotropical genus *Proceratophrys* Miranda-Ribeiro currently comprises 24 species distributed in Brazil, northeastern Argentina, and Paraguay (Martins & Giaretta 2011, Ávila *et al.* 2011, Frost 2011). These species are usually ordered within three main phenetic groups, mostly characterized by the presence or the absence of a single and long palpebral (upper eyelid) appendage and postocular swellings.

Species with a single and long uni-cuspidate palpebral appendage are combined within the species complexes of *P. boiei* and *P. appendiculata* (Izecksohn *et al.* 1998; Prado & Pombal 2008, Cruz & Napoli 2010), and species lacking this feature are grouped in the *P. bigibbosa* and *P. cristiceps* groups. Two species are not promptly associated to one of these groups: *P. rondonae* Prado and Pombal holds a single and short multi-cuspidate palpebral appendage, but was considered within the long-horned toads by Prado and Pombal (2008); *P. schirchi* (Miranda-Ribeiro) was not assigned to a species group by its singular external morphology, including short palpebral appendages (Prado & Pombal 2008), a decision followed by Cruz and Napoli (2010) and Martins and Giaretta (2011).

The *Proceratophrys bigibbosa* species group is characterized by a blunt and short snout, presence of postocular swellings, and large marginal tubercles on eyelids (Kwet & Faivovich 2001), and currently comprises four species: *P. avelinoi* Mercadal de Barrio and Barrio, *P. bigibbosa* (Peters), *P. brauni* Kwet and Faivovich, and *P. palustris* Giaretta and Sazima. This species group occurs in southern and southeastern Brazil and adjacent countries (Giaretta *et al.* 2000, Kwet & Faivovich 2001).

The *Proceratophrys cristiceps* species group is characterized by the absence of palpebral appendages and postocular swellings (other shared characters are not evident), and is mainly distributed over open and seasonally dry environments (Giaretta *et al.* 2000); currently it comprises seven species: *P. concavitympanum* Giaretta, Bernarde and Kokubum, *P. cristiceps* (Müller), *P. cururu* Eterovick and Sazima, *P. goyana* (Miranda-Ribeiro), *P. moratoi* (Jim and Caramaschi), *P. strussmannae* Ávila, Kawashita-Ribeiro and Morais, and *P. vielliardi* Martins and Giaretta.

The *Proceratophrys boiei* and *P. appendiculata* species complexes are characterized by the presence of a single and long uni-cuspidate palpebral appendage, the latter with a triangular rostral appendage that is absent in the former. Three species are formally included in the *P. boiei* complex: *P. boiei* (Wied-Neuwied), *P. paviotii* Cruz, Prado and Izecksohn, and *P. renalis* (Miranda-Ribeiro); eight species are formally included in the *P. appendiculata* complex: *P. appendiculata* (Günther), *P. laticeps* Izecksohn and Peixoto, *P. melanopogon* (Miranda-Ribeiro), *P. moehringi* Weygoldt and Peixoto, *P. phyllostomus* Izecksohn, Cruz and Peixoto, *P. sanctaritae* Cruz and Napoli, *P. subguttata* Izecksohn, Cruz and Peixoto, and *P. tupinamba* Prado and Pombal. These species complexes are distributed mainly along the coastal Atlantic Rainforest.

Surveys of anurans in the northern sector of the Espinhaço mountain range in the State of Bahia, Brazil, namely the Chapada Diamantina ecoregion, led us to find a new species of *Proceratophrys* allied to *P. schirchi*, which is described herein.

Material and methods

Museum abbreviations of specimens used in the descriptions or examined for comparisons are: MNRJ (Museu Nacional, Rio de Janeiro, Brazil), UESB (Coleção de Anfíbios, Universidade Estadual do Sudoeste da Bahia, Vitória da Conquista, Estado da Bahia, Brazil), and UFBA (Museu de Zoologia da Universidade Federal da Bahia, Salvador, Bahia, Brazil).

Measurements of adult specimens follow Prado and Pombal (2008) and are in millimeters: SVL (snout–vent length), HL (head length), HW (head width), ED (eye diameter), UEW (upper eyelid width), IOD (interorbital distance), IND (internarial distance), END (eye to nostril distance), THL (thigh length), TL (tibia length), and FL (foot + tarsus length). Measurements were taken with a vernier caliper. Drawings of the holotype were made using a Leica-Wild MZ6 stereomicroscope with a drawing tube. Webbing formula notation follows Savage and Heyer (1997). The nomenclature used to describe the external morphology of the genus *Proceratophrys* follows Prado and Pombal (2008). Diagnosis and comparisons with other species were based on examined specimens (appendix 1) and on the following literature: *Proceratophrys bigibbosa* species group: Kwet and Faivovich (2001);

Proceratophrys boiei species group: Prado and Pombal (2008), Cruz and Napoli (2010); *P. cristiceps* species group: Ávila *et al.* (2011), Martins and Giaretta (2011).

The number of specimens in each lot of tadpoles follows the collection registration number, in parentheses. The analysis and description of the external morphology of tadpoles of *Proceratophrys minuta* is based on nine specimens: UFBA 10756 (7), 10757 (1), 10758 (1), in stages 31–38 (Gosner 1960); other eight individuals, UFBA 10750 (8) in earlier (25–27) and later (40–41) stages were considered for comparisons. We measured 17 morphometric characters, recorded in millimeters. Five measurements follow Altig and McDiarmid (1999): TL (total length), BL (body length), TAL (tail length), MTH (maximum tail height), and TMH (tail muscle height). Five measurements follow Mercês and Juncá (2010): DFH (dorsal fin height), VFH (ventral fin height), ED (eye diameter), ODW (oral disc width), and SSD (spiracle–snout distance). IOD (interorbital distance) follows Nascimento *et al.* (2010). The six other measurements are: BH (maximum body height), BW (maximum body width), IND (internarial distance, distance between internal borders of nares), ESD (eye–tip of snout distance, distance from anterior corner of eye to tip of snout), END (eye–nostril distance, distance from the anterior corner of eye to posterior border of nostril), and NSD (nostril–tip of snout distance, distance from anterior border of nostril to tip of snout). An ocular micrometer in a Zeiss stereomicroscope was used for measuring all variables. Nomenclature of morphological characteristics follow Altig and Johnston (1986) and Altig and McDiarmid (1999). Illustration of the tadpole is based on the individual stage 35 (UFBA 10758), employing the labial tooth row formula proposed by Altig (1970). All individuals were fixed in 4% formalin and are deposited in the Museu de Zoologia da Universidade Federal da Bahia.

Description of new species

Proceratophrys minuta sp. nov.

Figures 1–4

Holotype. UFBA 6721, adult male, collected at the Riacho do Dandá (11°26'S, 40°33'W, ca. 800 m above sea level), Parque Estadual das Sete Passagens (an environmental State protected area), Municipality of Miguel Calmon, State of Bahia, Brazil, on 22 November 2006, by Rafael Oliveira de Abreu and Heverton Cardona.

Paratypes. Brazil, State of Bahia: Municipality of Miguel Calmon, Parque Estadual das Sete Passagens (11°26'S, 40°33'W, ca. 800 m a.s.l.)—MNRJ 75410 (ex-UFBA 6229, adult female), 75411 (ex-UFBA 6230, adult male), collected on 22–25 July 2006, by A. Xavier, M.B. Santos, and R. Burger; UFBA 6287, adult male, collected on 12–16 October 2006, by A.L. Xavier, D. Cruz, M. Camardelli, P.M. Fonseca, and R.O. Abreu; UFBA 6289 (adult male), 6290 (adult female), collected on 12–16 October 2006, by A.L. Xavier, D. Cruz, M. Camardelli, P.M. Fonseca, and R.O. Abreu; UFBA 6356–6358 (adult males), 6353–6355 (adult females), MNRJ 75417 (ex-UFBA 6351), UFBA 6349, 6350, 6352 (juveniles), collected on 23 July 2006, by A.L. Xavier, D. Cruz, M. Camardelli, P.M. Fonseca, and R.O. Abreu; MNRJ 75412–75416 (adult males, ex-UFBA 6718, 6722, 6723, 6726, 6728 [stained and cleared], respectively), UFBA 6716, 6720, 6725, 6727 (adult males), 6724 (adult female), 6717, 6719 (juveniles), collected on 18–23 November 2006, by A.L. Xavier, D. Cruz, M. Camardelli, P.M. Fonseca, R.O. Abreu, and W. Fahning; UFBA 7156, 7158 (adult males), 7155, 7157 (juveniles), collected on 20 January 2007, by A. Xavier, D. Cruz, R.A. Abreu, N. Menezes, and T. Jordão. Municipality of Palmeiras, Morro do Pai Inácio (12°27'49"S, 41°28'26"W, ca. 840 m a.s.l.)—UFBA 10755, adult male, collected on 01 May 2006, by M.L. Del-Grande; UFBA 10751–10754 (ex-UESB 387–390), adult males, collected on 28 September 2006, by M.L. Del-Grande.

Diagnosis. In the genus *Proceratophrys* by lacking nuptial pads on thumb, body without enlarged glands, fingers not webbed, supernumerary tubercles present on hands and feet, dorsal surfaces of fingers and toes wrinkled, and dorsum adorned with sinuous longitudinal ridges outlining a spear-shaped ornamentation like a hastate-shaped leaf, with flaring pointed lobes at eyes and spear point at urostyle. *Proceratophrys minuta* is related to *P. schirchi* (Miranda-Ribeiro) by the presence of outer metacarpal tubercle single or partially grooved, and a short palpebral appendage with marginal tubercles, the largest tubercle in the middle more projected than lateral tubercles. The new species is diagnosed from its congeners by the following combination of characteristics: (1) small size (adult males SVL 20.4–25.2 mm, adult females 28.3–31.9 mm); (2) absence of rostral appendage; (3) a

short palpebral appendage with marginal tubercles, the largest tubercle in the middle more projected than lateral tubercles; (4) snout rounded from above, vertical or slightly oblique in profile; (5) canthus rostralis well-marked, curved; (6) dorsum adorned with sinuous longitudinal ridges outlining a spear-shaped ornamentation like a hastate-shaped leaf, with flaring pointed lobes at eyes and spear point at urostyle; (7) dorsum with a pair of parallel thin rows of warts extending from interorbital to scapular region; (8) distinct row of warts transversally on head, interrupted at the center, and extending to the border of each eyelid; and (9) outer metacarpal tubercle single or partially grooved.

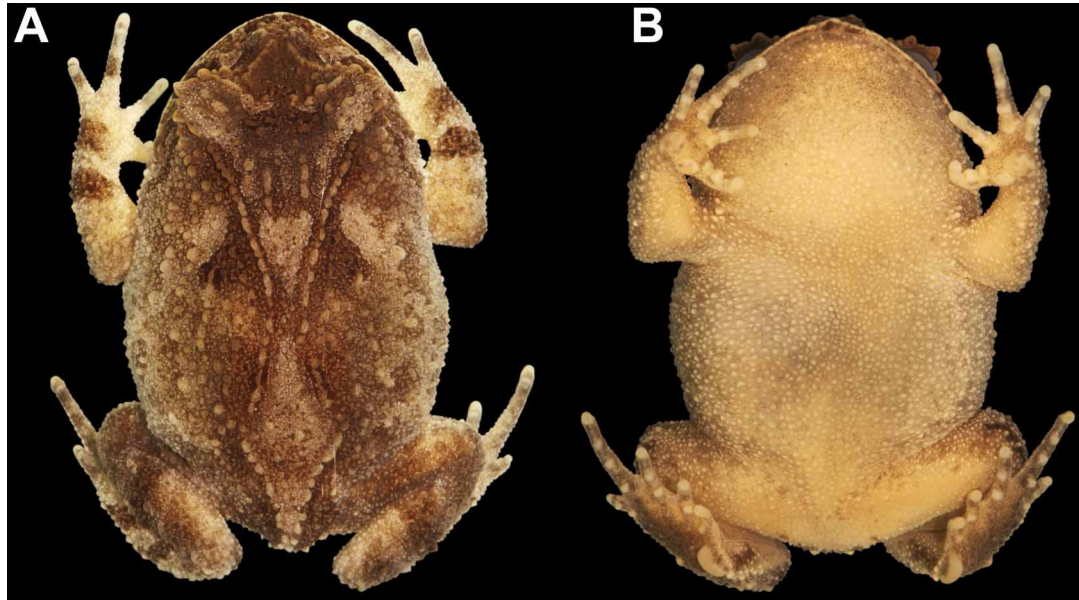


FIGURE 1. *Proceratophrys minuta* sp. nov. A, dorsal and (B) ventral views of holotype, UFBA 6721, adult male, SVL 23.9 mm. Photo Rafael O. Abreu.

Comparisons with other species. *Proceratophrys minuta* is promptly diagnosed from all species of the *P. bigibbosa* group (*P. avelinoi*, *P. bigibbosa*, *P. brauni*, and *P. palustris*) by the absence of postocular swellings (present in those species), from all species of the *P. boiei* group (*P. appendiculata*, *P. boiei*, *P. laticeps*, *P. melanopogon*, *P. moehringi*, *P. paviotii*, *P. phyllostomus*, *P. renalis*, *P. sanctaritae*, *P. subguttata*, and *P. tupinamba*) by the absence of a single long uni-cuspidate palpebral appendage (present in those species), and from *P. rondonae* by the smaller snout–vent length (*P. minuta* males 20.0–25.2 mm, females 28.3–31.9 mm; *P. rondonae* males 52.6–63.4 mm, females 37.7–72.8 mm); *P. minuta* is promptly distinguished from all species of the *P. cristiceps* group (*P. concavitympanum*, *P. cristiceps*, *P. cururu*, *P. goyana*, *P. moratoi*, *P. strussmannae*, and *P. vielliardi*) and from *P. schirchi* by the smaller snout vent–length 20.4–25.2 mm in males (*P. cristiceps* species group, SVL in males: *P. concavitympanum* 39.6–51.8 mm, *P. cristiceps* 40.6–49.1 mm, *P. cururu* 36.5–43.1 mm, *P. goyana* 28.0–55.5 mm, *P. moratoi* 26.4–30.0 mm, *P. strussmannae* 41.1–47.3 mm, and *P. vielliardi* 39.1–41.9 mm; *P. schirchi* 31.6–40.4 mm); *P. minuta* is also diagnosed from all species of the *P. cristiceps* group by the outer metacarpal tubercle single or partially grooved and a short palpebral appendage with marginal tubercles, the largest tubercle in the middle more projected than lateral tubercles (outer metacarpal tubercle completely divided, and absence of palpebral appendages in those species); from *P. moratoi* and *P. vielliardi* the new species also differs by the dorsum adorned with sinuous longitudinal ridges outlining a spear-shaped ornamentation like a hastate-shaped leaf, with flaring pointed lobes at eyes and spear point at urostyle (absent in those species); *P. minuta* is diagnosed from *P. concavitympanum*, *P. cristiceps*, *P. cururu*, *P. goyana*, *P. strussmannae*, and *P. schirchi* by dorsum with a pair of parallel thin rows of warts extending from interorbital to scapular region (thick rows of warts in those species); furthermore, *P. minuta* is diagnosed from *P. schirchi* by the absence of a rostral appendage (short rostral appendage present in that species).

Description of holotype. Head wider than long, head length 87% of head width; snout rounded in dorsal view, slightly oblique in profile (figs 1, 2A, B); nares elliptical, prominent, and external to the canthal crest, internarial distance 77% of eye to nostril distance; canthal crests well marked, curved, and prominent; no preocular crests;

loreal region oblique; distinct row of spatulated warts from posterior corner of eye to angle of jaw; eye directed anterolaterally, small, 29% of head length; six short palpebral appendages, central appendage prominent; tympanum not distinct; row of warts transversally on head, interrupted at the center, extending to the border of each eyelid; a pair of parallel thin rows of warts extending from interorbital region to scapular region; vocal sac slightly expanded externally; tongue cordiform, free posteriorly; choanae large, well separated one from the other; vomerine teeth in two short transverse series lying between choanae; vocal slits large; no frontoparietal crest. Arms moderately robust (fig. 1); finger lengths $I \approx II < IV < III$ (figs 1, 2C); nuptial asperities absent; interdigital webbing absent; inner metacarpal tubercle large, elliptical; outer metacarpal tubercle twice the size of the inner, elliptical, and partially grooved; scarce small rounded supernumerary tubercles; subarticular tubercles large, nearly rounded, and grooved anteriorly and posteriorly. Legs moderately robust (fig. 1), thigh length longer than tibia length, the sum of thigh and tibia lengths 78% of snout–vent length; dorsal surface of tibia with three oblique parallel rows of enlarged warts; foot length 57% of snout–vent length; toes adorned with marginal spinulose tubercles (fig. 2D); toe lengths $I < II < V < III < IV$; webbing formula I 1–2 II 1–3 III 2–4 IV 4–2 V; inner metatarsal tubercle large, spatulated; outer metatarsal tubercle small, rounded; numerous small rounded supernumerary tubercles; subarticular tubercles large, nearly rounded, and grooved anteriorly and posteriorly. Dorsum adorned with sinuous longitudinal ridges outlining a spear-shaped ornamentation like a hastate-shaped leaf, with flaring pointed lobes at eyes and spear point at urostile (fig. 1). Dorsal surfaces and flanks with warts of different sizes and shapes, set in rows or scattered; ventral surfaces, except hands and feet, covered by numerous small, circular, uniform warts; skin and warts of dorsal and ventral surfaces covered by minuscule asperities.

Color in life. Based on color photographs of two paratypes: an adult male not identified among paratypes UFBA 6230, 6256–6258, and an adult female, UFBA 6290 (fig. 3A–D). Dorsal ground color faded tan brown, maculated with variegated browns, mainly with color tones of cream, reddish and grayish browns, looking like dead leaves. Longitudinal ridges of the spear-shaped ornamentation on dorsum dark brown to reddish brown, not contrasting with dorsal ground color. Warts on dorsum cream, reddish brown or dark brown; palpebral appendages reddish brown. Interior surface of the spear-shaped ornamentation on dorsum not contrasting with the rest of the dorsal surface in one specimen (fig. 3A), and grayish brown in the other, in which it contrasts from the general tan background color (fig. 3B, C). Upper eyelids light brown to grayish brown, connected by a light brown or reddish brown interorbital stripe. An oblique row of cream color warts is noticeable from the angle of jaw to the upper arm. Upper lip cream color. Canthus rostralis delimited from below by a dark brown irregular stripe, from anterior corner of eye to nostril. Lorus with grayish brown to dark brown background color, maculated by a dark brown band from the anterior corner of eye to upper lip, followed by two other dark brown bands, the latter from the posterior corner of eye to near the upper arm. Tip of snout dark brown. Two to three transverse dark brown bars on forearm, shank, and foot. Ventral ground color of throat, chest, belly, arms, legs, hands, and feet tan color, with warts and tubercles cream (fig. 3D). Pupil black; iris copper brown, its lower region gray color ornamented by black reticulations, marginally delimited by an irregular black aureole.

Color in preservative. Based on the type-series. Follows the color in life, but with less vivid colors (fig. 1). The background of dorsal surface varied from light brown to dark brown. Specimens with light brown background color (UFBA 6287, 6289, 6290, 6349–6352, 6354, 6355, 6723, 6725, 7157) evidenced a spear-shaped ornamentation on dorsum bordered along its external sides by a wave-shaped dark brown band, somewhat fragmented into three main dark brown triangular marks. Yet, in these specimens the dark brown stripes on arms and legs are well distinct from the background. These features are still noticeable, but less evident, in specimens of darker background color (UFBA 6357, 6358, 6716–6722, 6724, 6726, 6727), and not visible in specimens of darkest brown background color (UFBA 6353, 6356, 7156). Dorsal warts dark brown or cream color. Anterior and posterior surfaces of thigh with background color cream to homogeneous brown, immaculate or maculated by irregular dark brown marks and/or dark brown pin dots. Throat, chest, belly, ventral surfaces of arms and legs with cream background color, varying from almost immaculate (UFBA 6287, 6289, 6290, 6352, 6355, 6358, 6717, 6719–6721, 6723) to intensively scattered with dark brown pin dots (UFBA 6725, 6726, 6230). Palm of hand and sole of foot dark brown; subarticular and supernumerary tubercles cream color.

Measurements of holotype (mm). SVL 23.9; HL 9.6; HW 11.0; ED 2.8; UEW 3.3; IOD 2.7; IND 1.7; END 2.2; THL 9.8; TL 8.9; FL 13.7.

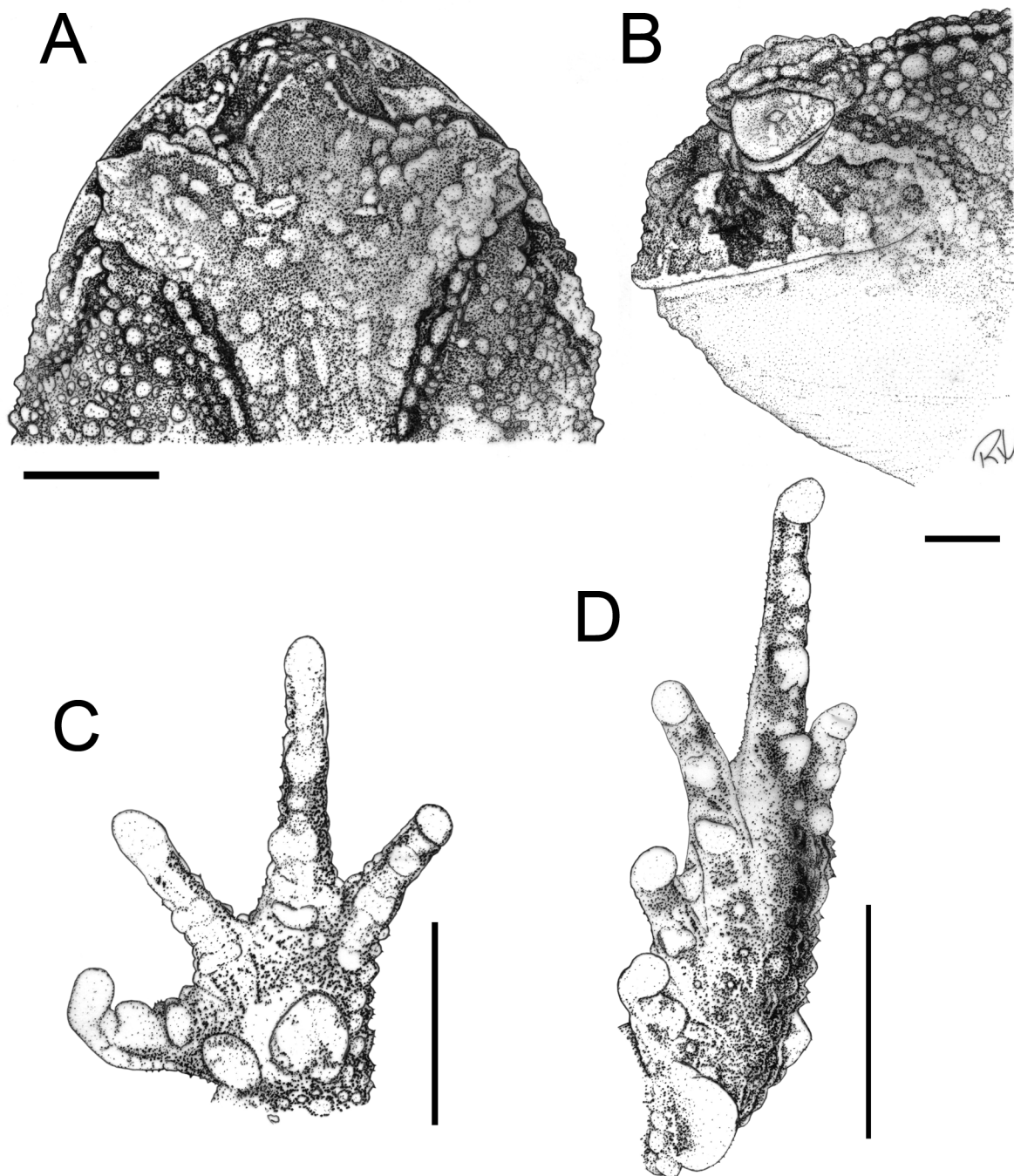


FIGURE 2. Holotype of *Proceratophrys minuta* sp. nov., UFBA 6721, adult male. Dorsal (A) and lateral (B) views of head; ventral views of hand (C) and foot (D). Horizontal and vertical lines equal 3.0 mm. Line drawing Rafael O. Abreu.

Variation. Specimens are congruent with respect to the morphologic characters. Descriptive statistics of measurement variables from adult males and females are in Table 1. Variations in color patterns were already described in color in life and color in preservative items.

Etymology. The specific name, a Latin adjective (*minutus* = small, minute), is an allusion to the small size of the new species.

TABLE 1. Descriptive statistics of adult males (including the holotype) and females of *Proceratophrys minuta* from the Parque Estadual das Sete Passagens, Municipality of Miguel Calmon, and from Morro do Pai Inácio, Municipality of Palmeiras, both in the State of Bahia, Brazil. Mean = arithmetic mean; SD = standard deviation. Measurements are in millimeters.

	Parque Estadual das Sete Passagens								Morro do Pai Inácio			
	Males (n = 18)				Females (n = 6)				Males (n = 5)			
	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max
SVL	22.7	1.2	20.4	25.2	30.3	1.5	28.3	31.9	21.0	0.8	20.0	22.1
HL	9.6	0.4	9.0	10.4	12.1	0.6	11.5	13.0	8.2	0.6	7.4	9.1
HW	11.1	0.6	10.4	12.9	14.5	1.1	13.5	16.1	9.5	0.8	8.4	10.5
IND	1.7	0.3	1.4	2.5	2.3	0.2	2.0	2.5	1.6	0.2	1.5	1.9
END	2.1	0.2	1.5	2.5	2.7	0.3	2.5	3.1	1.8	0.1	1.7	1.9
ED	2.9	0.2	2.7	3.2	3.7	0.1	3.5	3.8	2.7	0.2	2.5	3.0
UEW	3.4	0.3	3.0	3.8	4.3	0.3	3.9	4.7	2.7	0.1	2.7	2.9
IOD	2.7	0.2	2.3	3.0	3.3	0.3	3.0	3.7	2.6	0.1	2.4	2.7
THL	9.9	0.5	8.8	10.5	12.9	0.7	12.0	13.7	8.8	1.0	7.4	10.0
TL	8.8	0.3	8.3	9.5	11.5	0.7	10.5	12.3	7.6	0.3	7.4	8.0
FL	14.0	0.4	13.2	15	18.1	0.9	17.0	19.2	11.6	0.4	11.1	12.1
HL/SVL	0.43	0.02	0.39	0.45	0.40	0.01	0.38	0.41	0.39	0.02	0.37	0.43
HW/SVL	0.49	0.02	0.46	0.52	0.48	0.02	0.46	0.51	0.45	0.03	0.42	0.49
HW/HL	1.16	0.04	1.10	1.24	1.20	0.04	1.14	1.27	1.15	0.02	1.13	1.18
THL/SVL	0.44	0.02	0.40	0.46	0.43	0.01	0.41	0.45	0.42	0.03	0.37	0.45
TL/SVL	0.39	0.02	0.36	0.42	0.38	0.01	0.36	0.39	0.36	0.01	0.35	0.37
FL/SVL	0.62	0.03	0.57	0.67	0.60	0.01	0.59	0.61	0.55	0.02	0.52	0.57
THL+TL/SVL	0.83	0.04	0.77	0.87	0.81	0.02	0.78	0.84	0.78	0.03	0.74	0.81

Natural History. All specimens of *Proceratophrys minuta* were captured inside gallery forests, always near (1–5 m distance) forest brooks of shallow waters (2–50 cm deep) with approximately 0.5–2 m wide. Advertisement calls of specimens from the Parque Estadual das Sete Passagens, Municipality of Miguel Calmon, State of Bahia, Brazil, were heard from these streams, from October to November 2008. Newly metamorphosed juveniles were recorded at the edge of a stream. Tadpoles were captured on 12–16 October 2006 by Rafael O. Abreu and Milena Camardelli, inside permanent forest streams of about 30 cm water depth, but also in temporary shallow streams (ca. 2–10 cm deep) of shaded areas in the Campo Rupestre (open habitat) that receive water from rivers and springs located in gallery forests. Adult specimens released distress calls when manipulated by the researchers. All paratypes from Morro do Pai Inácio, Municipality of Palmeiras, State of Bahia, Brazil, were emitting advertisement calls when they were captured, always positioned on the leaf litter, and never hidden under leaves or fallen logs. At this place, advertisement calls were always heard after nightfall, from September to October 2006. A detailed study of the spatial distribution of the anuran fauna of the Parque Estadual das Sete Passagens, including *P. minuta*, can be assessed in Xavier and Napoli (2011), referred in that publication as '*Proceratophrys* sp. nov., allied to *P. schirchi*'.

Tadpoles. Description of the tadpole of *Proceratophrys minuta* was based on nine specimens [UFBA 10756 (7), 10757 (1), 10758 (1)] in stages 31–38. Descriptive statistics is in Table 2. Total length 29.7–36.1 mm. Body wider than high, depressed, ovoid-elongated in lateral view, oval in dorsal view (fig. 3E). Body length 38.8–41.7% total length; body height 69.2–78.8% body width, and 45.7–57.4% body length. Snout rounded in lateral and dorsal views; snout slopes gradually toward the oral disc. Eye small, its diameter 9.0–10.3% body length, positioned dorsally, laterally directed; interorbital distance 36.1–44.4% body width; eye–snout distance 27.1–31.3% body length; eye–nostril distance 7.5–10.7% body length; nostril small, reniform, with small cutaneous extension on its inner margin, positioned dorsally midway between eyes and snout, but slightly nearer to eyes. Internarial distance 15.0–19.7% body width. Spiracle short, sinistral, inner wall free from body, positioned laterally on the beginning of the medium third of body, posterodorsally directed. Vent tube short, with dextral opening, fused to tail fin.

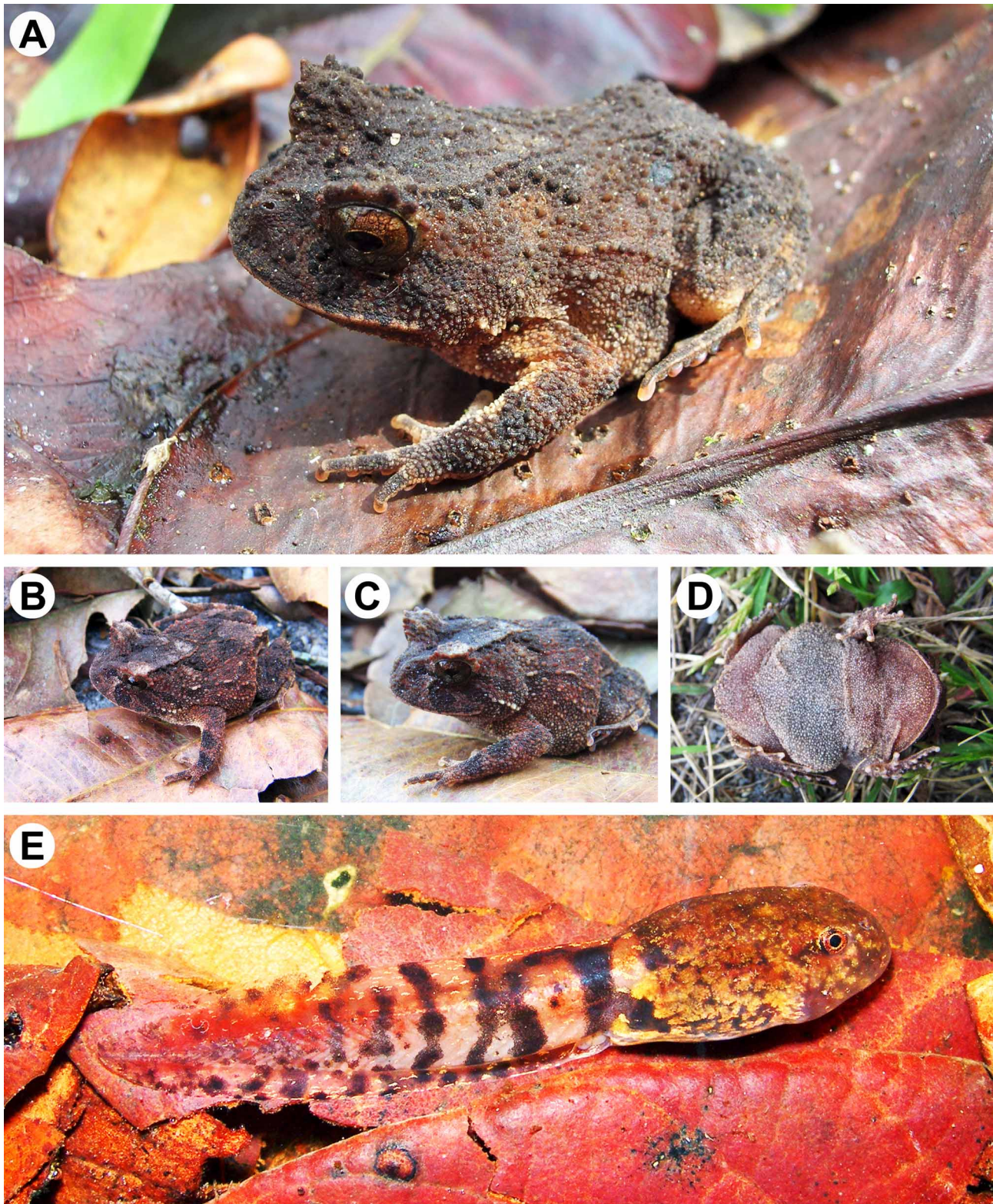


FIGURE 3. Living specimens of *Proceratophrys minuta* sp. nov. from Parque Estadual das Sete Passagens, Serra de Jacobina, Municipality of Miguel Calmon, State of Bahia, Brazil. A, adult male, vouchered, but not identified among paratypes UFBA 6230, 6256–6258. B–D, adult female, UFBA 6290, SVL 28.3 mm; E, tadpole, UFBA 10757, CT 33.1 mm, stage 35 (Photos by Deise Cruz and Rafael O. Abreu: A, 24 July 2006; B–D, 13 October 2006; E, 23 January 2007).

Tail length 58.3–61.2% total length; tail as high as the body height, slightly arched. Tip of tail rounded to slightly pointed. Dorsal fin starts on junction of body to tail, 1.3–1.7 times higher than the ventral fin, both highest at the second third of the tail; ventral fin slightly less arched than the dorsal fin. Oral disk emarginated, ventrally

positioned, its width 30–38% body width, surrounded by a single row of conical or rounded marginal papillae, which are widely interrupted at the anterior labium. The marginal papillae are larger at the posterior labium, becoming smaller laterally towards the anterior labium. Tooth row formula 2(2)/3(1) with rows of teeth placed on ridges; rows A-1 and A-2 of equal length and P-3 shorter than the others. Labial teeth black, long, slightly curved towards oral opening. Upper and lower jaw sheaths wide, with serrated edges; upper sheath shaped as a shallow-M, lower sheath U-shaped.

Live tadpoles with dorsum densely covered by irregularly bordered golden blurs that reach the lower region of flanks, in which they became sparse, fragmented and shaped as small horizontal lines, which also occur in the venter and tail. Tail with 1–5 well marked broad and black irregular vertical bars, which are fragmented into smaller blotches towards fins and tail tip. The transparency of the skin confers to musculature a clear whitish-pink color. Venter transparent, oral region white, internal organs slightly visible. Iris orange-red, bordered internally and externally with the same golden color of dorsum, presenting a darken region that resembles a vertical bar. Limb bud with black marks. Dorsal surfaces of body, tail musculature, and dorsal fin at the end of tail with irregular areas of reddish-brown faded blurs.

Preserved tadpoles have translucent pale brown skin, clearer in tail. Dorsum with sparse dark-brown spots, the golden color became a clear bare visible brown. Black bars and blotches became dark brown. Intestine remains visible. Iris black. Tadpoles (UFBA 10750) in earlier (25–27) and later (40–41) stages are congruent with respect to general morphology and color of tadpoles in stages 31–38.

Out of 24 species of *Proceratophrys*, only 13 have their larvae formally described: *P. boiei* (Izecksohn *et al.* 1979), *P. appendiculata* (Peixoto & Cruz 1980), *P. laticeps* (Peixoto *et al.* 1981), *P. schirchi* (Peixoto *et al.* 1984, as *P. precrenulata*; see Caramaschi & Velosa 1997), *P. moehringi* (Weygoldt & Peixoto 1985), *P. concavitympanum* (Giaretta *et al.* 2000), *P. palustris* (Giaretta & Sazima 1993), *P. moratoi* (Rossa-Feres & Jim 1996), *P. cururu* (Eterovick & Sazima 1998), *P. avelinoi* (de Sá & Langone 2002), *P. cristiceps* (Vieira *et al.* 2007), *P. renalis* (Nascimento *et al.* 2010), and *P. tupinamba* (Fatorelli *et al.* 2010).

Live tadpoles of *Proceratophrys minuta* differ in color from that of *P. avelinoi*, *P. cristiceps*, *P. concavitympanum*, *P. cururu*, *P. palustris*, and *P. moratoi* mainly by the golden blurred dorsum and presence of black vertical bars in tail of the former (background color brown, maculated with dark brown or gray blotches in these species), and also from *P. moehringi* and *P. renalis* (these two species differ from the six former species mainly by the presence of dark brown transverse bands on dorsal surfaces of the tail musculature). The overall color pattern of *P. minuta* tadpoles resembles that of *P. schirchi*, *P. appendiculata* and *P. laticeps*, but differs in the pattern of bars and blotches/spots on tail. In *P. minuta*, the tail musculature is often covered in its entire vertical range by transversal black bars, which sometimes reach the dorsal fin (transversal brown bars covering only dorsal region of tail musculature in *P. schirchi*, *P. appendiculata*, *P. boiei*, and *P. laticeps*); *P. minuta* tadpoles present only the first third of ventral fin transparent, ventral fin fully transparent and maculated by small golden blotches in *P. schirchi* (Peixoto *et al.* 1984); tadpoles of *P. minuta* lack a small cream blotch in the middle of dorsum reported for *P. appendiculata* by Peixoto and Cruz (1980). The blurs that cover the dorsum and flanks of *P. minuta* are golden colored, silver in *P. boiei*. *Proceratophrys minuta* lacks pale brown reticulations on caudal musculature and fins reported for *P. moehringi* by Weygoldt and Peixoto (1985). The golden blurred dorsum and the presence of black vertical bars on tail musculature of *P. minuta* tadpoles differ them from that of *P. renalis*, which lack such patterns. Morphological features of tadpoles of *Proceratophrys minuta* are similar to that observed for the genus, with few subtle differences among species. Tadpoles of *P. minuta* differ from that of *P. cururu* by presenting the nostril nearer to eye than to tip of snout (closer to tip of snout in *P. cururu*), and by the spiracle nearer to snout than to body-tail junction (closer to body-tail junction in *P. cururu*; Eterovick & Sazima 1998). The tip of tail is rounded in *P. minuta*, pointed in *P. cururu*, *P. concavitympanum*, *P. cristiceps*, *P. laticeps*, *P. renalis*, and *P. tupinamba*. The size of eyes in *P. minuta* (eye diameter [ED] 9–10% body length [BL]) is similar to that of some species with palpebral appendages (*P. laticeps* and *P. renalis*; ED up to 9.5% BL), *P. schirchi* (ED 10% BL), *P. avelinoi* (ED 9% BL), smaller than that of *P. palustris* (ED 11% BL) and species related to the *P. cristiceps* group (*P. cristiceps*, *P. concavitympanum*, and *P. cururu*; ED larger than 12% BL), and larger than *P. appendiculata*, *P. boiei*, *P. moehringi*, and *P. tupinamba* (ED < 9% BL). Second tooth row interrupted in *P. minuta*, continuous in *P. appendiculata* and *P. tupinamba*.

Geographic distribution. *Proceratophrys minuta* is known from two localities in the northern sector of the Espinhaço mountain range (fig. 5), both included in the Chapada Diamantina ecoregion (Velloso *et al.* 2002). The

Chapada Diamantina ecoregion is comprised in the Caatinga Morphoclimatic Domain, characterized by vegetation morphologically and physiologically adapted to semiarid conditions (Ab'Sáber 1977). At both localities, elevations range from approximately 800 m to 1300 m. The topography is characterized by mountainous terrain, with deep valleys and steep cliffs, and is classified as extremely unstable with medium slopes ranging from 30° to 45°, except for the tops. According to the Köppen classification, the climate is of the semi-arid BSwH type, rainy in the summer and dry during winter. The rainy period is from October to April, and the wettest months are from November to January. Because of the high elevations, minimum temperatures reach less than 14° C in winter whereas in the surrounding areas are up to 20° C. Such characteristics are reflected in the vegetation cover, which consists of seasonal semi-deciduous forests and environments of campo rupestre (rocky mountain fields), which contrasts with lowland areas surrounding these mountains (up to ca. 500 m a.s.l.) that are characterized by shallow soils with caatinga vegetation (Ab'Sáber 2003). An extended description of the study area of the Parque Estadual das Sete Passagens can be assessed in Xavier and Napoli (2011).

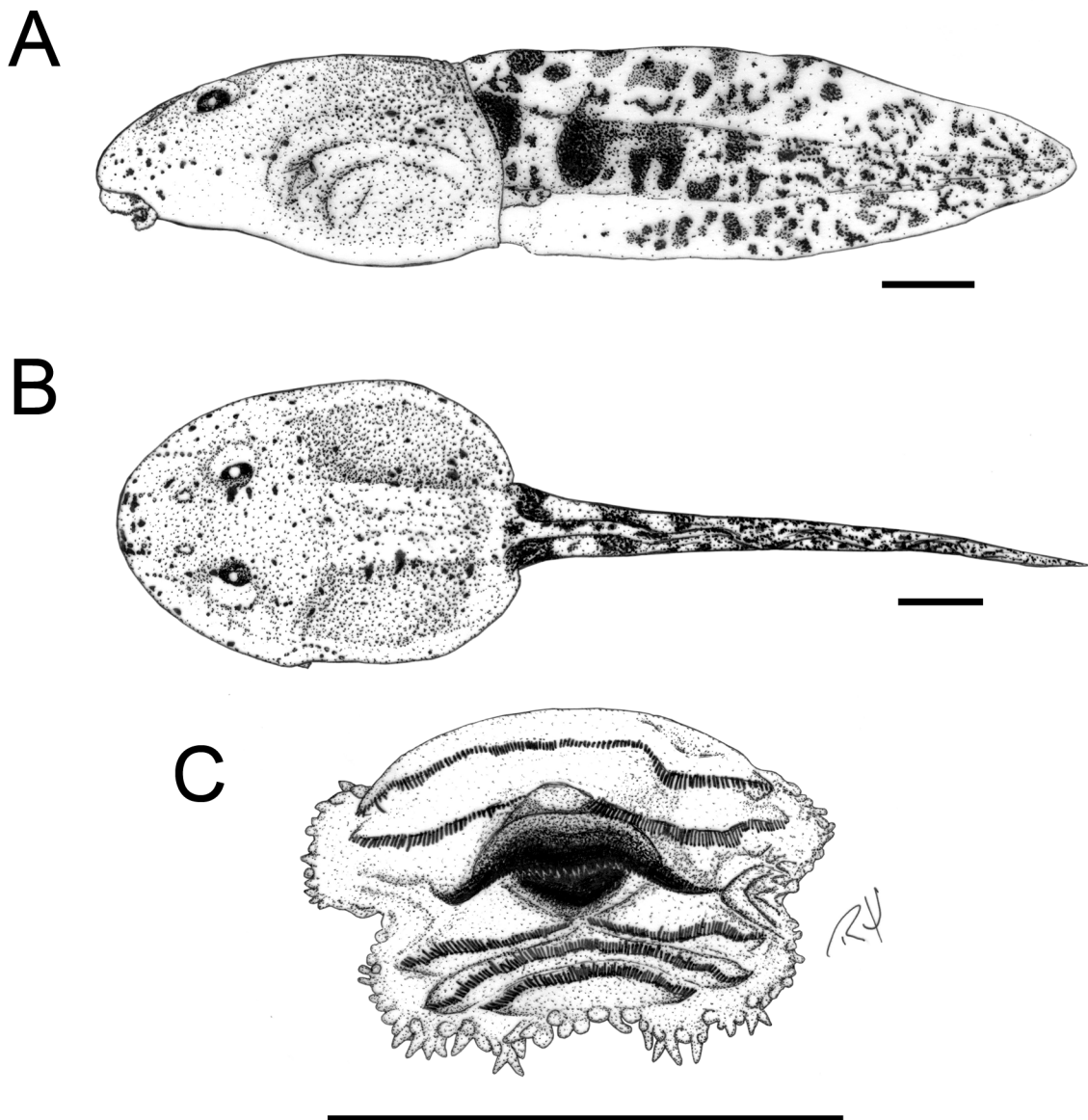


FIGURE 4. Tadpole of *Proceratophrys minuta*, UFBA 10758, stage 35. (A) Lateral and (B) dorsal views, and (C) oral disc. Horizontal lines equal 3.0 mm.

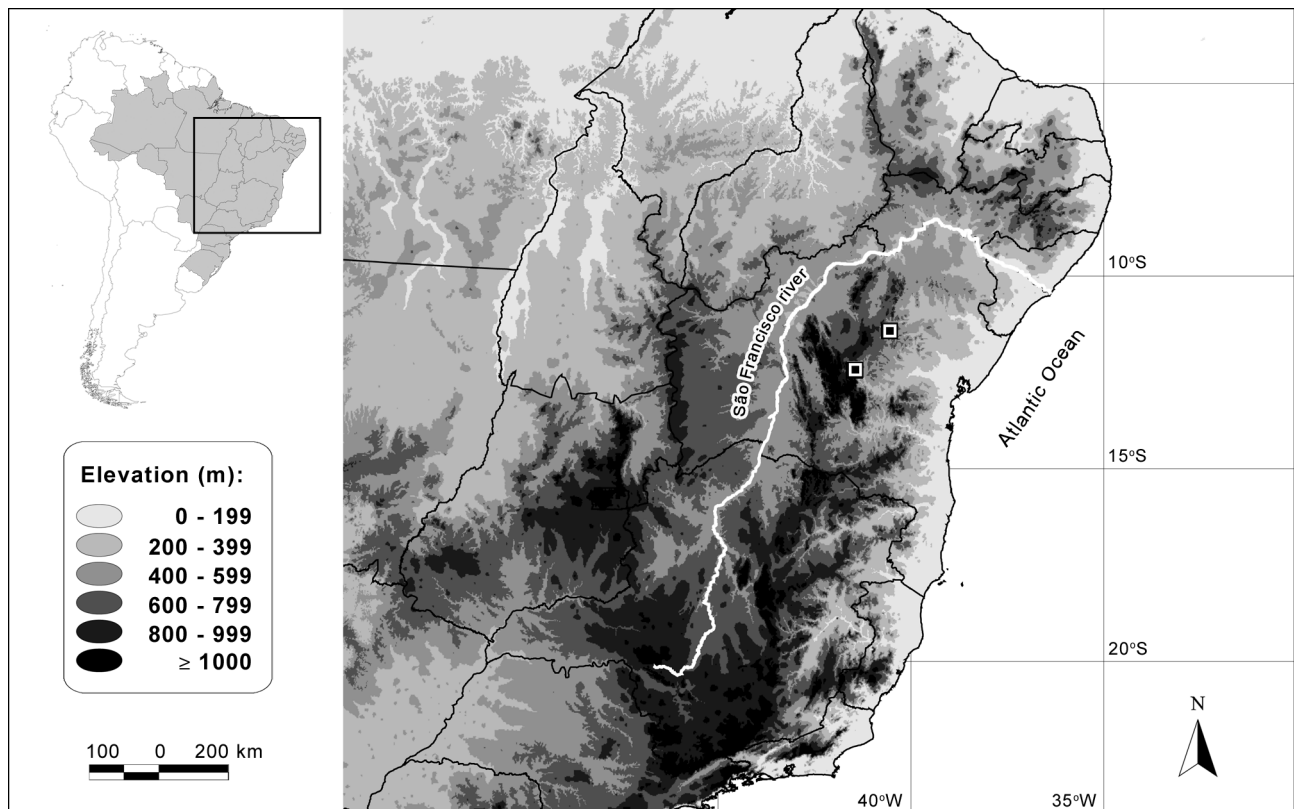


FIGURE 5. Geographic distribution of *Proceratophrys minuta* on topographic map.

TABLE 2. Descriptive statistics of tadpoles of *Proceratophrys minuta* (n = 9, stages 31–38) from the Parque Estadual das Sete Passagens, Municipality of Miguel Calmon, State of Bahia, Brazil. Mean = arithmetic mean; SD = standard deviation. Measurements are in millimeters.

	Stages (Gosner 1960)										
	31	34	35	36 (n = 2)				38 (n = 4)			
				Mean	SD	Min	Max	Mean	SD	Min	Max
TL	31.4	29.7	33.1	35.7	0.5	35.3	36.1	35.1	0.9	33.8	35.7
BL	12.3	11.5	13.8	14.3	0.1	14.2	14.4	14	0.3	13.7	14.4
MBH	5.7	6.4	7.4	7.0	0.7	6.5	7.4	7.5	0.6	6.7	8.0
MBW	7.8	9.0	10.3	10.0	0.1	9.3	10.7	10.1	0.8	9.3	11.1
TAL	19.2	18.1	19.3	21.4	0.7	20.9	21.8	21.0	0.9	19.8	21.7
MTH	6.2	6.2	6.7	7.5	0.3	7.3	7.7	7.3	0.4	6.7	7.6
TMH	24.0	25.0	22.0	30.0	0.0	30.0	30.0	28.0	0.8	27.0	29.0
DFH	2.4	2.6	2.7	2.8	0.2	2.7	3.0	2.8	0.2	2.6	3.0
VFH	1.5	1.6	2.0	1.7	0.2	1.5	1.9	1.9	0.2	1.5	2.1
ED	1.1	1.1	1.2	1.3	0.0	1.3	1.3	1.4	0.1	1.3	1.4
IOD	3.3	3.6	3.8	4.0	0.3	3.8	4.2	4.1	0.1	4.0	4.3
IND	1.5	1.6	1.5	1.7	0.1	1.6	1.8	1.8	0.1	1.6	1.9
ODW	3.0	3.0	3.1	3.3	0.1	3.2	3.4	3.2	0.1	3.1	3.4
ESD	3.6	3.6	3.8	4.0	0.1	3.9	4.1	3.9	0.2	3.7	4.1
END	1.0	1.2	1.2	1.1	0.0	1.1	1.1	1.2	0.1	1.0	1.3
NSD	2.4	2.5	2.6	2.9	0.1	2.9	3.0	2.8	0.3	2.4	3.1
SSD	6.3	6.7	7.0	7.1	0.6	6.7	7.5	7.8	0.4	7.3	8.2

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Appendix 1. Additional species and specimens examined

Proceratophrys cururu—BRAZIL: State of Minas Gerais: Serra do Cipó (MNRJ 17905, paratype).

Proceratophrys cristiceps—BRAZIL: State of Ceará: Milagres (MNRJ 75156–75157). State of Sergipe: São Cristóvão (MNRJ 50377). State of Bahia: Barreiras (MNRJ 1737, 22367); Feira de Santana (MNRJ 1684, 1747, 2023, 3703, 3752, 3758); Miguel Calmon (MNRJ 7896–7898).

Proceratophrys goyana—BRAZIL: State of Tocantins: Nova Olinda (MNRJ 48137, 66815). State of Goiás: Rio São Miguel (MNRJ 296, 47902, lectotypes); Colinas do Sul (MNRJ 66224–66225, 66527); Campinorte (MNRJ 53096); Serra da Mesa (MNRJ 20209–20212).

Proceratophrys concavitympanum—BRAZIL: State of Pará: Serra dos Carajás, Paravapebas (MNRJ 58854–58855).

Proceratophrys moratoi—BRAZIL: State of São Paulo: Botucatu (MNRJ 15872).

Proceratophrys schirchi—BRAZIL: State of Bahia: Amargosa (UFBA 6427, 7505, 8492); Jussari (MNRJ 26456–26458). State of Minas Gerais: Marliéria (UFV 5401, 5402, 5408, 5735). State of Espírito Santo (MNRJ 56000, 1831).