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A new species of Rock-Dwelling *Scinax* Wagler (Anura: Hylidae) from Chapada dos Veadeiros, Central Brazil

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Abstract

A new species of the *Scinax ruber* clade is described from Chapada dos Veadeiros region, Central Brazil. The new species is diagnosed by having SVL 21.9–27.7 mm in males and 26.7–31.7 mm in females; snout acuminate in dorsal view and rounded in profile; medium-sized tympanum; vocal sac single, median, subgular, that does not reach the pectoral region; iris iridescent yellow, with some thin, darker reticulations; tadpoles with ventral oral disc; P-3 regular and unmodified as a labial arm; absence of keratinized and colored plates on the sides of the lower jaw-sheath; presence of a keratinized and colored spur on each side behind the lower jaw-sheath; dorsolateral eyes, ventrally invisible; and advertisement call composed of 8–14 notes each with 4–18 pulses, and duration of 290–420 ms. The new species uses temporary creeks in rock meadows above 1.000 m a.s.l. and males calls from rock outcrops. The dorsal color pattern enables this species to camouflage in this kind of surfaces.

Key words: *Scinax rupestris* **sp. nov.**, advertisement call, tadpole, brazilian Cerrado, rock-bed rivulets, morphology, taxonomy

Introduction

Scinax Wagler comprises the most species rich genus of neotropical hylid frogs, with 112 described species (Frost 2014), ranging from Mexico to Central Argentina. The genus comprises two large clades (Faivovich 2002; Faivovich *et al.* 2005), the *S. catharinae* and the *S. ruber* clades. The former comprises 44 species that occur mostly in the Atlantic Forest of SE Brazil, with a few occurring as well in similar habitats in central-eastern Brazil and reaching southwards central-eastern Argentina. Several species of this clade reproduce on streams or headwaters (species in the *S. catharinae* group; e.g. Duellman & Wiens 1992; Pombal & Bastos 1996; but see Faivovich 2002 for a few exceptions) or on bromeliads (the *S. perpusillus* group; Peixoto 1986). The *S. ruber* clade comprises 66 species ranging between Central Argentina and Mexico. These occupy diverse habitats, including both open and forested areas, and most frequently reproduce on temporary or permanent lentic water bodies (e.g. Duellman 1970; Cardoso & Sazima 1980; Pombal *et al.* 1995a). The study of specimens collected during the 1970s by the late Werner C.A. Bokermann in Chapada dos Veadeiros, Central Brazil, and recent fieldwork on that locality lead to the discovery of a new species of the *S. ruber* clade that calls from stones along rivulets and streams, and it is described here.

Material and methods

Adult specimens were fixed in 10% formalin and stored in 70% ethanol. Webbing formula follows Savage & Heyer

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(1967) as modified by Myers & Duellman (1982). Measurements (in millimeters) follow Duellman (1970) and were taken with a digital caliper (0.01 mm) under a stereomicroscope. The following measurements were taken SVL (snout-vent length), HL (head length), HW (head width), IND (internarial distance), IOD (interorbital distance), ED (eye diameter), END (eye-nostril distance), TD (tympanum diameter), TL (tibia length), and FL (foot length). Sex was determined by examination of secondary sexual characters (nuptial pads, vocal slits, and expansion of the vocal sac) or, when in doubt, by examination of gonads.

Calls were recorded using a digital recorder (Marantz PMD660, set at 44.1 kHz and 16-bit resolution) coupled to directional microphone (Sennheiser ME-66). Temporal parameters of calls are given as mean ± standard deviation. Climate data (air humidity and temperature) were obtained using a compact pen-type thermohygrometer. All recordings were analyzed on Raven Pro 1.5 software (The Cornell Lab of Ornithology – Bioacoustics Research Program) with FFT 512 points, at a sampling rate of 44.1 kHz, with resolution of 16 bits. Terminology for advertisement call descriptions follows Heyer *et al*. (1990); specifically as referred by these authors, in this article the term *notes* indicates the unit of sound consisting of one or more pulses. A total of 10 call parameters were analyzed: note, call and pulse duration (ms), dominant frequency of calls and its harmonics (kHz), number of notes per call, number of pulses per note, interval between notes (ms), interval between pulses (ms), and call rate (number of calls per minute). Call duration was obtained directly from the oscillogram.

Tadpoles were collected using manual nets in the same rivulets and creeks where the adults were found. Two of these tadpoles were raised in an aquarium until metamorphosis to confirm their identity (CHUNB 72704–72705). A total of 44 tadpoles were fixed in 5% formalin and deposited in the Célio F.B. Haddad Amphibian collection, Rio Claro, São Paulo, Brazil (CFBH 38063). Terminology for larval morphology follows Altig & McDiarmid (1999), with the exception of the position of the intestinal mass, which follows Faivovich (2002). Larval developmental stages determination follows Gosner´s (1960) table. Methylene blue was employed to enhance visualization of oral disc structures. Seventeen measurements were taken from tadpoles from stage 38 of Gosner´s table. Twelve measurements follow Lavilla & Scrocchi (1986): TL (total length), BL (body length), TAL (tail length), MTH (maximum tail height), TMH (tail muscle height), BH (body height), BW (body width), ED (eye diameter), ODW (oral disc width), END (eye-nostril distance), NSD (nostril to tip of snout distance), and ND (nostril diameter: distance of inner margins of the largest nostril axis). We also used five other measurements: TMW (tail muscle width), IND (internarial distance), and IOD (interorbital distance) following Altig & McDiarmid (1999); DFH (dorsal fin height), and VFH (ventral fin height) following Grosjean (2005). Measurements (in millimeters) were taken using an ocular grid to the nearest 0.1 mm in a Zeiss steromicroscope (Stemi SV-11), except TL, BL, and TAL, which were measured to the nearest 0.01 mm using digital calipers.

Illustrations were made with a drawing tube attached to a Zeiss steromicroscope (Stemi SV-11). Colors and patterns descriptions in life are based on photographs taken in the field and field notes. Institutional abbreviations follow Sabaj Pérez (2014).

Results

Scinax rupestris sp. nov.

(Figs. 1–3)

Holotype. MZUSP 112877, adult male, from Chapada dos Veadeiros, Goiás, Brazil (about 14°09'30" S, 47°36'42" W, 1.200 m elevation), collected on January 6th–10th, 1974 by the late Werner C.A. Bokermann.

Paratopotypes. Adult males (26): MZUSP 112859–112876, 112878; CHUNB 72964–72965 collected on November 15th, 2010; 73648–73652 collected on February 9th, 2011. Adult females (2): MZUSP 112880; CHUNB 73653 collected on February 12th, 2011. MZUSP specimens were collected together with the holotype. CHUNB specimens were collected in the type locality by the second author.

Referred specimens. Adults (5): CFBH 38058–38062 collected on February 9th, 2011. Juveniles (2): CHUNB 72704–72705 collected on February 12th, 2011. All specimens were collected in the type locality by the second author.

Diagnosis. *Scinax rupestris* **sp. nov.** is a member of the *S. ruber* clade for having the single morphological synapomorphy known for the group, the tadpole vent tube that does not reach the free margin of the lower fin. The new species can be diagnosed by the following set of characters: (1) moderate size (SVL in males 21.9–27.7 mm, females 26.7–31.7 mm); (2) snout acuminate in dorsal view, rounded in profile; (3) tympanum medium-sized (TD 61.1–71.0% of ED); (4) vocal sac single, median, subgular, that does not reach the pectoral region, and externally evident by the loose skin on the sides of jaw; (5) iris iridescent yellow, with some thin, darker reticulations; (6) tadpoles with ventral oral disc; (7) regular P-3, unmodified as a labial arm; (8) absence of keratinized and colored plates on the sides of the lower jaw-sheath; (9) presence of a keratinized and colored spur on each side behind the lower jaw-sheath; (10) dorsolateral eyes, invisible ventrally; and (11) advertisement call composed of 8–14 notes each with 4–18 pulses, and duration of 290–420 ms.

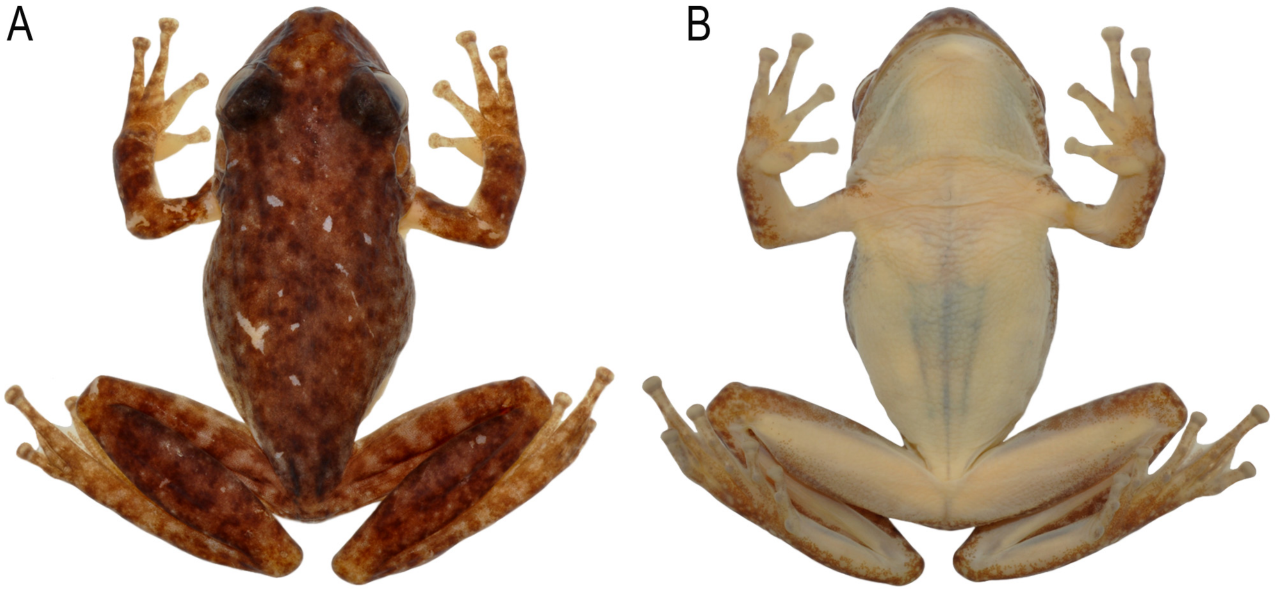

FIGURE. 1. *Scinax rupestris* **sp. nov.**, holotype (MZUSP 112877; SVL 25.2 mm). A: Dorsal view. B: Ventral view. Photos: M.R.C.

Comparison with other species. The *Scinax ruber* clade includes 66 species, of which 55 are not included in the two monophyletic groups currently recognized: *Scinax rostratus* and *Scinax uruguayus* groups (Faivovich *et al.* 2005; Frost 2014). For this reason we present comparisons with all species. The structure for the comparison is based first on obvious size differences in adults (that is, no overlapping nor a minimal gap between size ranges), followed by more detailed comparisons with species that cannot be differentiated on the basis of size, or in case that there are conspicuous external morphological characters.

Scinax rupestris **sp. nov.** differs from all species in the *S. rostratus* and *S. uruguayus* group for lacking the synapomorphies from external morphology of larvae and adults of these groups (see below; Faivovich 2002; Faivovich *et al.* 2005).

The SVL in males (21.9–27.7) promptly distinguish the new species from *Scinax acuminatus* (39–45; Lutz 1973), *S. baumgardneri* (29.0–32.0; Rivero 1961), *S. camposseabrai* (28.9–33.5; Caramaschi & Cardoso 2006), *S. castroviejoi* (male holotype 45.0; De la Riva 1993), *S. dolloi* (male syntype 34.9), *S. eurydice* (44.0–52.0; Bokermann 1968), *S. exiguus* (18–20.8; Duellman 1986), *S. funereus* (29.8–36.9; Duellman & Wiens 1993), *S. fuscovarius* (41.0–44.0; Cei 1980), *S. granulatus* (32.0–38.0; Cei 1980), *S. hayii* (39.0–42.0; Lutz 1973), *S. iquitorum* (male paratype 35.0; Moravec *et al.* 2009), *S. oreites* (28.4–33.5; Duellman & Wiens 1993), *S. perereca* (34.0–38.5; Pombal *et al.* 1995b), *S. quinquefasciatus* (29.6–34.0; Duellman 1972), *S. ruber* (29.4–41.2; Duellman & Wiens 1993), and *S. sateremawe* (35.2–36.7; Sturaro & Peloso 2014).

The dorsal color pattern which consists of a background brown or creamy with some scattered small round and irregular dark blotches differentiates the new species from *Scinax altae*, *S. cardosoi*, *S. fuscomarginatus*, *S. madeirae*, *S. squalirostris*, *S. staufferi*, and *S. villasboasi* (dorsum with a variable number of dorsal and/or lateral stripes; Duellman 1970; Lutz 1973; Heyer *et al.* 1990; Carvalho-e-Silva & Peixoto 1991), *S. alter*, *S. auratus*, *S. cretatus*, *S. crospedospilus*, *S. cuspidatus*, *S. imbegue*, *S. juncae*, and *S. tymbamirim* (light or dark dorsal continuous or broken stripes, sometimes delimiting a central darker area; Bokermann 1969; Lutz 1973; Nunes & Pombal 2010, 2011; Nunes et al. 2012), *S. blairi* (few brown markings and blotches, or small scattered dark dots; Fouquette & Pyburn 1972), *S. boesemani* (dorsum with or without small white and brown dots; Lescure & Marty

2000), *S. caldarum*, *S. curicica*, and *S. duartei* (two irregular longitudinal stripes arising from an interocular marking; Pugliese *et al.* 2004), *S. chiquitanus* (small and scattered grayish dots and marks; De la Riva 1990), *S. danae* (small scattered dark brown dots), *S. lindsayi* (a few small scattered reddish brown dots and blotches), and *S. maracaya* and *S. tigrinus* (large dark blotches; Cardoso & Sazima 1980; Nunes *et al.* 2010).

The new species differs from *Scinax baumgardneri*, *S. exiguus*, *S. fuscomarginatus*, *S. madeirae*, *S. manriquei*, *S. villasboasi*, and *S. wandae* for having a small vocal sac that does not reach the pectoral region (vocal sac large that reaches the anterior pectoral region; Barrio-Amorós *et al.* 2004); *S. cruentommus* for having an iridescent yellow iris, with some thin, darker reticulations (silvery bronze iris with a median horizontal red streak; Duellman 1972); and *S. karenanneae* for having white bones, a single vocal sac, and the flank color pattern, continuous with the dorsal pattern (green bones, bilobed vocal sac, and yellow or white flanks; Pyburn 1993).

The name *Scinax x-signatus* Spix still has some complications (Pombal *et al.* 1995b) as its type is considered destroyed, a neotype has still not been designated, and apparently there are several species to which this name could be applied in the state of Bahia, Brazil (its type locality, "Provinciae Bahiae"; Spix 1824). In the meantime, the absence of yellow flash coloration in the hidden surfaces of limbs and inguinal region in *S. rupestris* **sp. nov.**, is here considered a character state that allows to differentiate this species from those to which the name *S. x-signatus* could potentially be applied in northeastern Brazil (Lutz 1973).

The advertisement call of the new species, composed of 8–14 notes each with 4–18 pulses, and duration of 290–420 ms further differentiates it from *Scinax blairi* (single multi-pulsed note, 140–160 ms, 18–22 pulses; Fouquette & Pyburn 1972), *S. boesemani* (single multi-pulsed note, eight pulses; Lescure & Marty 2000), *S. chiquitanus* (single multi-pulsed note, 80–100 ms; Duellman & Wiens 1993), *S. cruentommus* (single multi-pulsed note, 350–370 ms; Duellman 1972), *S. danae* (single multi-pulsed note, 200–220 ms; Duellman 1986), *S. elaeochrous* (single multi-pulsed note, 170 ms; Duellman 1970), *S. ictericus* (single multi-pulsed note, 70–90 ms; Duellman & Wiens 1993), *S. lindsayi* (single note, 80–100 ms; Pyburn 1992), *S. rogerioi* (single multi-pulsed note, 6–12 pulses, 270–700 ms; Pugliese *et al.* 2009), and *S. similis* (single multi-pulsed note, 4–10 pulses, 185–225 ms, Bilate & Lack 2011).

The new species further differs from *Scinax rogerioi*, the other species from Chapada dos Veadeiros, for having a dorsum brown or creamy with some scattered small round and irregular dark blotches (brown dorsal blotches extending as a pair of longitudinal irregular and interrupted blotches/stripes from head to inguinal region and inverted brown triangular interocular blotch; Pugliese *et al.* 2009), and the advertisement call (see comparison above).

Scinax rupestris **sp. nov.** is most similar with *S. cabralensis* (see Figs. 1–3 in Drummond *et al.* 2007) from which it differs for having a wider nuptial pad that covers almost the complete dorsal surface of metacarpal II and obscures nearly half of the inner metacarpal tubercle (covers only the medial margin of metacarpal II, and obscures only the outer margin of the inner metacarpal tubercle), a stronger forearm, more developed webbing on feet (I 2^- –2 II 2^- – 3 III 2^+ – 3^- IV 2^+ – $1^{1/2}$ V), a tympanum medium-sized (TD = 1.2–1.4; Drummond *et al.* 2007), and a different dorsal color pattern (dorsum with small dark spot equally distributed; Drummond *et al.* 2007).

The larval morphology of *Scinax rupestris* **sp. nov.** differentiates this species from most of those with known tadpole in the *S. ruber* clade. The P-3 unmodified as a labial arm differentiates *S. rupestris* **sp. nov.** from *S. alter*, *S. auratus*, *S. crospedospilus*, *S. cuspidatus*, and *S. juncae*, plus all known tadpoles of the *S. rostratus* group (P3 modified as a labial arm; Heyer *et al.* 1990; Alves & Carvalho-e-Silva 2002; Faivovich 2002; Alves *et al.* 2004; Mercês & Juncá 2012). The lack of colored keratinized plates on the sides of the lower jaw-sheath differentiates *S. rupestris* **sp. nov.** from known tadpoles in the *S. uruguayus* group (keratinized plates on the sides of the lower jaw-sheath present; Kolenc *et al.* "2003" [2004]). The presence of a colored keratinized spur on each side behind the lower jaw-sheath differentiates the new species from *S. ictericus* (spurs absent; Faivovich 2002). The ventral oral disc differentiates *S. rupestris* **sp. nov.** from most known tadpoles in the clade that have either a terminal oral disc (*S. acuminatus* and the *S. rostratus* group, see Faivovich 2002), or a subterminal disc (e.g. *S. similis* and *S. elaeochrous*; Alves & Carvalho-e-Silva 1999; Faivovich 2002). The only known exceptions are *S. cruentommus* and *S. ictericus* (Duellman & Wiens 1993; Faivovich 2002) where Faivovich (2002) considered that the position of the disc was polymorphic for ventral and subterminal positions. The dorsolateral eyes, invisible ventrally, are also mostly unique to *S. rupestris* **sp. nov.** in the *S. ruber* clade, with the only known exception being *S. ictericus* (Duellman & Wiens 1993; Faivovich 2002).

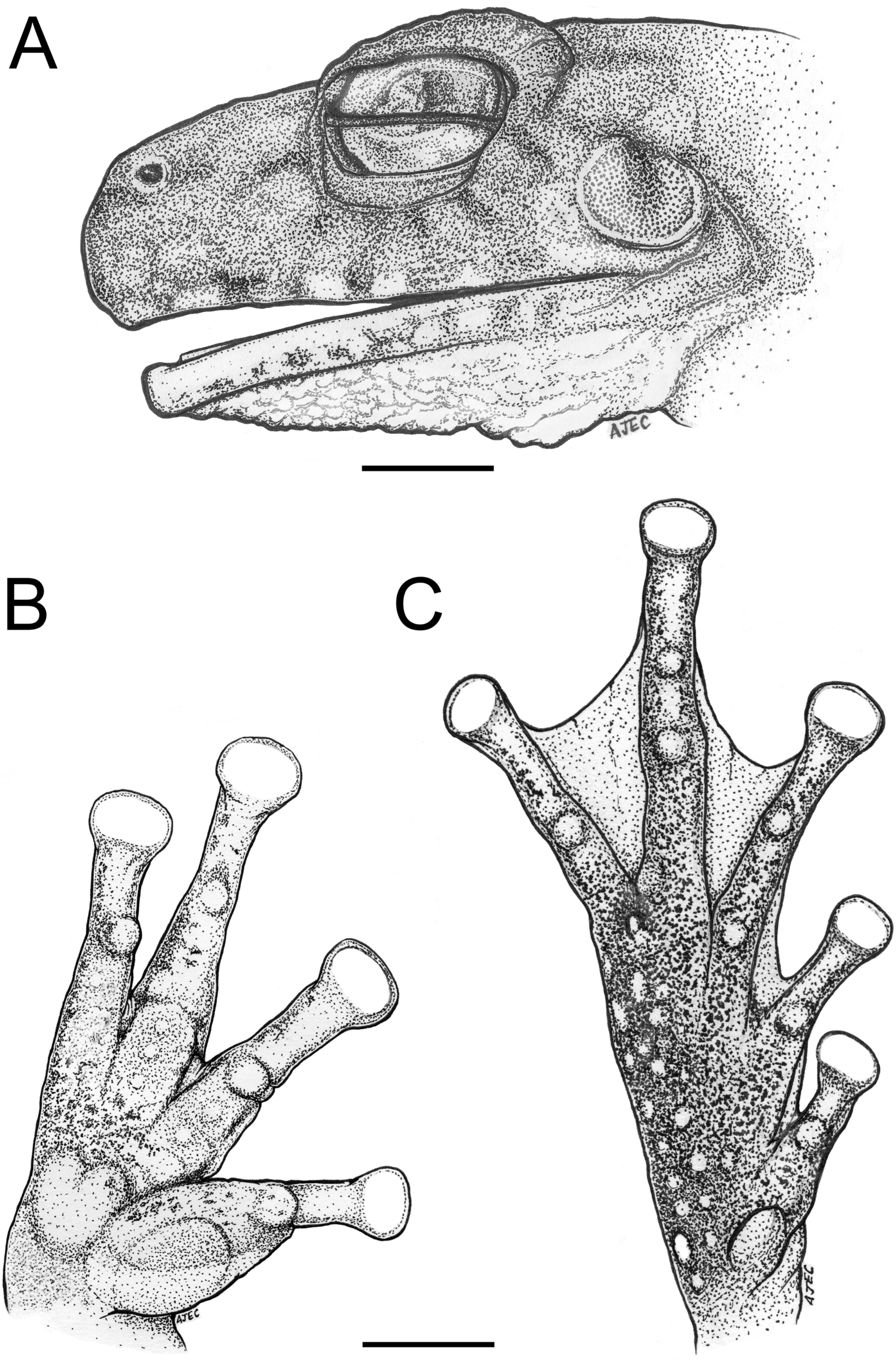

FIGURE. 2. *Scinax rupestris* **sp. nov.**, holotype (MZUSP 112877). A. Head in lateral view. B: Right hand in palmar view. C: Right foot in palmar view. Drawings by Agustín J. Elías Costa. Scale bars = 2 mm.

Description of holotype. Body moderately robust, head rounded in profile, acuminated in dorsal view; head as large as wide, 37.7% of SVL. Nostrils dorsolateral, elliptical, slightly protruded; distance between nostrils 64.3% of IOD. Canthus rostralis evident and convex. Loreal region slightly concave. Eyes protuberant, ED 10.7% larger than IOD, almost equal to END. Tympanum rounded, separated from eye by a distance almost half TD. TD 61.3% of ED. Supratympanic fold barely evident, from the corner of the eye to the insertion of the arm. Vocal sac single, median, subgular, externally evident by the loose skin on the sides of jaw. Vocal slits present, located diagonally to the longitudinal body axis, originating laterally to the tongue and running towards the corner of the mouth. Tongue elliptical, free laterally and posteriorly notched. Vomerine teeth in two slightly convex series between and only just posterior the choanae, each bearing six teeth. Choanae oval.

Axillary membrane absent. Upper arm slender, forearm moderately robust. Fingers slender, subarticular tubercles single, conical in fingers I and II; rounded on fingers III and IV. Subarticular tubercle in the third finger smaller than the others. Supernumerary tubercles absent. Relative finger length I<II< IV<III. Discs elliptical, wider than long; disc on Finger I slightly smaller than the others. Inner metacarpal tubercle single, medium-sized, elliptical; outer metacarpal tubercle flat, medially divided. Webbing absent between fingers I and II; basal between fingers II, III, and IV. Basal fringe between fingers I and II. Thick, wide, light colored nuptial pad covering almost the complete dorsal surface of Metacarpal I and medially obscuring nearly half of the inner metacarpal tubercle (Fig. 3A). Hind limbs robust; TL 52.8% of SVL. Toes slender; subarticular tubercles single, conical, and rounded. Supernumerary tubercles poorly developed, single, and rounded. Relative toe length I< II< V< III< IV. Discs elliptical, wider than long. Inner metatarsal tubercle single, oval; outer metatarsal tubercle simple, rounded. A poorly developed fringe on the lateral margin of foot, originating approximately at middle of metatarsus and joining the lateral fringe of Toe V. Webbing formula I 2^-–2^- II $1^{1/2}$–$2^{1/2}$ III 1–2^- IV 2–1 V.

Skin on dorsum smooth, with some scattered granules located mainly on the interorbital portion and between the canthus rostralis. Ventrally the body, ventral surfaces of thighs, and subcloacal region densely covered with rounded, low granules. Ventral surfaces of arms and tibiae smooth. Pectoral fold present, with pre- and postaxillar elements present. No glandular patches apparent in the pectoral region.

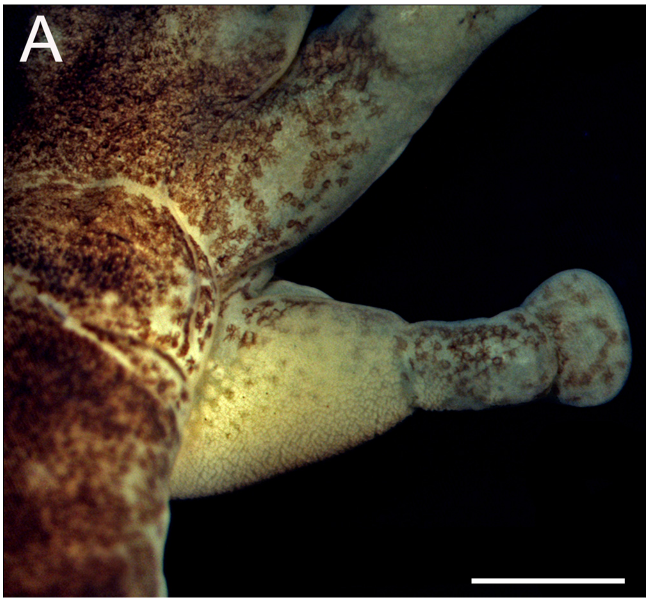

FIGURE. 3. A: Nuptial pad of *Scinax rupestris* **sp. nov.**, holotype (MZUSP 112877). Scale bar = 1 mm.

Color in preservative of the holotype. Dorsum brown with some scattered small round and irregular dark blotches; fore- and hindlimbs with irregular, transverse dark markings. Flanks and inguinal region lighter, with diffuse dark blotches. Hidden area of thigh and shank brown with some diffuse light blotches. Venter creamy white.

Measurements of the holotype (mm). SVL 25.2; HL 9.5; HW 9.4; IND 1.8; IOD 2.8; ED 3.1; END 2.8; TD 1.9; TL 13.3; FL 10.8.

Variation in the type series. Some measurements are presented in Table 1. The number of vomerine teeth in males varies between three and seven on both the right and left processes. In one male paratype (MZUSP 112859) the right process (three teeth) is smaller (about half of the left process size) than the left process (four teeth). Dorsally, small, scattered, slightly conical and rounded tubercles are evident mainly on head (68.2%) and body (68.2%), sometimes on limbs (36.4%), and less commonly on eyelid (22.7%). Ulnar tubercles, small and low are in line on the ventrolateral portion of the forearm, starting immediately after the elbow reaching approximately the wrist (68.2%). In some individuals these ulnar tubercles are white (13.6%). In addition, a fringe on the lateral margin of the metacarpal is present; it starts at level of the anterior margin of the palmar tubercle for after to join to the external fold of the Finger V, and can be complete (9.1%) or interrupted (50.0%).

TABLE 1. Measurements (in mm) of the type series of *Scinax rupestris* **sp. nov.** from Chapada dos Veadeiros, Goiás, Brazil.

Measurements	Females (*n* = 2)		Males (*n* = 27)	
	Mean ± SD	Range	Mean ± SD	Range
SVL	29.18 ± 3.49	26.7–31.6	24.94 ± 1.33	21.9–27.7
HL	10.57 ± 0.95	9.9–11.2	9.42 ± 0.52	8.5–10.7
HW	10.05 ± 1.33	9.1–11.0	9.24 ± 0.48	8.3–10.3
ED	3.03 ± 0.49	2.7–3.4	2.92 ± 0.18	2.6–3.3
IND	1.85 ± 1.78	1.7–2.0	1.87 ± 0.08	1.7–2.0
IOD	3.24 ± 3.17	3.1–3.4	2.64 ± 0.26	2.3–3.3
TD	2.16 ± 0.11	2.1–2.2	1.91 ± 0.16	1.6–2.3
END	3.02 ± 0.47	2.7–3.3	2.70 ± 0.24	2.0–3.1
TL	14.37 ± 2.10	12.9–15.8	12.79 ± 0.75	11.4–14.6
FL	10.81 ± 1.85	9.5–12.1	10.05 ± 0.73	8.6–11.5

Tarsal tubercles, small and low could be present on the ventrolateral portion of the tarsus, starting immediately after the tibia-tarsus articulation and almost reaching the outer metatarsal tubercle (18.2%). These tubercles can also be white pigmented (22.7%). An internal fold, elliptical is present on the internal margin of the tarsus, starting immediately after of the tibia-tarsus articulation followed by three or four small tubercles towards to the inner tubercle metatarsal, reaching the anterior third of the tarsus (31.8%); the fold and tubercles are white pigmented in two specimens. Otherwise, the small tubercles are absent in some individuals (36.4%). Additionally, calcar tubercles small and low can be present in some individuals (22.7%). Webbing formulae among paratypes varies as follows: I (2–2^{-}) – (2–2^{-}) II (1–1^{-}) – (2^{-}–$2^{\frac{1}{2}}$) III (1–1^{-}) – (2^{-} $2^{\frac{1}{2}}$) IV (2–$1^{\frac{1}{2}}$) –1 V. The two available mature females are larger than males. Their forearms are not robust as in males.

There is a single male (MZUSP 112875) that shows on the internal margin of the left arm a light colored, glandular pad, that we consider an aberrant occurrence considering that it is absent on the right arm and in all other male specimens available to us. Most specimens have a thickening of the ventral portion of the webbing between toes IV and V that is also evident on the dorsal aspect as a number of wrinkles or an ampulla-like dilation. This is common in several species of *Scinax*, and seems related to a parasite infection, as unidentified eggs are sometimes visible under high magnification in the affected webbing.

In life, the species show notable color differences by night and day. At night, the dorsal color pattern of head, body and limbs could be dark brown-olivaceous, with small round and irregular dark-brown blotches (Fig. 4D–E); dark-brown with dark round and irregular blotches and some white spots on head and body, but with limbs with dark transversal bars (Fig. 4D); or head and body overall dark-brown, with limbs yellowish with some irregular brown blotches (Fig. 4C). Flanks vary from yellowish to olivaceous. Venter immaculate white. Iris iridescent yellow, with some thin, darker reticulations.

During the day, the dorsal color pattern of head, body and limbs are marbled creamy white, with small, round and irregular dark gray blotches. In some individuals, these blotches form transversal bars on the limbs and a discrete interocular blotch (Fig. 4A–B). Flanks are pale-yellowish.

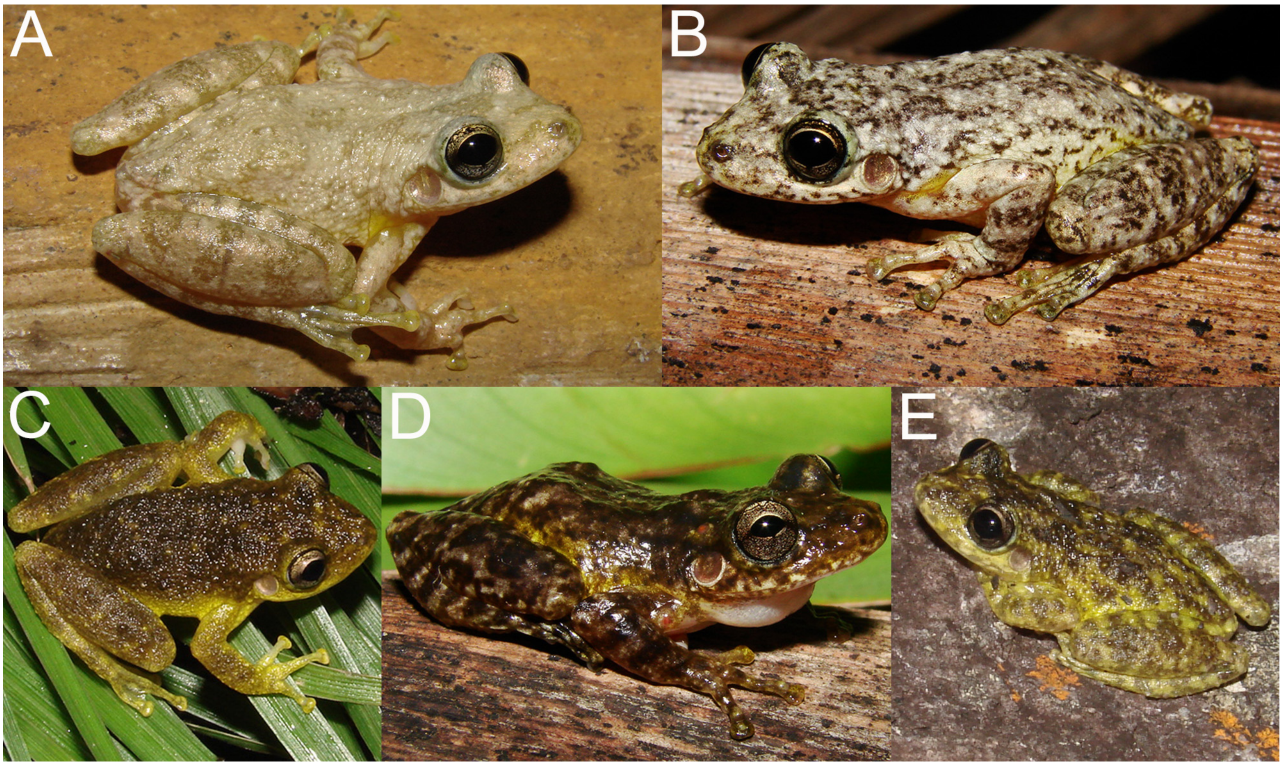

FIGURE. 4. *Scinax rupestris* **sp. nov.** A and B: Diurnal pattern color. C, D and E: Nocturnal pattern color. Photos: R.A.B.

In preservative, the dorsal color pattern of head, body and limbs varies from light and dark gray to dark brown, with some round and irregular dark blotches; in some specimens, small white spots are present on head, body and limbs. Additionally, two individuals show an inverted interocular triangular blotch. Hidden surfaces of thigh and shank light or dark brown, with light, diffuse blotches. Flanks and inguinal region lighter, with diffuse dark blotches. A dark brown canthal line is present in some individuals (45.5%). Transversal dark bars on limbs.

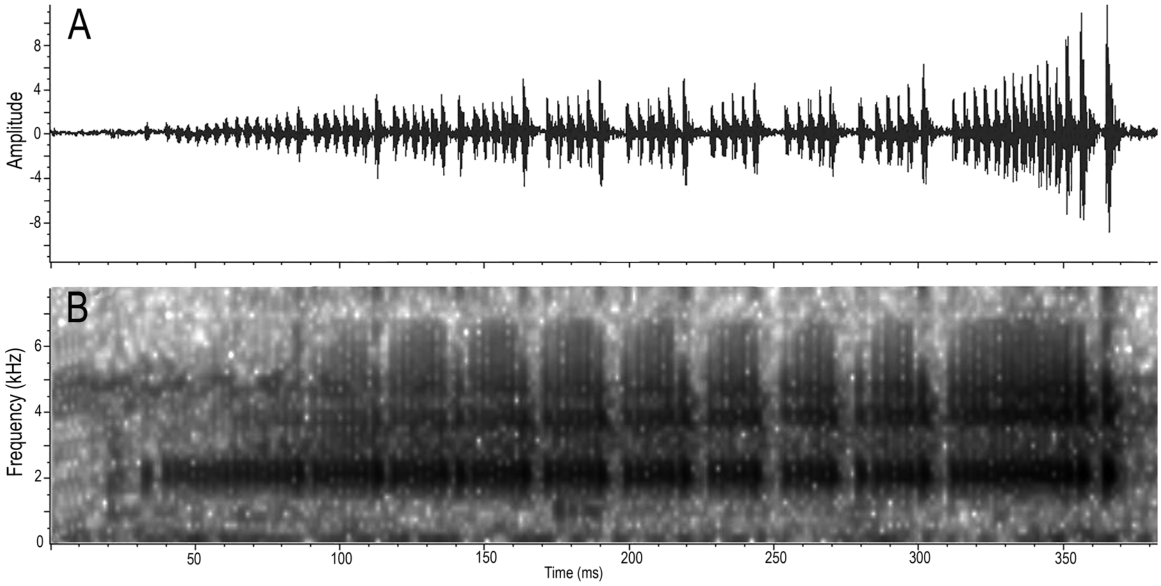

FIGURE. 5. Waveform (above) and spectrogram (below) of the advertisement call of *Scinax rupestris* **sp. nov.** (CHUNB 73649) recorded at Chapada dos Veadeiros, Goiás, Brazil, depicting 10 notes, with 5–14 pulses. Notice isolated single pulses between notes, and at the beginning and end of the call. The final pulse of a given note is more intense than the surrounding ones and the uprising sound intensity towards the end of the call.

Calls. Air temperature and humidity during recordings were 22°C and 80%, respectively. The advertisement call (Fig. 5; $n = 1$ male; CHUNB 73649; $n = 16$ calls) consists of 8–14 (11.06 ± 1.57) multipulsed notes. Each note is composed of 4–18 (7.06 ± 3.06) pulses that are increasingly modulated within each note, with the amplitude suddenly falling at the beginning of the contiguous note. Single pulses (2.95 ± 0.98 ms) are sometimes isolated between notes, and also at the beginning and end of the call. Note duration is 26.70 ± 12.40 ms (14.0–76.0 ms) and they are separated by an interval of 1.0–12.0 ms (5.40 ± 2.74). Pulse duration is 1.96 ± 0.57 ms (1.0–3.0 ms), interval between pulses is 1.0–2.0 ms. Calls have a mean duration of 350 ± 30 ms (290–420 ms), with a call rate of 4–6 calls/min

At the end of the call, the single pulses can be organized in groups of up to eight pulses (3.50 ± 2.39). The first and last notes are longer (first: 21.0–76.0 ms; last: 21.0–48.0 ms) than the intervening notes (14–25 ms), and are composed of 4–18 (11.33 ± 3.37) pulses (first note) and 6–14 (9.71 ± 2.15) pulses (last note), as opposed to the 4–8 pulses (5.52 ± 0.92) in the intervening notes.

The call has two emphasized harmonics, with the fundamental frequency being also the dominant frequency, between 2067–2239 kHz (2085.66 ± 54.27 kHz), and the second between 3962.1–4478.9 kHz (3986.70 ± 246.83 kHz).

Tadpole description. Tadpole description is based on five specimens (CFBH 38063) in Gosner stage 38, for which the morphological measurements are given separately below. Body robust, elongated and slightly ovoid in lateral view and elliptical in dorsal view (Fig. 6A−B), wider than high (BW/BH = 1.13–1.14); BH about 53.5% of BL (BH/BL = 0.53–0.54); BL about 38% of TL. Maximum body height in the middle of body length and maximum body width just behind the eyes. Snout rounded in dorsal, ventral and lateral views. Eyes relatively large (ED/BL = 0.16–0.17), dorsolateral, and not visible in ventral view (Fig. 6C). IOD about 81% of BW (IO/BW = 0.79–0.82). Nostrils rounded, small (diameter about 22% of ED), dorsolateral, located nearer to the eyes than the tip of snout (ESD/NSD = 0.76–0.97). NSD about 11% of body length (NSD/BL = 0.10–0.12). Narial opening with a pigmented marginal rim (Fig. 6A–B).

Oral disc ventral, not emarginated, width about 56% of BW (ODW/BW = 0.55–0.57). Marginal papillae small, homogeneous in size, conical, with pointed tip; arranged as a simple row around the oral disc; dorsal gap about 9.0–9.8% of BW. Many submarginal papillae conical, scattered, located in the lateral portion of the angular and posterior regions, reaching the posterior portion of P3 (Fig. 6D–E). Large conical papilla on each side of the internal portion of the angular region. Labial tooth row formula (LTRF): 2(2)/3 or 2(2)/3(1); A1>A2; A2 with a very narrow gap in the medial portion; P1, P2, and P3 similar in size; P3 regular, not modified as a labial arm. In one individual, the P1 is interrupted medially. Jaw sheaths densely pigmented, serrated; upper jaw-sheath arch-shaped, with medial projection and long lateral process; lower jaw-sheath V-shaped (Fig. 6E). Behind the lower jaw-sheath, there is a colored keratinized spur on each side.

Spiracle single, sinistral, short, located at the middle of the body, below the body midline, oriented posterodorsally, with inner wall fused to body wall, except for its posterior margin, and external wall shorter than inner wall; spiracle opening elliptical. Vent tube dextral, as large as wide, positioned above the margin of the ventral fin; vent tube opening elliptical and directed downward. The intestinal mass is positioned at a right angle to the longitudinal body axis. Tail elongated (TL 51.9–68.1% longer than BL), with pointed tip. Tail musculature moderately developed (TMH/MTH = 0.43–0.46). Dorsal fin continuous, originating at posterior third of body; ventral fin origin at posteroventral-most edge of the body; both fins tapering to the tip of the tail in the last half; dorsal fin slightly higher that the ventral fin (DFH/VFH = 1.20–1.26). The lateral line is visible as a series of elliptical, vertical whitish stitches. The V-shaped supraorbital line includes 17−21 stitches that diverge medially on the head between the nares and continues anteroventrally onto the snout. The postorbital series consist of a short dorsolateral row that includes 6−8 stitches.

Tadpole color. In life, body dorsally yellowish brown, marbled with irregular black blotches; two golden interrupted dorsolateral stripes, from the tip of snout to the body-tail junction, both delimited above by a narrow black stripe, which extends from the nostrils to the tail tip, along the basis of the dorsal tail. A golden elliptical blotch on snout, marbled laterally with irregular black blotches on the dorsal half of the body (Fig. 7C). Iris black with a wide golden ring around the pupil. Venter white and translucent (intestinal mass is visible). Tail musculature with some scattered brown blotches and a vermiculated dark brown stripe between the epaxial and hypaxial musculature extending from the tail-body junction to tail tip. Dorsal and ventral fins with dark blotches and some thin, dark reticulations near the free margins of both fins.

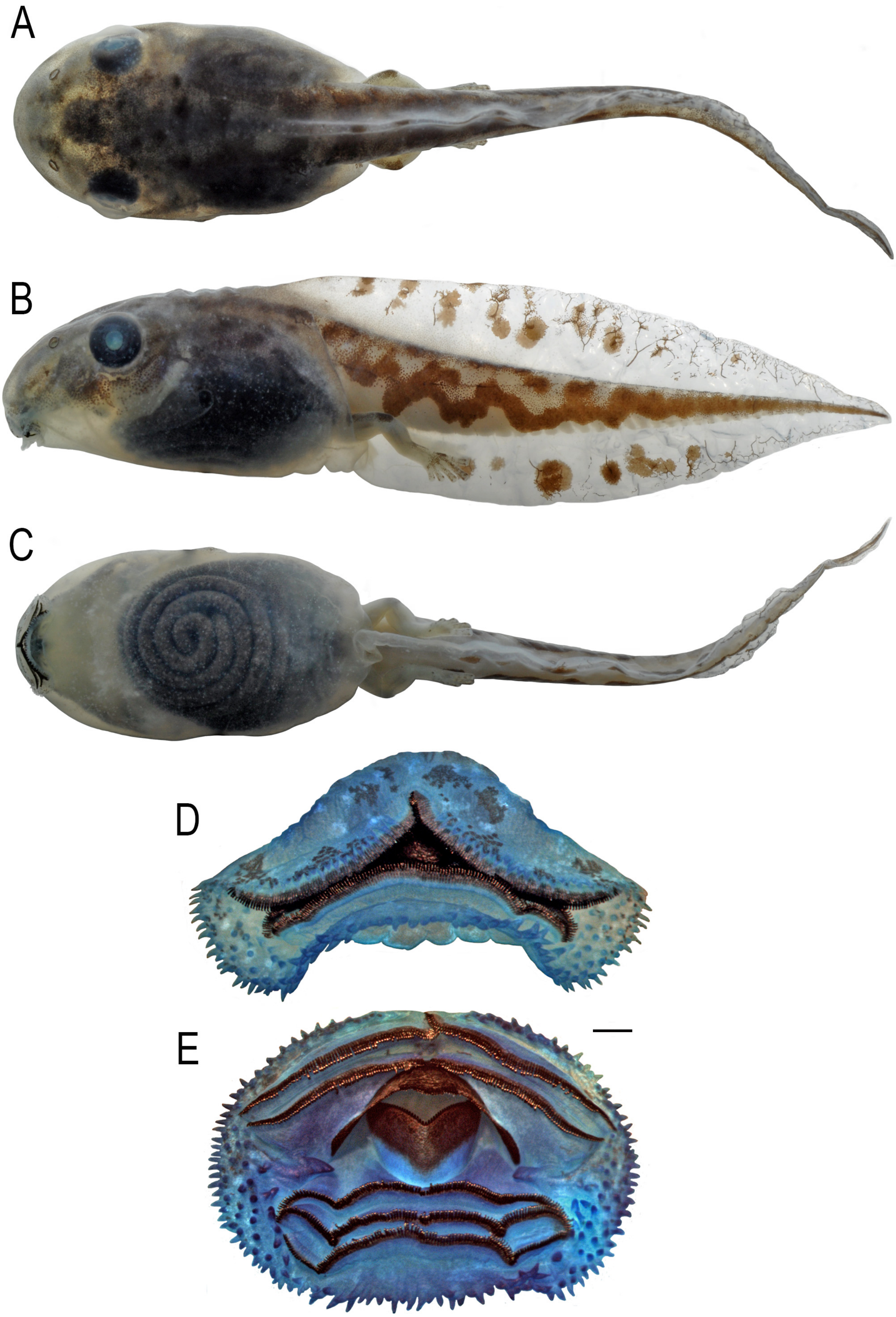

FIGURE. 6. Tadpole of *Scinax rupestris* **sp. nov.** (CFBH 38063, stage 38. TL = 29.63 mm). A: Dorsal view. B: Lateral view. C: Ventral view. D and E: Oral disc. Photos A, B and C: M.R.C. Scale bar = 1 mm.

In preservative, the color pattern is similar to that of living tadpoles, but fades and loses its golden and yellowish tones. The venter is totally translucent. The iris becomes black and the black tones become dark brown. Body dorsally translucent with small brown rounded spots, densely distributed and brown blotches; the black and golden stripes disappear.

Measurements (*n* = 5, mean ± standard error, range into parenthesis). TL 27.10 ± 2.24 (24.3–29.6); BL 10.21 ± 0.62 (9.5–11.1); TAL 16.89 ± 1.91 (14.5–18.6); MTH 6.37 ± 0.71 (5.6–7.2); TMH 2.85 ± 0.19 (2.6–3.1); BH 5.46 ± 0.32 (5.1–5.9); BW 6.19 ± 0.34 (5.8–6.6); ED 1.65 ± 0.10 (1.6–1.8); ODW 3.44 ± 0.23 (3.1–3.8); END 0.99 ± 0.02 (1.0–1.02); NSD 1.15 ±1.37 (1.0–1.4); ND 0.37 ± 0.02 (0.3–0.4); TMW 2.78 ± 0.11 (2.6–2.9); IND 2.97 ± 0.18 (2.7–3.1); IOD 4.92 ± 0.4 (4.5–5.4); DFH 2.29 ± 0.35 (1.9–2.8); VFH 1.90 ± 0.29 (1.6–2.2).

Variation among tadpoles. There are no evident morphological variations in the oral disc, marginal and submarginal papillae, and vent tube in the different development stages examined. LTRF is either 2(2)/3 (20 specimens) or 2(2)/3(1) (16 specimens). In addition to the submarginal papillae on the lateral portion of the angular and infraangular regions, some individuals also present submarginal papillae anteriorly, immediately below the marginal papillae, near A1 (two specimens). Some individuals show loss of labial teeth (four specimens), and damage in the papillae (one specimen). One individual (stage 30) shows P1 (half of its length) and P3 (one third of its length) reduced, and P2 taking place on one side of P3.

Most color variation among larvae involves the density of dorsal pigmentation, but some individuals show the vermiculated stripe replaced by brown blotches in the first two thirds of the tail musculature, or a straight stripe (less common), instead of the vermiculated one. In other individuals, the vermiculated stripe can be either interrupted, incomplete or absent; in this latter case, it is replaced by some blotches and many small spots until the tail tip. The oral disc can be pigmented near the marginal papillae (eight specimens), and in the submarginal papillae (five specimens). The margin of the vent tube can also be pigmented (two specimens). Furthermore, we detected some injuries in the tails of tadpoles of *Scinax rupestris* **sp. nov.** (six specimens; in the developmental stages 25 to 28, 34 and 36) at several stages of regeneration.

Natural history and Geographic distribution. *Scinax rupestris* **sp. nov.** is an inhabitant of high altitude temporary rock-bed rivulets and creeks in the quartzitic rock mountains in Chapada dos Veadeiros region, northern state of Goiás, Central Brazil. This species has not been observed calling from vegetation (the individual of Fig. 4C was jumping away from observer and stopped on a clump of grass, where it was photographed), but males typically call from rocks along these streams. When disturbed, the individuals stop calling and shelter under rocks or rock crevices, exhibiting high ability for climbing on rock surfaces. The dorsal coloration confers camouflage to the individuals against rock surfaces. Although the males call several meters from each other, some small aggregations can be observed close to larger rivulets pools.

Tadpoles are apparently diurnal. Its coloration is similar to that of the quartzitic rocks on rivulets beds that they inhabit (Fig. 7C). These rivulets and creeks are located on open habitats, and the sunlight can reach the rivulet bed. The golden blotches and stripes of the tadpole reflect the light in similar way that quartzitic sand, pebbles and rocks. The new species shares the same habitats in Chapada dos Veadeiros with *Ameerega flavopicta* (Dendrobatidae), *Bokermannohyla pseudopseudis* (Hylidae), *Leptodactylus tapiti* (Leptodactylidae), *Proceratophrys goyana* and *P. salvatori* (Odontophrynidae). One individual of *Scinax rupestris* **sp. nov.** was found in the stomach of *B. pseudopseudis*.

Etymology. The specific epithet "*rupestris*" is an allusion to the use of rock outcrops along temporary creeks in rock meadows at Chapada dos Veadeiros region, Central Brazil.

Remarks. The typical habitat of *Scinax rupestris* **sp. nov.** is open rock Cerrado habitats (Lenza *et al.* 2011). The rock Cerrado ecosystem habitat at Chapada dos Veadeiros is characterized by the presence of small to medium trees, very shallow soil (saturated by water during rainy season) and several rock outcrops of different sizes (Fig. 7A–B). During the rainy season, some small rivulets are formed by the drainage of the soil. These rivulets are used by several frog species for reproduction, including some stream specialists. Although this habitat is poorly represented on the Cerrado landscape, it holds several endemic species, as *Ameerega flavopicta*, *Bokermannohyla pseudopseudis*, *Leptodactylus tapiti*, *Phyllomedusa oreades* (Hylidae), *Proceratophrys goyana*, *P. salvatori*, *Scinax skaios*, and *S. rupestris* **sp. nov.** (Brandão 2002; Brandão *et al.* 2013; Santoro & Brandão 2014). At Chapada dos Veadeiros, the main threat for this habitat is illegal mining for quartz crystals, commonly sold to tourists or for quartzitic rocks, used for buildings.

FIGURE. 7. Rock-bed rivulets. A and B: Typical habitat of *Scinax rupestris* **sp. nov.**. C: Tadpole of *Scinax rupestris* **sp. nov.** in life on a rock-bed rivulet, showing disruptive color pattern against white rocks and sand substrate. Photo A: R.D. Photo B and C: R.A.B.

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http://dx.doi.org/10.1590/0031-1049.2014.54.02

APPENDIX 1. Adult specimens examined.

Scinax baumgardneri: KU 129753 (paratype). *S. cabralensis*: MNRJ 42884, 42888 (paratypes). *S. danae*: KU 167089–167090 (paratypes). *S. exiguus*: KU 167118, 167121 (paratypes). *S. karenanneae*: UTA-A 3768–3769 (paratypes). *S. lindsayi*: UTA-A 4301, 4303 (paratypes). *S. wandae*: KU 131717(paratype).